An Empirical Study on the Development of China's Chemical Trade

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Abstract. Based on the trade data from 2008 to 2017, this paper empirically analyzes the development of China's chemical trade. The scale of China's chemical trade has expanded year by year, trade has been in a state of deficit, and the concentration of import and export commodity structure is high. The overall performance of chemical trade is trade competition disadvantage and comparative disadvantage. More than half of the classified products are characterized by trade competition disadvantages and comparative disadvantages. Products with export advantages have weak competition. Therefore, China should actively promote enterprises to go global and expand export channels, cultivate emerging products and pay attention to innovation, to improve the competitive advantage of products and promote the sustainable and healthy development of chemical trade. With the continuous adjustment of the world industrial structure, the chemical industry has become the economic growth point of modern industry. Chemical trade is an important part of world trade. In 2017, the world trade volume reached 483.9 billion US dollars. The chemical industry is the foundation and pillar industry of China. It has always occupied an important position in China's foreign trade. The scale of trade has been increasing year by year. It sorts out the development of China's chemical trade and proposes countermeasures in a targeted manner, which is conducive to the sustainable and healthy development of China's chemical trade

1. The status of China's chemical trade

There are a wide variety of chemical products, and the classification habits and statistical calibers vary from country to country. According to the Harmonized Commodity Name and Coding System (HS), the article takes the product of Chapters 28-40 as the research object, including: inorganic chemicals, organic chemicals, pharmaceuticals, fertilizers, dyes & pigments, spices, soap detergents, albuminoidal substances, explosives, photographic materials, miscellaneous chemicals, plastic products, rubber products [1]. The data used in the calculation of the article is derived from the ITC database.

1.1. China's chemical trade scale and international market share have increased year by year

China is a major chemical trade country in the world, and the scale of chemical trade ranks among the top in the world. In 2017, the chemical trade volume was second only to the United States and Germany, ranking third in the world [2]. China's chemical trade scale and international market share
have been increasing year by year, rising from US$247.9 billion and 6.1% in 2008 to US$426.4 billion and 8.8% in 2017. The export volume of chemical trade increased overall, from 110.3 billion US dollars in 2008 to 206 billion US dollars in 2017, an increase of 87%; the import volume showed a small increase trend, with less fluctuations, from $13.7 billion in 2008 to $220.4 billion in 2017.

Table 1. Import and export of China's chemical trade (Unit: 100 million US dollars, %)

|           | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Total     |        |        |        |        |        |        |        |        |        |        |
| China     | 2479   | 2183   | 2984   | 3746   | 3799   | 4003   | 4184   | 3850   | 3649   | 4264   |
| World     | 40941  | 34985  | 41438  | 48547  | 48099  | 49390  | 50078  | 45353  | 44636  | 48389  |
| Proportion| 6.1    | 6.2    | 7.2    | 7.7    | 7.9    | 8.1    | 8.3    | 8.4    | 8.6    | 8.8    |
| Export    |        |        |        |        |        |        |        |        |        |        |
| China     | 1103   | 900    | 1246   | 1634   | 1718   | 1826   | 1998   | 1922   | 1804   | 2060   |
| World     | 20085  | 17182  | 20382  | 23803  | 23765  | 24387  | 24662  | 2204   | 21845  | 23602  |
| Proportion| 5.5    | 5.2    | 6.1    | 6.9    | 7.2    | 7.5    | 8.1    | 8.7    | 8.3    | 8.7    |
| Import    |        |        |        |        |        |        |        |        |        |        |
| China     | 1377   | 1283   | 1738   | 2112   | 2081   | 2177   | 2186   | 1928   | 1846   | 2204   |
| World     | 20856  | 17803  | 21056  | 24745  | 24335  | 25002  | 25416  | 23149  | 22791  | 24787  |
| Proportion| 6.6    | 7.2    | 8.3    | 8.5    | 8.6    | 8.7    | 8.6    | 8.3    | 8.1    | 8.9    |
| Trade balance | -274 | -383  | -493  | -477  | -363  | -352  | -188  | -5  | -42  | -144 |

1.2. China is a net importer of chemical products, and the chemical trade presents a trade deficit
In recent years, China's chemical exports have been less than the amount of imports, showing a trade deficit, and is a net importer of chemical products. In 2008-2017, the inverse difference fluctuated greatly, and the deficit showed a trend of first expanding and then shrinking, with a mean deficit of $27.2 billion. Most of our chemical products are net imported products. In 2017, organic chemicals, pharmaceuticals, soap detergents, albuminooidal substances, photographic materials and miscellaneous chemicals are the main deficit products. Inorganic chemicals, fertilizers, dyes & pigments, explosives, plastic products and rubber products are surplus products, of which plastic products and rubber products have been transformed into surplus products in recent years.

