

Analysis of Trade Symbiosis between China and Countries along the "Belt and Road"

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Abstract: Under the prevailing trade protectionism and the continuing downturn in the world economy, China has proposed the "Belt and Road" Initiative, so as to build a community of interests, responsibilities and destiny, leading countries to achieve diversified, balanced and sustainable development. The concept of symbiosis coincides with the Silk Road spirit of peace and cooperation, openness and inclusiveness, and mutual benefit and win-win situation, as advocated by the "Belt and Road" Initiative. In this context, this study selects trade data from 2011 to 2020 and measures the symbiosis trade relations between China and different regional countries along the Belt and Road in four dimensions: Complementarity, Competitiveness, Dependence and Integration. The results show that the trade competitiveness between China and the "Belt and Road" countries is weak, the trade complementarity is at a medium level, the trade dependence is generally high, and they have relatively close trade contacts. In brief, trade cooperation needs to be further strengthened. Finally, this study provides some policy recommendations to improve the trade symbiosis relations and perfect trade structure.

Keywords: The "Belt and Road", Symbiosis, Trade Complementarity index, Trade and Export Similarity index, Trade Intensity index, Trade Integration index.

1. Introduction

Since 2013, the Belt and Road Initiative has transformed from concept to action, from vision to reality, and has become the largest and most popular platform for international cooperation. From 2013 to 2019, according to the Belt and Road database, China's total import and export of goods with countries along the Belt and Road increased from US\$1.04 trillion to US\$1.34 trillion, an increase of 10.8%, which is 7.4% higher than the overall growth rate of China's foreign trade. In 2019, China's total trade in goods with the 138 countries that have signed the "Belt and Road" cooperation document reached US\$1.90 trillion, accounting for 41.5% of China's total trade in goods, of which US\$983.76 billion was exported and US\$917.39 billion was imported. In 2019, China's total service import and export with countries along the "Belt and Road" reached US\$117.88 billion, of which US\$38.06 billion was exported and US\$79.82 billion was imported. The construction of the "Belt and Road" cooperation zone platform moved forward in an orderly manner. By the end of 2019, China had concluded 17 FTAs with 25 countries and regions, and was conducting negotiations or upgrading negotiations on 12 FTAs, as well as joint feasibility studies or upgrading studies on 10 FTAs. China's trade with countries participating in the Belt and Road Initiative (BRI) has shown good development. This was 0.7% higher than China's overall global import and export growth rate of 6.75 trillion yuan. This shows that trade, as one of the main ways to build the Belt and Road, plays a very important role and contributes significantly to the development and recovery of the global economy.

As a great practice of building a community of human destiny between China and the rest of the world, the "Belt and Road" Initiative is a solemn choice of China to build an all-round opening pattern and an open economy, and has become an important symbol of China's new round of reform and opening up. The "One Belt, One Road" not only promotes China to the world, reconstructs the pattern of opening up to

the outside world, but also shares China's development opportunities with countries along the "Belt and Road" and around the world, allowing all parties to ride on the "fast" and "convenient" trains of China's development.

2. Literature Review

At present, research on trade effects, trade structures and trade relations between China and Belt and Road countries has focused on the following areas.

On the effects of trade between China and the Belt and Road countries. There are some studies on bilateral trade issues and they show that China's export potential to the Belt and Road countries rose significantly after the initiative began, especially for exports of products in capital intensive industries (Yu LH, 2020; Hu w, 2020). Since the introduction of the Belt and Road Initiative, trade facilitation has increased significantly, which has a positive effect on China's cross-border e-commerce exports and meets the diversified needs of Belt and Road countries (Li BJ, 2020).

On the trade relations between China and countries along the Belt and Road. Some scholars have focused on the trade relations to illuminate the structure and evolution of trade relations, the relative positions of different countries, and changes in regional trade structure and the changing patterns of trade between them (Liu ZG, 2018). Some scholars have conducted research on the trade competitiveness of Belt and Road countries. In the trade of agricultural products, they found that Central and Southeast Asia, South Asia, and Central and Eastern Europe are competitive, but China, Central Asia, Mongolia, Russia, and West Asia and the Middle East are weak (Zhou LZ, 2022).

