

# Research on the Competitiveness and Complementarity of High-tech Industries Trade Between China and CPTPP Countries

Suping Zhao<sup>1</sup>

<sup>1</sup> School of International Finance and Trade, Sichuan International Studies University, Chongqing 400031, China

## ABSTRACT

This paper analyzes the competitiveness and complementarity of China's trade in high-tech industries with CPTPP (Comprehensive and Progressive Agreement for Trans-Pacific Partnership) countries using the Index of Displayed Comparative Advantage, the Export Similarity Index and the Trade Complementarity Index. The results show that: compared to CPTPP countries, China's high-tech industries are at a competitive advantage, especially in the industries of aerospace equipment, electronic communication equipment and computer office equipment; the degree of bilateral competition is generally mild, although the information chemicals industry is more intense; export complementarity is very significant, especially in the industries of information chemicals, computer office equipment and electronic communication equipment, etc. Therefore, China should, based on differentiated characteristics, vigorously expand the market space of advantageous industries, enhance the international competitiveness of disadvantaged industries, and consolidate the level of cooperation in complementary industries in order to cope with the market impact and cooperation opportunities that may be brought about by joining the CPTPP.

**Keywords:** High-tech industries, CPTPP, Competitiveness, Complementarity.

## 1. INTRODUCTION

The report of the 20th CPC National Congress pointed out that the unprecedented major turbulent situation in the world is accelerating its evolution and a new round of technological revolution and industrial transformation is deepening, providing a new strategic opportunity period for the development of China's high-tech industries. At present, China is actively promoting its accession to the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), in order to actively adapt to high standard international economic and trade rules and expand its economic and trade "circle of friends". CPTPP is a high standard free trade agreement signed by 11 countries, including Japan, Canada, Australia, Chile, New Zealand, Singapore, Brunei, Malaysia, Vietnam, Mexico, and Peru, which requires 98% of products among member countries to immediately or gradually achieve zero barrier and zero tariff,

including most high-tech products, which will have a profound impact on reshaping the global high-tech industry chain pattern. If China smoothly joins, on the one hand, due to the significant reduction of tariff and non-tariff barriers, China's high-tech products with comparative advantages will gain greater market space, further strengthen the resilience of the high-tech industry chain, and ensure the security and stability of the supply chain, and it will also help defeat the US's attempt of technology containment. On the other hand, China's relatively disadvantaged high-tech products will face stronger international competition, and some products may be replaced or even completely withdrawn from the market, thereby affecting the survival space of high-tech enterprises and threatening the achievement of China's goal of technological self-reliance. Therefore, in the negotiation process of joining the CPTPP, it is necessary to clarify the competitive and complementary relationship between China and

CPTPP countries in high-tech industry trade, evaluate the bilateral competition areas and cooperation prospects, provide empirical basis for formulating agreement texts that are conducive to the rapid development of China's high-tech industry, and also provide policy recommendations for improving the competitiveness of vulnerable products and expanding the scale of cooperation with advantageous products.

Exploring the competition and cooperation relationship in international trade usually relies on some indicators. The first method is to use the Trade Integration Index to compare the trade complementarity relationship between countries [1]; the second method is to use the Index of Displayed Comparative Advantage to analyze the international competitiveness of specific industries [2]; the third method is to use the Specialization Index and Consistency Index to analyze the competitive and complementary relationship between the two countries [3-7]. Summing up the above, this paper draws on the methodology of the above research and uses the HS6 quantile trade data from the CEPII-BACI database from 2002 to 2020 to analyze the competitive and cooperative relationship between China and CPTPP countries in high-tech industry trade using the Index of Displayed Comparative Advantage, the Export Similarity Index and the Trade Complementarity Index.

## 2. RESEARCH METHODS AND DATA EXPLANATION

This section mainly explains the formulas and specific meanings of indicators of competitive advantage, export similarity, and trade complementarity index.

$$ESI^k(ij, w) = \sum_p \left[ \left( \frac{X_{iw}^p / X_{iw} + X_{jw}^p / X_{jw}}{2} \right) \times \left( 1 - \left| \frac{X_{iw}^p / X_{iw} - X_{jw}^p / X_{jw}}{X_{iw}^p / X_{iw} + X_{jw}^p / X_{jw}} \right| \right) \right] \quad (2)$$

Among them,  $ESI^k(ij, w)$  represents the similarity index of export products from country  $i$  and country  $j$ 's  $k$  industry to third countries or world markets  $w$ ,  $X_{iw}^p / X_{iw}$  represents the share of the  $p$ -th commodity exported by country  $i$  to the  $w$  market, and commodity  $p$  belongs to industry  $k$ .  $ESI$  The index fluctuates between 0 and 1, and the closer the value is to 1, the more similar the export structure of country  $i$  and country  $j$  is, and the more intense the industrial competition between the two countries is.

