Analysis of the Competitiveness and Complementarity between China Japan and other RCEP Member Countries

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Abstract. Using ESI index, TCI Index and IIT Index to compare the competitiveness, complementarity and Intra-industry trade level between China Japan and other RECP member countries (South Korea, Australia, New Zealand and ASEAN). Both China and Japan are obviously competitive with South Korea and ASEAN, and are obviously complementary with Australia and New Zealand. Also, both China and Japan are mainly engaged in Intra-industry trade with South Korea and ASEAN, while mainly engaged in Intra-industry trade with South Korea and ASEAN, while mainly engaged in Inter-industry trade with Australia and New Zealand. Moreover, through the empirical analysis of panel data, the competition between trading countries is an important factor affecting the level of Intra-industry trade level of these countries, and the level of Intra-industry trade is an important indicator to measure a country's economic development level and industrial competitiveness. Therefore, both China and Japan should actively participate in the construction of "RCEP", while expanding the trade areas of economic complementarity with Australia and New Zealand, they should actively expand the trade depth with South Korea and ASEAN through benign competition.

Keywords: China; Japan; trade competitiveness; trade complementary; Intra-industry trade

1 Introduction

At present, there are also studies on competitiveness and complementarity related to RCEP member countries, but they are mainly limited to research on China with a certain member country, or on a specific industry. Such as: Meng Xia, Huang Chenliu, Zhang Xiao 's^[1]research on China's mechanical and electrical product exports; Liu Lei, Guan Quan 's^[2]research on manufacturing industries among China, Japan, and South Korea; Xu Junbian, Cai Yeping, Peng Hong's^[3]research on agricultural product trade between China and Australia; Wang Tieshan, Song Xin's ^[4]research on the service industry; Dong Hao 's^[5]research on manufactured goods trade between China and RCEP member states; Duan Jingyang, Luo Yiyi, Cheng Baodong 's^[6]research on engineered wood trade between China and RCEP member countries. Some researchers do not focus on the competitiveness and complementarity of RCEP member countries. Such as Zhang Yongtao^[7], Shi Jinfang, Li Bowen^[8], Ingot R S ,Laksani D D^[9], Ahmad B A T^[10].There are also literatures focusing on the competitiveness and complementarity of China and the Belt and Road countries. Such as Cui Jian, Liu Weiyan's^[11] thesis and Xie Bin, Wang Xiaoke's^[12] thesis.

There is few research on the competitiveness and complementarity between China and all other RCEP countries, especially with Japan, one of most important trading partner of China. Through comparative analysis of the competitiveness and complementarity between China Japan and other countries under the RCEP framework, this article is aim to provide suggestions for economic and trade cooperation between China Japan and other member countries (South Korea, Australia, New Zealand, ASEAN 10 countries, hereinafter referred to as "other member countries").

This article uses the ESI (Export Similarity Index) index as trade competitiveness indicators and the TCI (Trace Complementarity Index) index as trade complementarity indicators. This article also aims to study the impact of trade competitiveness on Intra-industry trade level through empirical analysis. Therefore, the IIT (Intra-industry Trade Index) index is used for Intra-industry trade indicators. All the specific calculation formula is explained in the following text. The required data for calculation are all from the United Nations Commodity Trade Statistics Database: UN Comtrade.

2 Analysis of Trade Competitiveness between China Japan and Other RCEP Member Countries

2.1 Overview of Competitiveness Index

The ESI Index (Export Similarity Index) is a commonly used indicator to describe the competitiveness of trade between two countries (regions). Originally proposed by Finger and Kreinin, and later modified by Glick and Rose, this article adopts the revised calculation formula:

$$ESI_{ij} = \left\{ \sum_{k} \left[\left(\frac{X_{iw}^{k} / X_{iw} + X_{jw}^{k} / X_{jw}}{2} \right) * \left(1 - \left| \frac{X_{iw}^{k} / X_{iw} - X_{jw}^{k} / X_{jw}}{X_{iw}^{k} / X_{iw} + X_{jw}^{k} / X_{jw}} \right| \right) \right] \right\} * 100$$

 ESI_{ij} is the export competitiveness index of i and j countries, k represents the product type, w represents the world market, and X represents the export volume. The value of this index is between 1 and 100, and the closer to 100, the more consistent and competitive of the composition of goods exported by the two countries. On the contrary, the closer to 0, the less competitive the two countries are. From the trend of change, if the ESI value shows an upward trend, the competition between the two countries gradually strengthens. On the contrary, it indicates that the competition between i and j is slowing down.