1.3. China's chemical products import and export structure is stable, and the concentration of import and export commodity structure is high
The import and export structure of China's chemical products is relatively stable, with high concentration, and the share of chemical products in different categories is quite different. As can be seen from Table 2, the top three exporters of chemical products in China are plastic products, organic chemicals and rubber products. In 2017, the export shares were 34.3%, 24.1% and 10% respectively, totaling 68.4%; the share of photographic materials and explosives is very low, 0.4% and 0.5% respectively. The top three importers were plastic products, organic chemicals and pharmaceuticals, with import shares of 31.3%, 25.3% and 11.5% respectively, totaling 68.1%. 
Table 2. Import and Export Structure of China's Chemical Trade in 2017 (%)

| Classified product | Inorganic chemicals | Organic chemicals | Pharmaceuticals | fertilizers | dyes & pigments | spices | Soap detergents |
|--------------------|---------------------|-------------------|------------------|-------------|----------------|--------|-----------------|
| Export share       | 7.3                 | 24.1              | 3.6              | 2.9         | 3.4            | 2.4    | 1.7             |
| Import share       | 4.8                 | 25.3              | 11.5             | 1.1         | 2.1            | 3.5    | 2.0             |

| Classified product       | albuminoidal substances | explosives | photographic materials | miscellaneous chemicals | plastic products | rubber products |
|--------------------------|-------------------------|-----------|------------------------|------------------------|-----------------|-----------------|
| Export share             | 1.4                     | 0.4       | 0.5                    | 7.9                    | 34.3            | 10.0           |
| Import share             | 1.5                     | 0.1       | 1.1                    | 7.2                    | 31.3            | 8.6            |

2. China's chemical trade competitiveness analysis

2.1. Trade Competitiveness Index (TC Index)

The Trade Competitiveness Index (TC) is the proportion of the difference between the import and export of a certain product in a country as a percentage of the total import and export of the product. The calculation formula is:

$$TC = \frac{(X_i - M_i)}{(X_i + M_i)}$$  \hspace{1cm} (1)

Where, $X_i$ represents the export value of $i$ products, $M_i$ represents the import value of $i$ products, and the TC value is between -1 and 1. The higher the value, the stronger the international competitiveness.

It can be seen from Table 3 and Figure 1. From 2008 to 2017, the overall TC value of China's chemical trade is negative, at a competitive disadvantage, but the competitiveness is improving year by year. The TC index rose from -0.11 in 2008 to 2017-0.03. In terms of 13 classified chemical products, the TC value of inorganic chemicals, fertilizers and explosives in China has been positive, and the explosives have the highest TC value in all classified products, with an average of 0.77, which is the most competitive. The TC value of dyes & pigments, plastic products and rubber products changed from a negative value to a positive value, and the competitiveness was improved. In the past two years, the TC value of spices has fallen from a positive value to a negative value, and competitiveness has declined. Organic chemicals, soaps detergents, albuminoidal substances, photographic materials and pharmaceuticals have always been a competitive disadvantage. The TC averages of the last three are -0.08, -0.31, and -0.38 respectively., pharmaceuticals has the biggest competitive disadvantage, and there is a tendency to deteriorate, relying heavily on foreign countries.
Table 3. China's chemical trade TC index