## 2.1 Research Methods

The indicators of comparative advantage and export similarity represent the competitiveness of trade relations, while the export complementarity index shows complementarity.

### 2.1.1 Index of Displayed Comparative Advantage

The Index of Displayed Comparative Advantage ( $RCA$ ) was proposed by American economist Balassa (1965) [2] to measure the relative value of the share of a specific industry in a country's (region's) exports and the share of that industry in world (regional) trade, in order to evaluate the international competitiveness of a specific industry in a country (region). The calculation formula is as follows:

$$RCA_{xik} = (X_{ik} / X_i) / (X_{wk} / X_w) \quad (1)$$

Among them,  $X_{ik}$  and  $X_{wk}$  represent the export volume of country (region)  $i$  and world  $w$  in category  $k$  industry, while  $X_i$  and  $X_w$  represent the total export volume of country (region)  $i$  and world  $w$ , respectively. Generally speaking, when  $RCA > 2.50$ , it indicates that the  $k$  industry in country (region)  $i$  has strong international competitiveness. When  $1.25 < RCA \leq 2.50$ , it means a strong competitive advantage. When  $0.80 \leq RCA \leq 1.25$ , it means a dominant comparative advantage. When  $RCA < 0.8$ , it doesn't have comparative advantages.

### 2.1.2 Export Similarity Index

The Export Similarity Index ( $ESI$ ) is used to measure the degree of similarity in the structure of goods exported by two countries (regions) to third countries (regions) or world markets [8]. The specific formula is as follows:

### 2.1.3 Trade Complementarity Index

If the structure of China's export products is in line with the demand structure of importing countries, it shows strong trade complementarity, high trade cooperation relationships, and great trade potential. To ensure the reliability of the results, this paper draws on the method of Wang Bingxin and Mi Jun (2021) [1] and uses the arithmetic mean  $CSC$  of Specialization Index ( $CS$ ) and Consistency

Index (*CC*) to define the Export Complementarity Index. The specific formula is as follows:

$$CS = 1 - \frac{1}{2} \sum_n |a_{it}^p - a_{jt}^p| \quad (3)$$

$$CC = \frac{\sum_n a_{it}^p a_{jt}^p}{\sqrt{\sum_n (a_{it}^p)^2 \sum_n (a_{jt}^p)^2}} \quad (4)$$

$$CSC = \frac{CS+CC}{2} \quad (5)$$

Among them,  $a_{it}^n$  represents the proportion of the export value of the  $p$ -th commodity of country  $i$  in year  $t$  to the total export value of that country, and  $a_{jt}^n$  represents the proportion of the import value of the  $p$ -th commodity of country  $j$  in year  $t$  to the total import value of that country. If  $CS=CC=1$ , it means that the export structure of the  $p$ -th commodity in country  $i$  in year  $t$  is completely consistent with the import structure of the  $p$ -th commodity in country  $j$ . The closer the  $CSC$  value is to 1, the stronger the complementarity of trade between the two countries.

## 2.2 Data Sources and Explanations

The basic trade data in this paper is from the CEPII-BACI database, with a research period of 2002-2020. Considering the impact of the financial crisis and the "the Belt and Road" initiative on the direction and scale of high-tech industry trade, the study is divided into three intervals: 2002-2008, 2008-2014 and 2014-2020. According to the Classification of High-tech Industries (Manufacturing) (2017) released by the National Bureau of Statistics, this study subdivides high-tech industries into six categories: pharmaceutical manufacturing, aerospace equipment manufacturing, electronic communication equipment manufacturing, computer office equipment manufacturing, medical and instrument and apparatus manufacturing, and information chemical manufacturing.

## 3. COMPETITIVE ANALYSIS OF HIGH-TECH INDUSTRIES BETWEEN CHINA AND CPTPP COUNTRIES

This section uses the Display Comparative Advantage Index and Export Similarity Index to analyze the competitiveness of high-tech industry trade between China and CPTPP countries.