2.2 Overview of Competitiveness between China Japan and Other Member Countries

From Tables 1 and 2, it can be seen that the level of competitiveness between China Japan and the other four countries. Firstly, For both Japan and China, the country with which they maintain the highest level of competition is South Korea, and the competitiveness between Japan and South Korea is higher than that between China and South Korea. Secondly, the competitiveness between Japan and ASEAN is steadily strengthening, so does the competitiveness between Japan and ASEAN. In 2020, the competitiveness between China and ASEAN even surpassed the level between China and South Korea. Finally, the competitiveness between China and Australia New Zealand, is weak and showing a certain downward trend, so does Japan.

That is to say, With the development of ASEAN, the competitiveness with China and Japan have gradually strengthened.

	Japan-South Ko- rea	Japan-Australia	Japan-New Zealand	Japan-ASEAN
2012	87.86	25.60	33.48	68.59
2013	90.27	26.14	32.02	70.26
2014	90.84	26.50	31.14	70.89
2015	92.93	28.72	32.65	72.88
2016	91.59	28.14	31.14	73.23
2017	91.28	26.62	29.04	73.41
2018	90.04	25.97	28.85	74.34
2019	89.62	25.75	27.21	74.62
2020	92.17	24.94	26.66	76.94
2021	91.35	22.77	25.75	76.66

Table 1. ESI Index between Japan and other RCEP member countries

Table 2. ESI Index between China and other RCEP member countries

	China-South Ko- rea	China-Australia	China-New Zea- land	China- ASEAN
2012	78.63	21.34	30.28	64.08
2013	77.03	20.63	28.34	65.74
2014	76.24	20.94	27.05	67.46
2015	76.40	22.47	29.15	72.25
2016	77.18	22.48	28.71	74.74
2017	77.30	20.39	26.30	74.98
2018	78.18	20.28	25.86	75.72
2019	77.75	20.14	25.00	77.22
2020	78.81	18.89	25.06	78.87
2021	79.08	16.24	25.64	79.19

3 Analysis of Trade Complementarity between China Japan and Other RCEP Member States

3.1 Overview of Complementarity Index

The TCI Index (Trace Complementarity Index) is a commonly used indicator to describe trade complementarity. It is based on the RCA index. This article adopts the index formula proposed by Peter Drysdale and supplemented by Jinping Yu.

Trade complementarity index for single category products:

$$TCI_{ijk} = RCA_{ik}^{x} * RCA_{jk}^{m}$$

Trade complementarity index for all category products: $TCI_{ij} = \sum_k [(RCA_{ik}^x * RCA_{jk}^m) * (M_{wk}/M_k)]$

Wherein, $RCA_{ik}^{x} = (X_{ik}/X_{i})/(X_{wk}/X_{w}); RCA_{jk}^{m} = (M_{jk}/M_{j})/(M_{wk}/M_{w})$

In the formula, RCA_{ik}^{x} , RCA_{jk}^{m} represents the export comparative advantage of country i in category k products and the import comparative advantage of country j in category k products respectively. Then, X represents the export value, M represents the import value, and w represents the world market. TCI_{ijk} represents the trade complementarity index for k category products between the two countries. TCI_{ij} is the trade complementarity index for all category products between the two countries. If the value of TCI is $0 \leq TCI_{ij} < 1$, it indicates a low degree of import and export compatibility and weak complementarity between the two countries; If $TCI_{ij} \geq 1$, it indicates that the complementarity of trade between the two countries is strong and the basic trade conditions are good.

3.2 Overview of Complementarity between China Japan and Other Member Countries

From Tables 3 and 4, it can be seen that Japan and Australia not only have weak competitiveness, but also have good complementarity in the structure of foreign trade products. Then, the complementarity between Japan's imports and New Zealand's exports is stronger. So the areas of trade cooperation between Japan and the two countries need to be further explored.

