A comparative analysis on the import and export trade patterns of China's mechanical and electrical products

Yu Hong¹, Bingbing Qu¹, Yuan Wang¹ and Ting Liu², ³

¹Jilin University of Economy and Finance, Changchun 130021, China
²Changchun Humanities and Sciences College, Changchun 130021, China
³Corresponding author’s e-mail: lqthlittle@sina.com

Abstract. This study uses annual data from 1985 to 2019 to analyze the export and import trade patterns of mechanical and electrical products of China. We employ H-index, or the difference between net export capability and symmetric revealed comparative advantage, to assess the trade policies in exports and imports. The results reveal that China has comparative advantage in the imports, and has had comparative disadvantage in the exports before 1999. In recent years, the policy of trade protectionism has been adopted, which promotes exports in terms of exports and restricts imports in terms of imports.

1. Introduction
Since the 1980s, with China’s reform and opening up and the in-depth development of the international division of labor, relying on the advantages of land and labor, vigorously developing the manufacturing and processing industry. The export competitiveness of mechanical and electrical products has been continuously strengthened. At the same time, due to the needs of domestic economic development and technical level restrictions, the import trade volume of mechanical and electrical products is also increasing, and the trade deficit is relatively large.

Joining the WTO in 2001, China has participated more deeply in the international trade system, the scale of imports and exports of mechanical and electrical products has increased significantly, and its status in the international division of labor has been continuously improved. The export volume of various mechanical and electrical products ranks first in the world, the trade balance has also turned from a deficit to a surplus, and the balance has gradually increased. It is inferred that the balance will continue to expand in the next few years. But does this mean that China's mechanical and electrical products have become a strong trading country, does the comparative advantage of mechanical and electrical products still exist, and what changes have been made in the import and export trade policies of mechanical and electrical products? These questions can only get real answers through empirical research.

2. Methods and data of research

2.1. Measurement method of trade pattern

2.1.1. Symmetric revealed comparative advantage index. Balassa (1965) originated the indicator of "revealed comparative advantage" [1]:
In this part, X means export, Xck is the export of k products in country c, Xk is the export of all products in country c, and Xwk is the total export of k products in the world. If RCAck >1, it means that country c is more capable of specialized production of k products, and has a comparative advantage over the world average standard in the export trade of k products.

The range of RCA is 0 to infinity, but it does not determine the average value, and its distribution is asymmetrical. Dalum, Laursen and Villumsen (1998) solved the above problem by performing logarithmic transformation on RCA index [2]:

\[
RSCA_{ck} = \left( \frac{RCA_{ck}}{RCA_{ck} + 1} \right)
\]

The RSCAck represents the "symmetrical revealed comparative advantage" of country c's exports of k products. The average value of RSCAck is 0, and the range of it is [-1,1]. If RSCAck >0, then RSCA >1. It means that country c has a comparative advantage in the export of k products. On the contrary, if RSCAck <0, there will be RCAck <1, which means that country c is at a comparative disadvantage in the export of k products. If RSCAck =0, it means that the export of country c's product k has neither comparative advantage nor comparative disadvantage. So the export comparative advantage situation is the same as that of other countries in the world. Since one of the key points of the analysis in this paper is "the comparative advantage shown in product imports", it is necessary to adopt a certain deformation of equations (1) and (2) to measure the comparative advantage of imports:

\[
RCA_{ck}^M = \left( \frac{M_{ck}}{M_c} / \left( \frac{M_{ck}}{M_w} \right) \right)
\]

In equation (3), M represents imports, and the subscripts c, k, and w represent country c, product k, and the world, respectively.

\[
RSCA_{ck}^M = -(RCA_{ck}^M - 1)/(RCA_{ck}^M + 1)
\]

Correspondingly, equation (4) is used to express the size of the “symmetrical revealed comparative advantage” of imports. According to the theory of comparative advantage, when other conditions are the same, the more products k imported by country c indicates that the comparative advantage is smaller, not larger, so a minus sign is added here [3].