The above-mentioned research literature provides a reference for this study. However, the existing literature on the trade structure of the Belt and Road countries and their trade relations with China is relatively scarce, and most of the trade relations are related to the competition and complementarity between two countries, while even fewer studies have analyzed the overall trade symbiosis between

China and the Belt and Road countries. The literature on the overall trade symbiosis between China and the Belt and Road countries is even less.

Based on the symbiosis theory, this paper use UNCTAD data to analyse the trade symbiosis between China and the Belt and Road countries in terms of four aspects: Complementarity, Competitiveness, Dependence and Integration. This study divides the Belt and Road countries into five regions based on geographical distribution: Southeast Asia region, South Asia region, West Asia region, The Commonwealth of the Independent States regions(CIS) and Central and Eastern Europe regions(CEE). The results of the study provide a policy basis for strengthening bilateral trade relations and optimizing trade structures between China and the Belt and Road countries in the future.

3. The Basic Situation of Bilateral Trade

3.1. Trade Scale

Since the Belt and Road Initiative was launched, value of import and export between China and countries along the Belt and Road has continued to grow steadily and bilateral trade relations have become increasingly close.

From 2013 to 2021, the annual trade volume between

China and countries along the Belt and Road expanded from US\$1.04 trillion to US\$1.8 trillion, an increase of 73%. In 2017, China's import and export volume with countries along the "Belt and Road" reached US\$1,404.02 billion, up 13.4% from 2016, accounting for 36.2% of China's total import and export trade. Among them, China exported US\$774.26 billion to countries along the Belt and Road, up 8.5% year-on-year, accounting for 34.1% of China's total exports. Meanwhile, China imported US\$666.05 billion from countries along the Belt and Road, up 19.8% year-on-year and accounting for 39% of China's total imports, with the growth rate of imports exceeding that of exports for the first time in the past five years.

The scale of export trade between China and countries along the Belt and Road from 2011 to 2020 is shown in Figure 1. It can be seen from this that South East Asia has become a very important trading partner for China. According to the Belt and Road trade cooperation data, in 2016, the trade volume between China and Southeast Asia was USD 455.44 billion, accounting for 47.8 percent of the total trade volume between China and countries along the routes. In terms of exports, China's exports to Southeast Asia were the largest at \$259.16 billion, accounting for 44.1%.The volume of Export trade increased from \$244 billion in 2013 to \$384 billion in 2020.