### 3.1 Analysis of International Competitiveness

As shown in "Table 1", compared to most CPTPP countries, China's high-tech industries have obvious advantages. In 2020, the *RCA* index was only second to Malaysia, Vietnam, and Singapore, and far higher than other countries. The Research Report on the Development of China's Manufacturing Industry 2022 points out that the proportion of high-tech industry added value in China has been increasing year by year from 2002 to 2021, exceeding 15% by 2021, and the PMI index is also above 50%, which is in a stage of rapid growth and continuous structural optimization. In recent years, China has established more than 200 national and local innovation centers, continuously increasing research and development investment through special policies, especially accelerating the construction of digital infrastructure, empowering "specialized, refined, special and new" enterprises to enhance their technological innovation capabilities, and continuously improving the position of the industrial chain through competition and cooperation with foreign investment, thereby promoting the transformation and upgrading of high-tech industries. However, from a dynamic perspective, the international competitiveness of China's high-tech industries tends to be at a disadvantage, with the *RCA* index continuing to decline from 1.87 in 2013 to 1.55 in 2020. This is partly due to the fact that the rapidly increasing export scale in China dilutes the contribution of high-tech industries. On the other hand, the rapid rise of high-tech industries in countries such as Vietnam and Malaysia has a significant impact on the overall scale of world exports. Since 2011, large-scale investment by multinational corporations has driven the rapid development of Vietnam's high-tech industries. By 2017, Vietnam's *RCA* index had surpassed China and become one of the main competitors in the international market. Malaysia's *RCA* index remains above 1.9, ranking first among CPTPP countries. It is worth noting that the *RCA* index of high-tech industries in Japan and Mexico is stable between 1.1 and 1.3, and they also have strong international competitiveness, but their dynamic advantages have decreased. The *RCA* index of high-tech industries in other countries is below 0.5, indicating weak overall competitiveness. Especially Brunei, Chile, and Peru have the lowest *RCA* indexes, which were less than 0.1 from 2002 to 2020, and these countries don't have a comparative advantage.

In terms of specific industries, compared to CPTPP countries, China's aerospace equipment, electronic communication equipment, computer office equipment and other industries have shown strong competitiveness. Among them, the export value of computer office equipment accounts for 48.4% of the global total, and the *RCA* index exceeded 2.50 in 2008, 2013, and 2020, which is higher than all CPTPP countries. Although it has decreased in recent years, it still shows strong international competitiveness. The *RCA* index of aerospace equipment was second only to Vietnam and Mexico in 2020, demonstrating high international competitiveness. In terms of aerospace equipment, China has become a major supplier to more than 30 countries, with the largest export scale to the US. However, with the intensification of trade frictions between China and the US, the trend of export growth has been curbed, and in recent years, the *RCA* index has shown a dynamic downward trend. And as a "backyard" processing plant for the US, Mexico has become a purchasing country for more and more countries with its cheap labor and high standard aviation component manufacturing capabilities. In addition, the *RCA* index of electronic communication equipment of China is lower than Malaysia, Vietnam, and Singapore, but much higher than other countries, and also has high international competitiveness. Especially driven by the new round of digital

infrastructure construction such as 5G, China's export of electronic communication equipment is growing rapidly. However, it is still necessary to pay attention to the adverse impact of global industrial chain adjustments on the *RCA* index, especially the rise of Vietnam. In 2020, Vietnam became the fifth country in the world to independently produce 5G communication equipment, providing products and services to 11 countries and regions. With the rapid expansion of international business, Vietnam's international competitiveness has become increasingly strong. The *RCA* index of the information chemicals, medical and instrument and apparatus industries shows that China is on the edge of a revealed comparative advantage. The *RCA* index of information chemicals was only 0.87 in 2020, far lower than Malaysia, Singapore, and Japan, being in the middle of the CPTPP countries and showing a fluctuating downward trend, which may lead to the loss of competitive advantage in the future. The *RCA* index of medical and instrument and apparatus is lower than Singapore, Japan, Mexico, and Malaysia, but higher than other countries. In terms of the pharmaceutical manufacturing industry, China's *RCA* index in 2020 was only 0.13, which is not as high as Singapore, Malaysia, Canada, Japan, Australia, and New Zealand, and is at a serious disadvantage. However, dynamically, the *RCA* index shows a slight growth trend.

Table 1. Index of Displayed Comparative Advantage of China and CPTPP countries' high-tech industries

Type	Year	CHN	AUS	BRN	CAN	CHL	JPN	MYS	MEX	NZL	PER	SGP	VNM
High-tech industries	2002	1.24	0.30	0.00	0.50	0.06	1.36	2.13	1.39	0.23	0.03	2.12	0.25
	2008	1.74	0.21	0.02	0.49	0.06	1.38	1.97	1.48	0.26	0.04	1.70	0.53
	2013	1.87	0.16	0.03	0.45	0.07	1.30	1.86	1.38	0.22	0.05	1.59	1.44
	2020	1.55	0.13	0.02	0.41	0.08	1.15	1.92	1.24	0.21	0.03	1.65	1.68
Pharmaceuticals	2002	0.09	0.63	0.00	0.29	0.13	0.26	0.42	0.23	0.27	0.05	0.16	0.02
	2008	0.09	0.50	0.00	0.65	0.08	0.22	0.44	0.20	0.33	0.03	0.67	0.04
	2013	0.11	0.39	0.00	0.56	0.10	0.24	0.56	0.34	0.33	0.04	0.98	0.05
	2020	0.13	0.33	0.00	0.61	0.06	0.43	0.66	0.12	0.24	0.04	1.31	0.04
Aerospace equipment	2002	1.00	0.26	0.00	1.19	0.25	1.29	0.43	3.37	0.30	0.21	0.28	1.16
	2008	1.49	0.20	0.03	0.84	0.23	1.41	0.50	2.50	0.26	0.17	0.39	1.59
	2013	1.59	0.11	0.06	0.75	0.31	1.42	0.39	2.86	0.13	0.15	0.25	1.46
	2020	1.33	0.07	0.01	0.79	0.23	1.16	0.36	2.84	0.07	0.14	0.27	1.77
Electronic communication equipment	2002	1.49	0.17	0.00	0.37	0.03	1.63	2.64	1.73	0.21	0.02	2.29	0.35