2.1.2. Net export ratio.

\[
NX_{ck} = \frac{X_{ck} - M_{ck}}{X_{ck} + M_{ck}}
\]

The relative position of the import and export of product k in country c’s trade is reflected by the net export ratio (NX), so NX can reflect the net export capacity of country c [4-6]. It is obvious to find that the range of NX is the same as RSCA which also is [-1,1]. And its average value is also 0. When NXck >0, it shows that country c is in a surplus position in the trade of product k; NXck <0 means that country c is in a deficit position in the trade of product k. More importantly, the range and average value of NX and RSCA are the same, so that the RCAck and NXck can be analyzed at the same time.

2.1.3. Trade pattern deviation index. According to the Heckscher-Ohlin model: a country should specialize in the production and export of products with comparative advantages. At the same time, according to Ricardo's free trade theory: the stronger a country’s comparative advantage in a certain product, the more it should export and the less it should import. Equation (6) is also a sufficient and necessary condition for free trade. In equilibrium, NXck and RCAck should be strictly consistent, which is NXck-RCAck=0. And we can get the equation:

\[
NX_{ck} = RSCA_{ck}^M = RSCA_{ck}^X
\]

The difference between NXck and RSCAck is:

\[
h_{ck}^M = NX_{ck} - RSCA_{ck}^M
\]

\[
h_{ck}^X = NX_{ck} - RSCA_{ck}^X
\]
The difference between NX\textsubscript{ck} and RSCA\textsubscript{ck} is the "trade divergence index" or "policy intervention index" of country c in the import and export trade of product k. When country c shows a certain comparative advantage in the import of product k, it means that the country's net export capacity is higher or lower than the actual situation of comparative advantage. When the trade pattern is in equilibrium, there should be h\textsubscript{ck} = 0. If h\textsubscript{ck} > 0, then the net export ratio is greater than the indicated comparative advantage of imports, indicating that country c has adopted a trade policy that restricts imports, and at this time it will also increase the net export ratio of its product k. If h\textsubscript{ck} < 0, it means that country c adopts to encourage import and import trade. Policy, the net export ratio at this time has fallen[7-9].

2.1.4. The weighted average index of policy intervention. This study uses a weighted average to obtain the import trade policy intervention index for the entire product category, because the Chinese products concerned include n specific product categories. The equation is:

\[ H_{cj} = \sum_{i=1}^{n} W_{ck} \cdot H_{ck} \]  

(9)

H\textsubscript{cj} is the trade policy intervention index for category. The weight of each commodity is:

\[ \omega_{ck} = \frac{(X_{ck} + M_{ck})}{(X_{ck} + M_{ck})} \]  

(10)

The weight of each commodity is the proportion of each specific product k in the import and export trade of mechanical and electrical products of China. In the calculation process of h and H index, the NX part will inevitably involve the import and export volume at the same time, so the total import volume cannot be selected, and the total import and export trade volume of aquatic products is weighted. When weighting the NX index of the j product, the method is the same as equation (10). When weighting the RSCA, the weight used is the proportion of a certain product in the total imports of the entire product[10-12]:

\[ RSCA_{cj}^{X} = \sum_{k=1}^{n} (\omega_{ck}^{X,RSCA} \times RSCA_{ck}) \]  

(11)

\[ \omega_{ck}^{X,RSCA} = \frac{X_{ck}}{\sum_{i=1}^{n} X_{ck}} \]  

(12)

\[ RSCA_{cj}^{M} = \sum_{k=1}^{n} (\omega_{ck}^{M,RSCA} \times RSCA_{ck}) \]  

(13)

\[ \omega_{ck}^{M,RSCA} = \frac{M_{ck}}{\sum_{i=1}^{n} M_{ck}} \]  

(14)