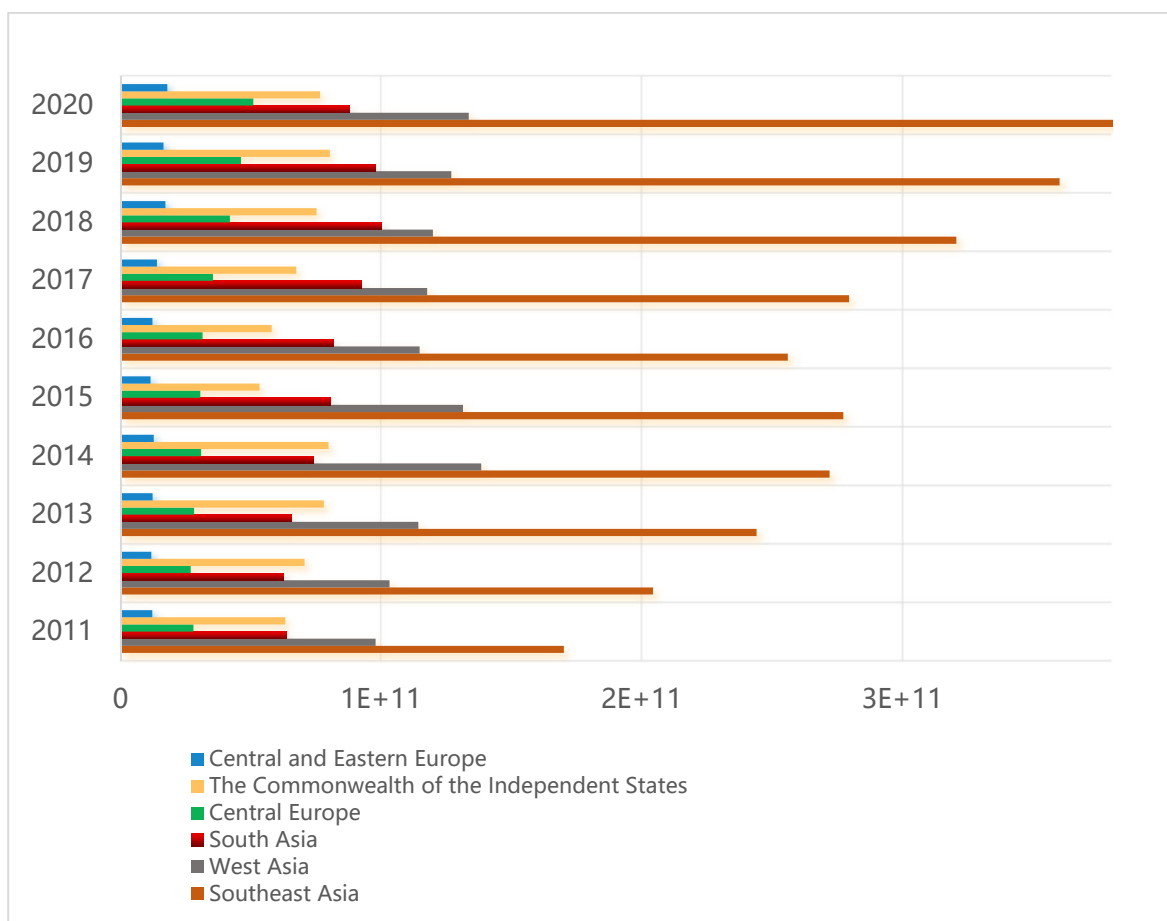


Figure 1. China's Export to countries along the Belt and Road from 2011 to 2020
Source: UN Comtrade Database

The scale of import trade between China and countries along the Belt and Road from 2011 to 2020 is shown in Figure 2. Whether in terms of import or export trade, Southeast Asian countries have the highest share of trade with China among the "Belt and Road" countries. In 2019, the total value of

China's imports from Southeast Asia was \$282 billion, with a 5% increase compared with 2018. However, Trade value between China and Central and Eastern Europe countries is relatively the lowest among the "Belt and Road" countries.

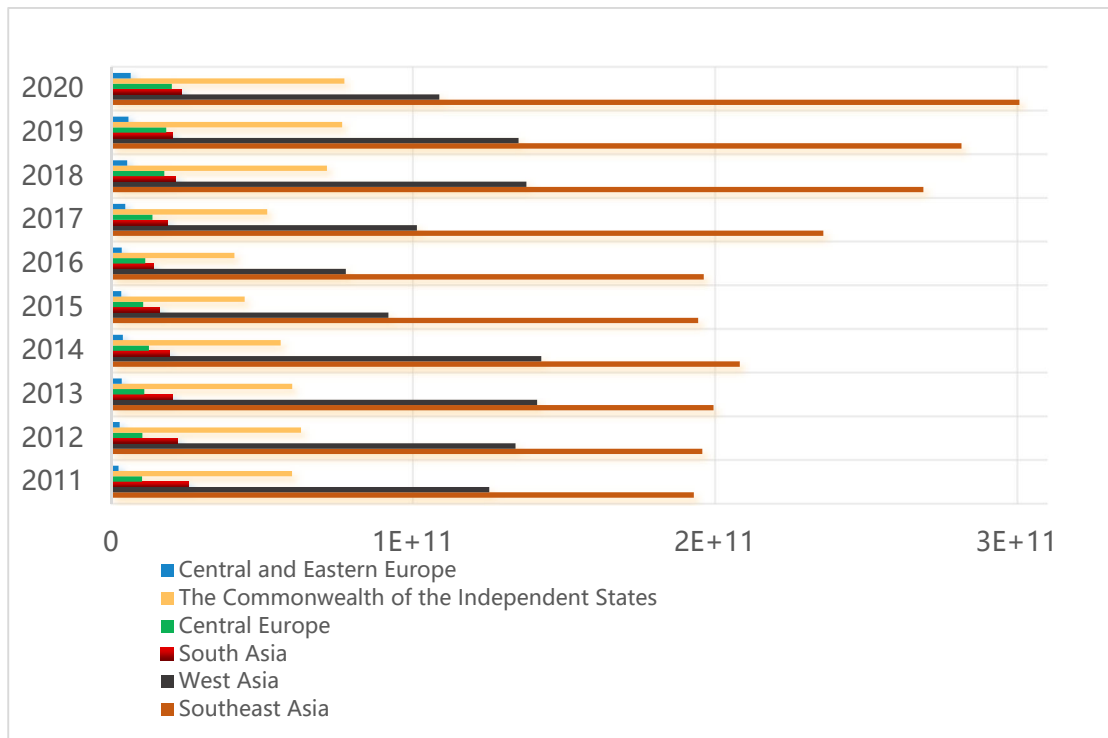


Figure 2. China's Import from countries along the Belt and Road from 2011 to 2020
Source: UN Comtrade Database