Type	Year	CHN	AUS	BRN	CAN	CHL	JPN	MYS	MEX	NZL	PER	SGP	VNM
Electronic communication equipment	2008	1.96	0.11	0.02	0.32	0.04	1.63	2.39	2.01	0.21	0.02	2.08	0.53
	2013	2.23	0.08	0.02	0.26	0.05	1.44	2.63	1.73	0.18	0.03	2.02	2.15
	2020	1.92	0.06	0.01	0.19	0.02	1.20	2.78	1.31	0.10	0.01	1.95	2.66
Computer office equipment	2002	1.88	0.14	0.00	0.24	0.02	1.14	3.61	1.30	0.08	0.02	4.14	0.07
	2008	3.23	0.13	0.01	0.25	0.04	1.21	3.56	1.14	0.13	0.02	2.51	0.94
	2013	3.53	0.10	0.01	0.18	0.04	1.05	2.27	1.15	0.10	0.02	1.74	1.78
	2020	2.70	0.05	0.00	0.15	0.03	0.73	1.47	1.89	0.06	0.01	0.99	1.22
Medical and instrument and apparatus	2002	0.79	0.55	0.01	0.40	0.02	1.89	0.63	1.18	0.41	0.02	1.08	0.15
	2008	1.07	0.44	0.03	0.46	0.03	1.90	0.74	1.35	0.51	0.02	1.02	0.26
	2013	1.03	0.34	0.10	0.43	0.03	2.07	0.91	1.38	0.47	0.02	1.40	0.33
	2020	0.82	0.28	0.04	0.48	0.02	2.16	1.14	1.53	0.66	0.02	2.26	0.37
Information chemicals	2002	1.47	0.59	0.01	0.27	0.02	2.62	1.67	0.98	0.09	0.01	1.35	0.15
	2008	1.49	0.21	0.03	0.37	0.07	2.92	1.36	0.48	0.20	0.02	2.55	0.10
	2013	1.35	0.14	0.09	0.25	0.05	3.07	1.70	0.37	0.14	0.03	2.15	0.16
	2020	0.87	0.12	0.02	0.20	0.02	2.71	3.62	0.63	0.06	0.01	2.91	0.13

a Note: The headers are three-letter country codes, representing China, Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam from left to right.

### 3.2 Export Similarity Analysis

From "Table 2", it can be seen that there is a moderate level of competition between China and most countries in the CPTPP in the high-tech industries, but there is strong competition with Vietnam and Malaysia. From 2002 to 2020, most of the *ESI* indexes were concentrated below 0.5 and had little change, indicating that the overall similarity of export product structure was not high. However, from the perspective of country distribution, China had strong competition in high-tech industries with Vietnam and Malaysia, with the highest and rising *ESI* index with Vietnam, reaching 0.66 by 2020. The *ESI* index of China and Malaysia fluctuated to 0.62 from 2002 to 2007, and in recent years, it has dropped to around 0.44. Although the competitiveness has eased, it is still at a high level. In 2020, the *ESI* index of China with Japan, Mexico, and Singapore was between 0.35 and 0.43, indicating a moderate competitive relationship. However, the *ESI* index of China with Brunei, Chile, and Peru was relatively low, maintaining between 0.15 and 0.3. There were

significant differences in the structure of export products, and the level of competition between them was not high. From the perspective of time trend, except for Vietnam, the *ESI* index of China with other CPTPP countries has shown a fluctuating downward trend, indicating a more significant difference in export product structure, further easing direct competition, and showing a greater possibility of future cooperation.