|                      | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  |
|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| total                | -0.11 | -0.18 | -0.17 | -0.13 | -0.10 | -0.09 | -0.04 | 0.00  | -0.01 | -0.03 |
| inorganic chemicals  | 0.18  | 0.11  | 0.08  | 0.23  | 0.18  | 0.18  | 0.18  | 0.15  | 0.15  | 0.17  |
| organic chemicals    | -0.15 | -0.20 | -0.21 | -0.23 | -0.20 | -0.22 | -0.14 | -0.06 | -0.02 | -0.06 |
| pharmaceuticals     | -0.26 | -0.28 | -0.24 | -0.31 | -0.38 | -0.42 | -0.46 | -0.47 | -0.50 | -0.55 |
| fertilizers          | 0.11  | 0.13  | 0.36  | 0.39  | 0.29  | 0.30  | 0.45  | 0.47  | 0.46  | 0.44  |
| dyes & pigments      | -0.04 | -0.08 | -0.01 | 0.10  | 0.14  | 0.15  | 0.20  | 0.21  | 0.18  | 0.21  |
| spices               | 0.27  | 0.24  | 0.25  | 0.22  | 0.21  | 0.21  | 0.11  | 0.02  | -0.12 | -0.22 |
| soap detergents      | -0.10 | -0.13 | -0.16 | -0.10 | -0.07 | -0.08 | -0.07 | -0.08 | -0.10 | -0.11 |
| albuminoidal substances | 0.02  | -0.04 | -0.11 | -0.13 | -0.15 | -0.12 | -0.09 | -0.07 | -0.11 | -0.08 |
| explosives           | 0.89  | 0.87  | 0.80  | 0.79  | 0.77  | 0.76  | 0.74  | 0.73  | 0.64  | 0.67  |
| photographic materials | -0.22 | -0.31 | -0.29 | -0.30 | -0.31 | -0.31 | -0.31 | -0.30 | -0.35 | -0.37 |
| miscellaneous chemicals | -0.06 | -0.16 | -0.12 | -0.13 | -0.16 | -0.12 | -0.08 | -0.04 | -0.04 | 0.01  |
| plastic products     | -0.24 | -0.31 | -0.29 | -0.21 | -0.11 | -0.08 | -0.06 | 0.00  | 0.01  | 0.01  |
| rubber products       | -0.01 | 0.01  | -0.06 | -0.05 | 0.04  | 0.08  | 0.15  | 0.18  | 0.15  | 0.05  |

2.2. Revealed Comparative Advantage index (RCA index)
The Revealed Comparative Advantage index (RCA) indicates the ratio of the export value of a product in a country to the total value of the country's exports and the ratio of the world's total value of the product to the world's total export value of all products. The formula is as follows:

\[
RCA = \frac{(X_{ij}/X_{it})}{(X_{wj}/X_{wt})}
\]

Where, \(X_{ij}\) and \(X_{it}\) are the exports of \(j\) products and all products respectively in \(i\) country, and \(X_{wj}\) and \(X_{wt}\) are the exports of \(j\) products and all products in the world. The larger the RCA index, the more obvious the comparative advantage of the product.

It can be seen from Table 4 and Figure 2 that in 2008-2017, the overall RCA index of China's chemical trade is lower than 0.8, which does not have a comparative advantage, but is slowly improving. As far as classified products are concerned, the RCA index of China's explosives has remained above 1.25, with an average of 1.65. The comparative advantage is the strongest among all products, but the comparative advantage has a weakening trend. The RCA average values of inorganic chemicals, organic chemicals, rubber products, plastic products and fertilizers ranged from 0.8 to 1.25, which were 0.93, 0.80, 0.89, 0.81 and 0.92, respectively, and remained at a moderate comparative level. The RCA index of plastic products is gradually increasing, and the comparative advantage is slowly increasing. Most of the products are at a disadvantage. Dyes & pigments, photographic materials, soaps detergents, albuminoidal substances, spices and pharmaceuticals are relatively inferior. The RCA index all is less than 0.8. The average RCA of the latter three were 0.28, 0.44, and 0.10, respectively. The drug is the most inferior, the average RCA index is only 0.099.
Table 4. China's chemical trade RCA index

|                          | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|--------------------------|------|------|------|------|------|------|------|------|------|------|
| total                    | 0.61 | 0.54 | 0.58 | 0.65 | 0.65 | 0.64 | 0.66 | 0.63 | 0.63 | 0.68 |
| inorganic chemicals      | 1.07 | 0.82 | 0.93 | 1.11 | 0.89 | 0.88 | 0.93 | 0.81 | 0.85 | 0.97 |
| organic chemicals        | 0.82 | 0.75 | 0.76 | 0.78 | 0.77 | 0.76 | 0.79 | 0.77 | 0.85 | 0.92 |
| pharmaceuticals         | 0.08 | 0.08 | 0.10 | 0.11 | 0.11 | 0.11 | 0.10 | 0.10 | 0.10 | 0.10 |
| fertilizers              | 0.65 | 0.65 | 0.94 | 0.99 | 0.87 | 0.80 | 1.11 | 1.23 | 1.00 | 0.92 |
| dyes & pigments          | 0.61 | 0.54 | 0.59 | 0.65 | 0.62 | 0.61 | 0.65 | 0.62 | 0.63 | 0.69 |
| spices                   | 0.25 | 0.25 | 0.27 | 0.28 | 0.27 | 0.27 | 0.29 | 0.31 | 0.28 | 0.29 |
| soap detergents          | 0.43 | 0.39 | 0.41 | 0.46 | 0.47 | 0.46 | 0.46 | 0.44 | 0.45 | 0.47 |
| albuminoidal substances  | 0.82 | 0.75 | 0.75 | 0.76 | 0.75 | 0.74 | 0.72 | 0.71 | 0.72 | 0.77 |
| explosives               | 1.89 | 1.99 | 1.64 | 1.75 | 1.76 | 1.67 | 1.23 | 1.54 | 1.52 | 1.48 |
| photographic materials   | 0.54 | 0.49 | 0.58 | 0.60 | 0.61 | 0.61 | 0.59 | 0.59 | 0.56 | 0.58 |
| miscellaneous chemicals  | 0.62 | 0.52 | 0.60 | 0.62 | 0.55 | 0.57 | 0.60 | 0.56 | 0.59 | 0.67 |
| plastic products         | 0.69 | 0.66 | 0.69 | 0.77 | 0.87 | 0.88 | 0.87 | 0.86 | 0.87 | 0.92 |
| rubber products           | 0.82 | 0.88 | 0.84 | 0.86 | 0.90 | 0.95 | 0.99 | 0.88 | 0.88 | 0.87 |