	Japan-South Ko- rea	Japan-Australia	Japan-New Zealand	Japan-ASEAN
2012	0.77	1.08	0.97	1.02
2013	0.81	1.06	0.99	1.03
2014	0.81	1.04	1.00	1.00
2015	0.88	1.03	0.98	1.02
2016	0.89	1.03	0.98	1.02
2017	0.87	1.04	0.98	1.00
2018	0.83	1.01	0.97	1.00
2019	0.85	1.01	0.97	1.01
2020	0.90	1.02	0.94	1.02
2021	0.87	1.04	0.99	1.02

Table 3. TCI Index between Japan's Exports and RCEP member countries' Imports

Table 4. TCI Index between Japan's Imports and RCEP member countries' Exports

	Japan-South Korea	Japan-Australia	Japan-New Zealand	Japan-ASEAN
2012	0.87	1.45	1.17	1.03
2013	0.88	1.46	1.14	1.03
2014	0.88	1.49	1.11	1.02
2015	0.90	1.47	1.22	1.02

2016	0.92	1.44	1.21	1.03
2017	0.92	1.54	1.20	1.03
2018	0.93	1.56	1.18	1.02
2019	0.92	1.53	1.19	1.00
2020	0.93	1.44	1.19	0.99
2021	0.91	1.57	1.22	0.97

From Tables 5 and 6, it can be seen that China and Australia not only have weak competitiveness, but also have good complementarity in terms of foreign trade product structure. Meanwhile, China and New Zealand not only have weak competitiveness, but also maintain a strengthening trend of complementarity, and trade space could be further explored.

Table 5. TCI Index between China's Exports and RCEP member countries' Imports

	China-South Ko- rea	China-Australia	China-New Zea- land	China- ASEAN
2012	0.78	1.08	1.06	0.95
2013	0.81	1.09	1.08	0.95
2014	0.81	1.07	1.06	0.93
2015	0.89	1.07	1.06	0.96
2016	0.93	1.08	1.07	0.98
2017	0.91	1.04	1.07	0.97
2018	0.88	1.07	1.05	0.98
2019	0.89	1.07	1.05	0.99
2020	0.94	1.08	1.03	1.00
2021	0.89	1.10	1.09	0.98

Table 6. TCI Index between China's Imports and RCEP member countries' Exports

	China-South Ko- rea	China-Australia	China-New Zea- land	China- ASEAN
2012	0.99	1.78	0.91	1.03
2013	1.00	1.93	0.95	1.02
2014	1.00	1.88	0.92	0.99
2015	1.01	1.74	0.97	1.01
2016	1.01	1.78	0.98	1.01
2017	1.01	1.91	0.98	1.02
2018	1.02	1.82	0.97	1.01
2019	0.99	2.02	1.02	1.00
2020	1.00	2.04	1.01	1.00
2021	0.97	2.14	1.09	0.99

4 Intra-industry analysis between China Japan and other RCEP member countries

4.1 Overview of Intra-industry trade index

The IIT index (Intra-industry Trade Index) is used to measure the intra industry level of bilateral trade.

The Intra-industry trade index of a certain industry:

$$IIT_{ij}^{k} = 1 - \frac{\left| X_{ij}^{k} - M_{ij}^{k} \right|}{X_{ij}^{k} + M_{ij}^{k}}$$

Overall Intra-industry trade index:

$$IIT_{ij} = \sum_{k=1}^{n} w_k * IIT_{ij}^k = \sum_{k=1}^{n} \frac{x_{ij}^k + M_{ij}^k}{\sum_{k=1}^{n} (x_{ij}^k + M_{ij}^k)} * IIT_{ij}^k$$

In the formula, IIT_{ij}^k represents the level of Intra-industry trade of k category products between the two countries, IIT_{ij} represents the overall level of Intra-industry trade between the two countries. X_{ij}^k represents the export volume of k category products from country i to country j, M_{ij}^k represents the import volume of k category products from country i to country j, w_k represents the proportion of k products in the trade between the two countries. The range of values for this index is [0,1]. If IIT \geq 0.5, it indicates that Intra-industry trade dominates; if IIT<0.5, it means that the trade mode is mainly Inter-industry trade.