2.2. Collection and processing of data

This article uses the three-digit annual trade data of the First Amendment to the International Trade Standard Classification provided by the United Nations Statistics Office from 1985 to 2019. The author applied the method of classifying SITC Rev.1 three-digit products according to the technical structure. And we took China as the reporting country and identified 17 three-digit codes including "Power generating machinery, other than electric" (code 711), "Agricultural machinery and implements " (code 712), "Office machines" (code 714), "Metalworking machinery " (code 715), "Textile and leather machinery" (code 717), "Machines for special industries" (code 718), "Machinery and appliances non electrical parts" (code 719), "Elec19ric power machinery and switchgear" (code 722), "Equipment for distributing electricity" (code 723), "Telecommunications apparatus" (code 724), "Domestic electrical equipment" (code 725), "Elec. apparatus for medic. purp., radiological ap." (code 726), "Other electrical machinery and apparatus" (code 729), “Railway vehicles” (code 731), “Road motor vehicles” (code 732), “Road vehicles other than motor vehicles ” (code 733), “Aircraft” (code
734), “Ships and boats” (code 735). The world's total import and export of various mechanical and electrical products is obtained by adding up all countries in the database.

3. Empirical results and analysis

Figure 1 depicts the trade-weighted average $\text{NX}_{cj}$, $\text{RSCA}_{cj}$, and $\text{H}_{cj}$ indices of China's mechanical and electrical products exports during the period of 1985-2019:

![Figure 1](image_url)

**Figure 1.** The trade model of China's export of mechanical and electrical products (1985-2019).

First, the $\text{NX}_{cj}$ index during the sample period was negative from 1985 to 2003. Since 2004, the index has changed from negative to positive, and has remained stable after increasing to a certain level, indicating that China's mechanical and electrical product exports have changed from a trade deficit to a trade surplus.

Second, the $\text{RSCA}_{cj}$ index was negative from 1985 to 1998 and positive since 1999, indicating that with the rise of China’s independent brands and emerging technological forces, the revealed comparative advantage index of mechanical and electrical products has shown a steady rise, and China’s exports of mechanical and electrical products from comparative disadvantage to comparative advantage.

Third, the $\text{H}_{cj}$ index reflecting the intervention of export policies was less than zero in most years before 2014, and was positive after 2014, indicating that China has implemented export promotion policies for mechanical and electrical products after 2014, and its net export capacity has exceeded its level of comparative advantage.

Figure 2 depicts the trade-weighted average $\text{NX}_{cj}$, $\text{RSCA}_{cj}$, and $\text{H}_{cj}$ indices of China's mechanical and electrical products imports during the period of 1985-2019.

First, the $\text{RSCA}_{cj}$ index is always positive during the sample period, indicating that China has always had a comparative advantage in the import of mechanical and electrical products.

Second, the $\text{H}_{cj}$ index reflecting the intervention of import policies was negative during 1985-2001, and was positive in all subsequent years, indicating that since the 21st century, China has implemented a trade protectionist policy that restricts imports. Despite the comparison of imports advantages always exist, the degree of policy intervention in restricting imports has also increased and stabilized at a certain level.
4. Conclusions and implications

This paper analyzed the net export ratio, symmetrical revealed comparative advantage and policy intervention index of the mechanical and electrical products trade of China, and found that:

First, although China has comparative advantages in both export and import of mechanical and electrical products, they have different degrees of comparative advantage. In import trade, there has always been a comparative advantage, while in export trade, it has only had comparative advantages since 1999.

Second, regarding the import and export trade of mechanical and electrical products, the protectionist policy has been adopted in recent years in fact, which promotes exports in terms of exports and restricts imports in terms of imports.

Third, in the ever-changing international market, the overall level of foreign trade has risen, but the industry competition among countries is fierce. In response to the frequent trade barrier measures initiated by countries and regions such as Europe and the United States against China, China should improve the import and export trade policy system and properly solve various trade issues. At the same time, it is necessary to increase support and cultivation for the scientific and technological research and development of mechanical and electrical products, promote the R&D and manufacturing of high-tech mechanical and electrical products, give full play to the advantages of scale, maintain and expand comparative advantages, and consolidate and expand the world market.

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