There are significant differences in the performance of various industries. In terms of information chemicals, China has fierce competition with most countries under CPTPP. In 2020, the *ESI* index of China with Australia, Mexico, Malaysia, and Singapore all exceeded 0.7, indicating high competitiveness, while the *ESI* index with Brunei was only 0.28, indicating a significant difference in export structure. Except for Brunei, China also maintains high product similarity with other countries, with the *ESI* index fluctuating around 0.5, indicating a considerable degree of competition. From a dynamic perspective, the *ESI* index between China and almost all CPTPP countries is showing an upward trend, and the

competitive relationship will further intensify in the future. In terms of aerospace equipment, China has fierce competition with Malaysia, Vietnam, and New Zealand. In 2020, the *ESI* index exceeded 0.5, while the *ESI* index of China with Australia, Canada, and Singapore was around 0.45, indicating a relatively mild level of competition. Dynamically speaking, there is an upward trend in the *ESI* index between China and most countries, resulting in more intense competition in this field. In terms of electronic communication equipment, the *ESI* index between China and Vietnam, Australia, Canada, and Japan exceeded 0.5 in 2020, with high export similarity. Among them, the *ESI* index between China and Vietnam significantly increased to 0.74 in 2020, indicating an increasingly strong competitive relationship. However, for other countries, bilateral competitive relationships tend to weaken. In terms of computer office equipment, the *ESI* index of China with Vietnam, Australia, Canada, New Zealand, and Singapore all exceeded 0.5, with the *ESI* index with Australia consistently maintaining above 0.6, marking extremely fierce competitions. The *ESI* index between China and Peru, Brunei, and Malaysia ranged from 0.4 to 0.5, indicating a strong competitive relationship. However, China's *ESI* index was lower than 0.4 compared to Chile, Japan, and Mexico, indicating a

relatively low level of competition. And dynamically, except for Vietnam and Australia, the *ESI* index has shown a downward trend. In terms of medical and instrument and apparatus, China has relatively mild competition with CPTPP countries. China's *ESI* index was only slightly higher than 0.5 compared to Canada, Japan, Chile, and Peru in 2020, and was roughly between 0.35 and 0.45 compared to other countries. However, from a dynamic perspective, the overall *ESI* index of China with other countries is showing an upward trend, and competitions may intensify in the future. In terms of the pharmaceutical manufacturing industry, China only had an *ESI* index exceeding 0.5 with Brunei in 2020, resulting in intense market competitions. However, China had an *ESI* index between 0.3 and 0.5 with countries such as Vietnam, New Zealand, Japan, and Australia, resulting in weaker export competitions. In recent years, the index has shown a fluctuating downward trend, and the level of competition has tended to be moderate. Based on the *RCA* index, this paper believes that this is a manifestation of China's pharmaceutical industry's weak international competitiveness, and that improving the quality of Chinese domestic products, expanding the variety of exported products, and actively participating in international competition are still urgent matters.

Table 2. Export Similarity Index of high-tech industries between China and CPTPP countries

Type	Year	AUS	BRN	CAN	CHL	JPN	MYS	MEX	NZL	PER	SGP	VNM
High-tech industries	2002	0.28	0.67	0.36	0.19	0.48	0.58	0.46	0.32	0.26	0.48	0.31
	2008	0.32	0.29	0.41	0.31	0.44	0.58	0.45	0.30	0.20	0.45	0.39
	2013	0.32	0.27	0.36	0.27	0.42	0.47	0.43	0.29	0.22	0.37	0.53
	2020	0.29	0.21	0.31	0.15	0.43	0.42	0.37	0.25	0.22	0.35	0.66
Pharmaceuticals	2002	0.31	1.00	0.38	0.31	0.39	0.25	0.38	0.35	0.34	0.43	0.48
	2008	0.32	0.52	0.33	0.32	0.41	0.23	0.46	0.34	0.34	0.30	0.52
	2013	0.37	0.72	0.38	0.35	0.41	0.18	0.40	0.38	0.36	0.42	0.50
	2020	0.43	0.65	0.35	0.31	0.42	0.23	0.42	0.48	0.38	0.42	0.47
Aerospace equipment	2002	0.35	0.58	0.39	0.23	0.30	0.51	0.33	0.41	0.23	0.40	0.33
	2008	0.40	0.30	0.47	0.29	0.39	0.53	0.40	0.34	0.31	0.39	0.47
	2013	0.38	0.31	0.47	0.31	0.41	0.51	0.37	0.34	0.32	0.37	0.47
	2020	0.48	0.21	0.46	0.29	0.41	0.60	0.37	0.52	0.22	0.45	0.57
Electronic communication equipment	2002	0.42	0.85	0.48	0.33	0.45	0.52	0.46	0.41	0.35	0.42	0.33