4.2 Overview of Intra-industry trade between China Japan and Other Member Countries

From Tables 7 and 8, it can be seen that Japan and China mainly engage in Inter-industry trade with Australia and New Zealand, while mainly engage in Intra-industry trade with South Korea and ASEAN continues. The level of Intra-industry trade between Japan and South Korea is basically higher than that between Japan and ASEAN, while the level of Intra-industry trade between China and South Korea is basically lower than that between China and ASEAN.

Table 7. IIT Index between Japan and other RCEP member countries

	Japan-South Ko- rea	Japan-Australia	Japan-New Zealand	Japan-ASEAN
2012	0.60	0.11	0.15	0.50
2013	0.62	0.16	0.14	0.53
2014	0.66	0.14	0.12	0.55
2015	0.67	0.17	0.14	0.58
2016	0.65	0.16	0.15	0.59
2017	0.63	0.15	0.14	0.61
2018	0.67	0.14	0.13	0.61
2019	0.69	0.16	0.13	0.64

2020	0.67	0.11	0.13	0.68
2021	0.66	0.09	0.13	0.67
2022	0.68	0.10	0.15	0.64

China-South Ko-China-New Zea-China-China-Australia ASEAN rea land 2012 0.62 0.10 0.13 0.68 2013 0.63 0.09 0.67 0.11 2014 0.67 0.10 0.11 0.69 2015 0.67 0.11 0.15 0.66 0.12 2016 0.67 0.16 0.69 2017 0.66 0.10 0.70 0.13 2018 0.64 0.11 0.74 0.13 2019 0.69 0.11 0.12 0.72 0.09 0.74 2020 0.68 0.12 2021 0.67 0.09 0.10 0.71

Table 8. IIT Index between China and other RCEP member countries

5 Analysis of Economic and Trade Relations between China Japan and Other RCEP member countries

Both China and Japan have closer and more complex trade relations with South Korea and ASEAN, with high competitiveness and high level of Intra-industry trade level. The reasons for this are as follows:

Both Japan and South Korea are both developed countries with the advantage of technology intensive products, so their foreign trade shows obvious competitiveness and a high level of Intra-industry trade. Japan has closer economic and trade relations with ASEAN. On the one hand, Japan is facing economic stagnation and aging population. On the other hand, ASEAN is booming as a center of economic growth. Therefore, ASEAN has become an ideal region to undertake industrial transfer by the virtue of its geographical advantages, resource advantages, and labor cost advantages for Japan. Therefore, Japan has included ASEAN into its global production chain, and exhibit a high level of Intra-industry trade with ASEAN countries.

The relations between China and South Korea is more complex, so does that of China and ASEAN. The key is that: with the development of a country's economy, it is a trend for one country to shift some low-end industries which lose their comparative advantages outward. China has achieved significant development by labor-intensive products. Meanwhile, with the continuous improvement of technological level, the foreign trade of technology-intensive products of China has also made significant progress. But with the gradual reduction of China's labor advantage and the development of high-tech industries, the substitution effect of ASEAN exports on Chinese exports and the substitution effect of Chinese exports on Korean exports are gradually emerging. Although the competition between China and South Korea in foreign trade

is becoming increasingly fierce, it does not prevent China and South Korea from forming a closer complementary and dependent relationship at the same time, so does the relations of China and ASEAN.

It is seen that the trade relationships among China, Japan, South Korea and ASEAN are more complex and closer, mainly due to the economic development of China and ASEAN, which increase the competitiveness and promote the development of Intra-industry trade level with Japan and South Korea. Generally speaking, the more developed the economy is, the higher the per capita income level is, the stronger the competitiveness of a certain industry is, the higher the level of Intra-industry trade level will be. In other words, the level of Intra-industry trade is an important indicator to measure the level of economic development and industrial competitiveness of a country or region.

From this, it can be inferred that increasingly fierce competition is an important factor affecting the level of Intra-industry trade and the welfare of trading countries. The following empirical analysis will be conducted on this inference.