Figure 1. China's chemical trade TC changes
3. conclusions and countermeasures

3.1. Conclusion
The analysis of China's chemical trade data from 2008 to 2017 shows that the total import and export volume of China's chemical trade ranks among the top in the world, and the scale of trade is increasing year by year. The overall trade is in a trade deficit state, and the concentration of import and export commodities structure is high. The top three exporters are plastic products, organic chemicals and rubber products, the top three imported products are plastic products, organic chemicals and pharmaceuticals. China's chemical trade overall performance has trade competition disadvantage and comparative disadvantage, but there is a better trend; more than half of classified products show trade competition disadvantages and comparative disadvantages. Plastic products, organic chemicals and rubber products with big export volume showed moderate comparative advantage and trade competitive disadvantage. Although China's chemical export trade has grown rapidly, the export quantity advantage of some products is more obvious, but there is still a situation in which the export commodity structure is relatively simple and lacks high value-added products.

3.2. Countermeasures
First, deepen international cooperation and promote enterprises to “go global”. China is a net importer of chemical trade. It is necessary to actively promote enterprises to the international market through international cooperation, to expand exports. We can leverage production capacity cooperation project of the Belt and Road, adopt engineering contracting, investment and establishing overseas chemical parks to carry out international cooperation, extend the downstream links of the oil and gas industry chain, and promote the “going out” of Chinese enterprises and products. In addition, we will expand the field of international cooperation, further expand the potential of cooperation in the fields of coal chemical industry and bio-chemical industry [3]. Second, make full use of the Internet platform and big data technology to expand the export market. The network platform is an important channel for enterprises to enter the international market. The online channel can enhance the advantages of enterprises in terms of capital, brand and cost. Enterprises should vigorously develop online trade, expand export volume, increase international market share, and ease deficit situation trade in China.
Third, focus on the cultivation of emerging products and create competitive advantages in products. Although China's chemical export structure is constantly optimized, the competitive advantage of its products is weak, mainly because of export products of the low added value. In the future, the chemical market is developing in the direction of refinement, functionalization and greening. It is necessary to cultivate chemical products with high technical content such as medicines and essential oils in China. At the same time, it is necessary to move to higher-end electronic chemistry and fine chemicals, continue to enhance China's position in the value chain, and optimize the export commodities structure [4].

Fourth, attach importance to R&D investment and personnel training. Innovation is a magic weapon that stands in the international market. R&D investment and talent are the key factors for innovation. China's chemical companies need to further increase the proportion of scientific research investment, and support the research and development of enterprises with policies and funds. Colleges and universities should strengthen cooperation with foreign universities and multinational corporations, increase the integration of production and education, joint training and global professional qualification certification, and strive to cultivate a group of professional and international innovative talents to promote product innovation [5].

References
[1] China Chemical Information Center. China Chemical Industry Yearbook 2015/12 [M]. Beijing: China Petroleum and Chemical Industry Federation Press, 2015: 107-137.
[2] XinShi, Bin Xing. Research on the International Cooperation Strategy of the “One Belt and One Road” Oil and Gas Industry Chain [J]. International Economic Cooperation, 2015(8): 18-23.
[3] Lingduo Jiang, Yongbing Chen. Product heterogeneity and export duration of export enterprises [J]. World Economy, 2015, 38 (7): 3-26.
[4] Zesheng Sun. Analysis of the trade competitiveness of petrochemical industry in the “One Belt, One Road” major countries [J]. International Petroleum Economics, 2017 (1): 85-92.
[5] Haiying Dong. Comparative Study on International Competitiveness of Sino-US Chemical Products [J]. Journal of Wuxi Institute of Commerce and Technology, 2015(5): 15-20.