Type	Year	AUS	BRN	CAN	CHL	JPN	MYS	MEX	NZL	PER	SGP	VNM
Electronic communication equipment	2008	0.54	0.33	0.62	0.43	0.53	0.54	0.53	0.42	0.30	0.43	0.43
	2013	0.58	0.47	0.61	0.48	0.49	0.48	0.49	0.40	0.40	0.34	0.49
	2020	0.56	0.26	0.56	0.48	0.52	0.43	0.42	0.46	0.37	0.37	0.74
Computer office equipment	2002	0.66	0.57	0.62	0.48	0.84	0.78	0.68	0.63	0.55	0.63	0.61
	2008	0.62	0.56	0.66	0.53	0.43	0.75	0.50	0.58	0.53	0.53	0.35
	2013	0.60	0.52	0.65	0.31	0.41	0.48	0.51	0.58	0.48	0.59	0.66
Medical and instrument and apparatus	2002	0.25	0.61	0.37	0.36	0.44	0.39	0.28	0.23	0.52	0.34	0.42
	2008	0.27	0.31	0.41	0.35	0.39	0.30	0.26	0.24	0.29	0.37	0.30
	2013	0.31	0.27	0.46	0.40	0.48	0.38	0.33	0.26	0.33	0.37	0.32
Information chemicals	2002	0.16	0.78	0.22	0.25	0.40	0.64	0.45	0.27	0.49	0.43	0.37
	2008	0.34	0.22	0.28	0.51	0.39	0.44	0.20	0.32	0.31	0.58	0.52
	2013	0.37	0.22	0.35	0.40	0.38	0.46	0.42	0.37	0.30	0.71	0.63
	2020	0.78	0.28	0.52	0.52	0.56	0.70	0.74	0.53	0.46	0.70	0.46

a Note: The headers are three-letter country codes, representing China, Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam from left to right. The same below.

#### 4. ANALYSIS OF THE COMPLEMENTARITY OF CHINA'S EXPORT OF HIGH-TECH INDUSTRIES TO CPTPP COUNTRIES

From 2002 to 2020, China had strong export complementarity to high-tech industries in CPTPP countries, with *CSC* indexes higher than 0.65 in all years. As shown in "Table 3", China's *CSC* index to countries such as Japan, Mexico, New Zealand, and Peru has remained stable at above 0.8, indicating strong export complementarity. China's bilateral trade complementarity with Chile, Australia, and Canada has also continued to strengthen, with the *CSC* index exceeding 0.85 in 2020. Except for Brunei, Singapore, and Vietnam, China's *CSC* index for CPTPP countries has shown an overall fluctuating upward trend, indicating a more consistent export structure, closer trade connections, and a wider range. Overall, China's export complementarity of high-tech industries to CPTPP countries is clearly at a high level and has a positive

trend of development. This also means that China's accession to CPTPP will help expand the cooperation space between China and its member countries.

Specifically, China's *CSC* index for different types of high-tech industries in CPTPP countries has also maintained a high level, especially in industries such as information chemicals, computer office equipment, and electronic communication equipment. Among them, the performance of information chemicals is the most prominent. In 2020, China's *CSC* index against Canada, Malaysia, Australia, Mexico, Singapore, New Zealand, and Chile was all above 0.97, indicating that the trade structure was almost completely aligned, which helped to further strengthen bilateral trade cooperation. China's *CSC* index against Peru and Brunei was slightly lower, but also fluctuated around 0.90, with only Vietnam as low as 0.65. From a dynamic perspective, the *CSC* index of China with most CPTPP countries has increased significantly, and export complementarity is expected to further consolidate and enhance. The

performance of computer office equipment and electronic communication equipment in China is comparable. The CSC indexes of the two show that China's exports to six countries, including Australia, Japan, Chile, Peru, Canada, and New Zealand, are highly complementary, all exceeding 0.90 in 2020, indicating huge trade cooperation space. Other countries have also shown impressive performance. It is worth noting that in terms of electronic communication equipment, the CSC index of China with Malaysia and Vietnam is relatively low and showing a downward trend, reflecting the increasingly strong bilateral competitive relationship in recent years, which is consistent with the previous research conclusions. From a dynamic perspective, except for Brunei, Mexico, and Vietnam, the CSC indexes have shown a growth trend. If China smoothly joins the CPTPP, it can be estimated that the export scale of the aforementioned industries will further increase. China's pharmaceutical manufacturing industry, medical and instrument and apparatus, and aerospace equipment have shown weak performance. The CSC index of China's pharmaceutical manufacturing industry in the CPTPP countries remains between 0.75 and 0.89,

reflecting strong export complementarity. Although it is not outstanding enough compared to other industries, almost all CSC indexes show a dynamic upward trend, which is expected to become a new export growth point for China. In terms of medical and instrument and apparatus, China has the highest CSC index against Mexico, exceeding 0.90 except for 2002, and the bilateral trade cooperation relationship is very close. However, China's CSC indexes against Australia, Brunei, Chile, New Zealand, and Peru decreased to around 0.59 in 2008 and 2013, and remain stable above 0.6 in other periods, showing a U-shaped growth pattern. China's CSC indexes with other CPTPP countries remain between 0.6 and 0.9, indicating a high level of cooperation. In terms of aerospace equipment, China and Malaysia have the strongest export complementarity, with the CSC index reaching 0.91 in 2020. At the same time, China's trade structure with Australia, Mexico, New Zealand, Singapore, and Vietnam is closely aligned, with the CSC index being maintained at 0.7-0.89. Although China's export complementarity against countries such as Japan and Brunei remains at a high level, it is showing a downward trend.