6 Empirical Analysis of Economic and Trade Relations between China Japan and Other RCEP Member Countries

The competitiveness between trading countries is an important factor affecting the level of Intraindustry trade between trading countries. In order to make an empirical analysis of this conclusion, choose the logarithmization of IIT index from 2012 to 2021 of the above eight groups of bilateral trade relations as the dependent variable, and the logarithmization of ESI index from 2012 to 2021 of the eight groups of bilateral trade relations as the explanatory variable. For the Panel data with a sample size of 80, conduct the stationarity test, cointegration test and Regression analysis. The meanings of the dependent variable and the explanatory variables are shown in Table 9.

Variable type	Variable	Meaning of variables	Calculation of variable
dependent variable	lny	Intra-industry trade level	Logarithmization of IIT index
explana- tory vari- able	lnx	Trade competitiveness level	Logarithmization of ESI index

Table 9. Meaning and explanation of each variable

In order to avoid the problem of "pseudo regression" caused by non-stationary data, the data is firstly tested for stationarity. This article uses ADF test, basing on the test results, at the 1% significance level, the first-order difference of both lny and lnx are stationary. The results are shown in Table 10.

Inspection results	8	D_lny Statistic	D_lny p-value	D_lnx Statistic	D_lnx p-value
Inverse chi- squared(16)	Р	157.6398	0.0000***	125.9590	0.0000***
Inverse normal	Ζ	-8.6460	0.0000***	-6.5151	0.0000***
Inverse logit t(44)	L*	-15.1350	0.0000***	-11.9199	0.0000***
Modified inv. chi- squared	Pm	25.0386	0.0000***	19.4382	0.0000***

Table 10. Root of unity Test Results of First Order Difference: ADF-Fisher

Note: * * *, * * and * represent significance levels of 1%, 5%, and 10%, respectively

Basing on the results of the stationarity test mentioned above, in order to determine whether there is a long-term equilibrium relationship between variables, a cointegration test was conducted. The Westerlund test results showed that the original hypothesis was rejected at a significance level of 5%, and there was a cointegration relationship between variables. The results are shown in Table 11.

Table 11. Cointegration test results: Westerlund

Inspection method	Inspection form	Statistic	p-value
Westerlund	Variance ratio	-2.2287	0.0129

By the regression analysis of variables selected, the results are shown in Table 12. The fixed effect model, random effect model and Hausman test show that the p value is less than 0.05, and the original hypothesis is rejected. The fixed model should be selected.

The empirical analysis of sample data shows that competitiveness is an important factor in the level of Intra-industry trade, and for every 1% increase in the competitive trade index, the Intra-industry trade index between trading countries increases by 0.958%. Therefore, in the context of RCEP, both China and Japan should actively cooperate with other member countries to improve the level of Intra-industry trade through benign competition, especially emphasizing the construction of trade relations with South Korea and ASEAN.

Table 12. Regression results		
model selection	Fixed effect-lny	Random effect-lny
lnx	0.958***	1.332***
	(5.83)	(16.45)
_cons	-4.901***	-6.323***
	(-7.85)	(-20.25)
Ν	80	80
R^2	0.3241	

Through the Hausman test, Prob>chi2=0.0437, the original hypothesis is rejected, therefore a fixed effect model is chosen.

7 Conclusions

By analyzing the economic and trade relations between China Japan and other RCEP member countries, the following conclusions can be drawn:

Overall, it is same for both China and Japan. these two countries show significant competitiveness with South Korea and ASEAN, while showing significant complementarity with Australia and New Zealand. Moreover, China and Japan mainly engage in Intra-industry trade with South Korea and ASEAN, and Inter-industry trade with Australia and New Zealand. Therefore, both China and Japan should actively participate in the construction of the "RCEP", expand economic complementary trade areas with Australia and New Zealand, and attach importance to the construction of trade relations with South Korea and ASEAN.

Through empirical analysis, it can be concluded that the level of competitiveness between trading countries is an important factor affecting the level of Intra-industry trade between trading countries, and the level of Intra-industry trade level is an important indicator to measure a country's economic development level and industrial competitiveness. For both China and Japan, while maintaining high competitiveness with South Korea and ASEAN, it is beneficial to deepen economic and trade ties and improve the level of Intra-industry trade with these two countries. That is to say: on the basis of maintaining complex and close trade relations with other RCEP member countries, while Japan should use RCEP to find new trade growth points through resource complementarity, China should use RCEP to complete industrial upgrading.

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