Table 3. Export Complementarity Index of high-tech industries of China against CPTPP countries

Type	Year	AUS	BRN	CAN	CHL	JPN	MYS	MEX	NZL	PER	SGP	VNM
High-tech industries	2002	0.77	0.74	0.76	0.81	0.83	0.73	0.88	0.82	0.80	0.81	0.77
	2008	0.76	0.70	0.80	0.75	0.83	0.76	0.83	0.86	0.84	0.69	0.82
	2013	0.83	0.68	0.79	0.75	0.85	0.71	0.86	0.85	0.90	0.68	0.73
	2020	0.89	0.66	0.86	0.90	0.92	0.75	0.80	0.90	0.92	0.74	0.74
Pharmaceuticals	2002	0.77	0.75	0.76	0.78	0.77	0.78	0.78	0.78	0.77	0.79	0.76
	2008	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.81	0.79
	2013	0.83	0.84	0.83	0.84	0.83	0.84	0.84	0.84	0.84	0.89	0.84
	2020	0.87	0.80	0.89	0.87	0.88	0.84	0.89	0.88	0.89	0.89	0.83
Aerospace equipment	2002	0.74	0.60	0.60	0.66	0.81	0.68	0.73	0.74	0.67	0.73	0.62
	2008	0.86	0.68	0.72	0.76	0.82	0.79	0.83	0.85	0.75	0.76	0.79
	2013	0.87	0.71	0.76	0.74	0.78	0.88	0.85	0.85	0.81	0.80	0.82
	2020	0.85	0.58	0.72	0.72	0.76	0.91	0.81	0.84	0.74	0.85	0.81
Electronic communication equipment	2002	0.87	0.77	0.83	0.83	0.72	0.68	0.80	0.87	0.82	0.69	0.81
	2008	0.92	0.85	0.91	0.88	0.85	0.74	0.87	0.92	0.89	0.72	0.93
	2013	0.95	0.79	0.88	0.86	0.89	0.73	0.90	0.89	0.91	0.70	0.77



Type	Year	AUS	BRN	CAN	CHL	JPN	MYS	MEX	NZL	PER	SGP	VNM
Electronic communication equipment	2020	0.96	0.89	0.96	0.92	0.97	0.77	0.81	0.95	0.93	0.76	0.76
Computer office equipment	2002	0.97	0.93	0.95	0.97	0.96	0.92	0.95	0.97	0.96	0.93	0.98
Computer office equipment	2008	0.96	0.96	0.97	0.96	0.94	0.81	0.94	0.97	0.94	0.81	0.81
	2013	0.98	0.97	0.96	0.98	0.98	0.85	0.82	0.99	0.98	0.85	0.89
	2020	0.98	0.84	0.97	0.98	0.98	0.89	0.76	0.97	0.98	0.82	0.79
Medical and instrument and apparatus	2002	0.70	0.64	0.66	0.74	0.74	0.70	0.69	0.78	0.73	0.72	0.67
	2008	0.57	0.55	0.60	0.57	0.82	0.97	0.99	0.56	0.56	0.65	0.70
	2013	0.59	0.57	0.62	0.59	0.76	0.95	0.95	0.58	0.60	0.63	0.91
	2020	0.77	0.73	0.80	0.77	0.75	0.81	0.93	0.77	0.79	0.74	0.89
Information chemicals	2002	0.77	0.71	0.81	0.78	0.89	0.70	0.84	0.69	0.69	0.64	0.57
	2008	0.92	0.85	0.89	0.85	0.94	0.69	0.85	0.76	0.84	0.75	0.77
	2013	0.94	0.61	0.94	0.97	0.96	0.89	0.92	0.84	0.95	0.90	0.86
	2020	0.99	0.88	1.00	0.97	0.98	1.00	0.99	0.97	0.91	0.98	0.65

## 5. CONCLUSION

This paper is based on HS6 quantile trade data from 2002 to 2020, and uses the Index of Displayed Comparative Advantage, the Export Similarity Index and the Trade Complementarity Index to analyze the competitive and complementary relationship between China and CPTPP countries in high-tech industry trade. The research conclusions are as follows. Firstly, China's high-tech industries have a clear competitive advantage compared to most CPTPP countries, only weaker than Malaysia, Vietnam, and Singapore in 2020, especially in industries such as aerospace equipment, electronic communication equipment, and computer office equipment. Secondly, there is a moderate level of competition between China and most countries in the CPTPP in the high-tech industries, but there is strong competition with Vietnam and Malaysia. From an industrial perspective, there is fierce competition between China's information chemicals industry and most CPTPP countries. Computer office equipment and electronic communication equipment are facing competition from major countries, and overall bilateral competition is tending to ease. The Export Similarity Index of China's aerospace equipment, medical and instrument and apparatus equipment exports has shown a dynamic upward trend, and the

pharmaceutical manufacturing industry is also facing competition from individual countries. Thirdly, China has strong export complementarity to high-tech industries in CPTPP countries, especially to countries such as Australia, Canada, Chile, Japan, Mexico, and New Zealand. Specifically, in terms of certain industries, China's information chemicals, computer office equipment, and electronic communication equipment industries have high export complementarity.

Based on the CPTPP protocol text and the previous research conclusions, researchers obtain the following policy implications. Firstly, efforts should be made to fully leverage the comprehensive competitive advantages of China's high-tech industries, deeply develop markets such as Australia, Canada, Chile, Japan, Mexico, New Zealand, especially in industries with significant advantages in China such as aerospace, electronic communication, and computer office equipment, further improve the quality and level of external circulation, and expand the external market to provide more funds, information, technology, and channels for the development of Chinese domestic high-tech industries, thus forming a new development pattern of international circulation promoting Chinese domestic circulation. Secondly, China must continue to promote the innovation-driven strategy and enhance the international

competitiveness of China's high-tech industries. It needs to improve its intellectual property protection mechanism and innovation incentive mechanism, base itself on Chinese domestic advantageous industries, deeply implement the "Made in China 2025" strategy, promote in-depth cooperation between enterprises and domestic scientific research institutions and universities, build an innovation system with enterprises as the main body, market orientation, and collaborative research by industry, university, and research, break the "black box" shackles of foreign core technologies, and form a collaborative innovation ecosystem with Chinese characteristics. Thirdly, China needs to accelerate the creation of a stable, fair, transparent and predictable business environment, actively carry out policy negotiations and exchanges, strengthen economic and trade cooperation with countries with high export complementarity, effectively align its own advantages with the CPTPP rules, and continue to promote the transformation and upgrading of China's high-tech industries.

## ACKNOWLEDGMENTS

The National Social Science Foundation project "Research on the Mechanism and Path of Upgrading the Value Chain of China's High tech Industry" (Project No.: 23BGJ016); Chongqing Social Science Planning Fund Project "Research on the Collaborative Development of Chongqing's Competitive Advantage Cultivation and Manufacturing Export Quality Upgrade" (Project No.: 2018YBJJ045); The Science and Technology Project of Chongqing Education Commission "Research on the Mechanism and Impact Path of Intelligence Promoting the Value Chain Climbing of China's Manufacturing Industry" (Approval No.: KJQN202000904).

## REFERENCES

- [1] Wang Bingxin, Mi Jun. An Analysis on Trade Competition, Complementarity and Potentiality Between China and Eurasian Economic Union [J]. Journal of Dongbei University of Finance and Economics, 2021 (03): 56-65. (in Chinese)
- [2] BALASS B. Trade Liberalization and Revealed Comparative Advantage The Manchester School of Economic and Social Studies, 1965, 33 (2): 99-123
- [3] GLICK R, ROSE A K. Contagion and Trade: Why Are Currency Crises Regional Journal of International Money and Finance, 1999, 18 (4): 603-617
- [4] Gong Xinshu, Qiao Shanshan, Hu Zhigao. The Silk Road Economic Belt: Trade Competitiveness, Complementarity, and Trade Potential: Based on the Stochastic Frontier Gravity Model [J]. Inquiry into Economic Issues, 2016 (10): 145-154. (in Chinese)
- [5] Diao Li, Luo Pei, Hu Juan. Export Potential of Silk Road Economic Belt and its Determinants [J]. Statistical Research, 2017,34 (11): 56-68. (in Chinese)
- [6] Wang Shaoyuan, Feng Zhiqing. Study on the Competitiveness and Complementarity of Trade Relationship among China,Japan and South Korea in Manufacturing Industry [J]. Journal of Statistics and Information, 2021,36 (07): 29-40. (in Chinese)
- [7] Wang Qianqian, Wei Longbao, Wang Wenting. Empirical Analysis of Raw Milk Price Volatility in China Based on GARCH Model [J]. Issues in Agricultural Economy, 2020 (11): 97-107. (in Chinese)
- [8] Xu Xinpeng, Song Ligang, Wu Guiying. Export Similarity and the Pattern of East Asian Development [J]. World Economic Forum, 2002 (05): 3-15. (in Chinese)