3.2. Trade Structure

The "Belt and Road" has a large number of countries covering Southeast Asia, South Asia, Central Europe, West Asia and Central and Eastern Europe, mainly developing countries, with different levels of economic development. Some countries have similar factor structures and consumption preferences to China, while others differ significantly from China in terms of cultural background, market institutional environment and stage of development.

The structure of China's export trade with countries along the "Belt and Road" in 2013 and 2017 is shown in Figure 3.

It can be seen that the export trade structure of South East Asian countries is similar to that of China. In recent years, with the development of industrialization and changes in the industrial structure of these countries, the export capacity of their industrial goods has been increasing and the structure of their export commodities has changed to some extent. So their technology-intensive exports like machinery and transport equipment are larger in scale and account for a high proportion. The export trade structure of West Asia and the CIS countries is complementary to that of China due to the large share of capital-intensive products in these countries.

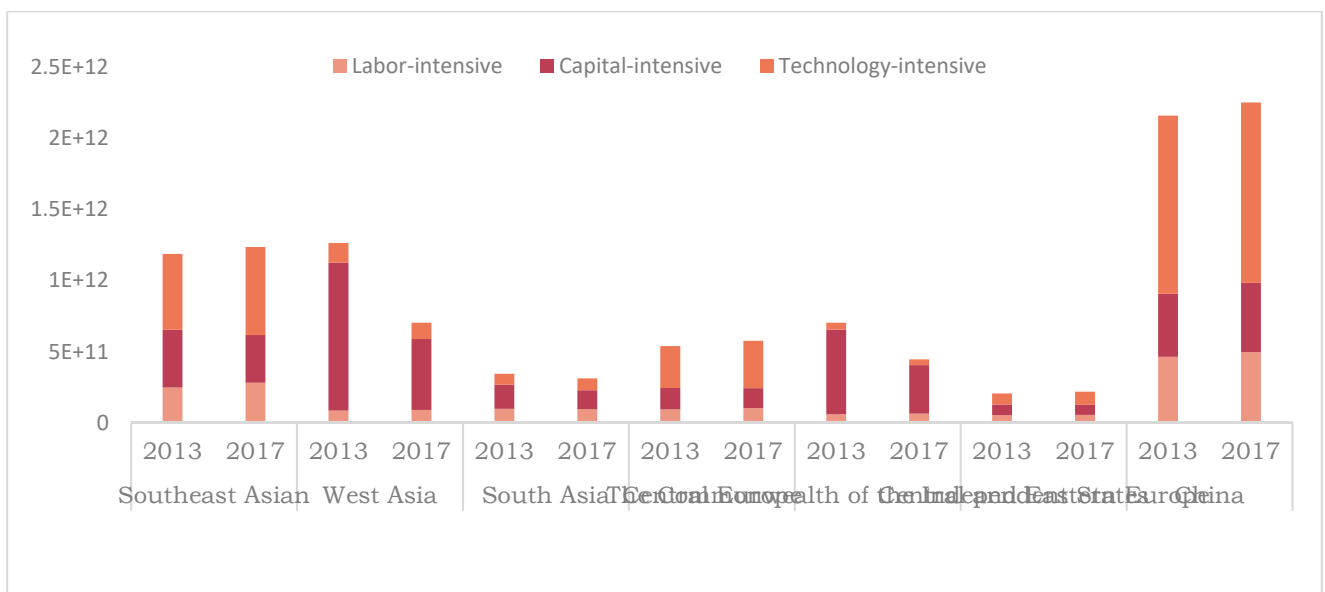


Figure 3. Export trade structure of China and countries along the Belt and Road
Source: UN Comtrade Database

The structure of import trade between China and countries along the Belt and Road in 2013 and 2017 is shown in Figure

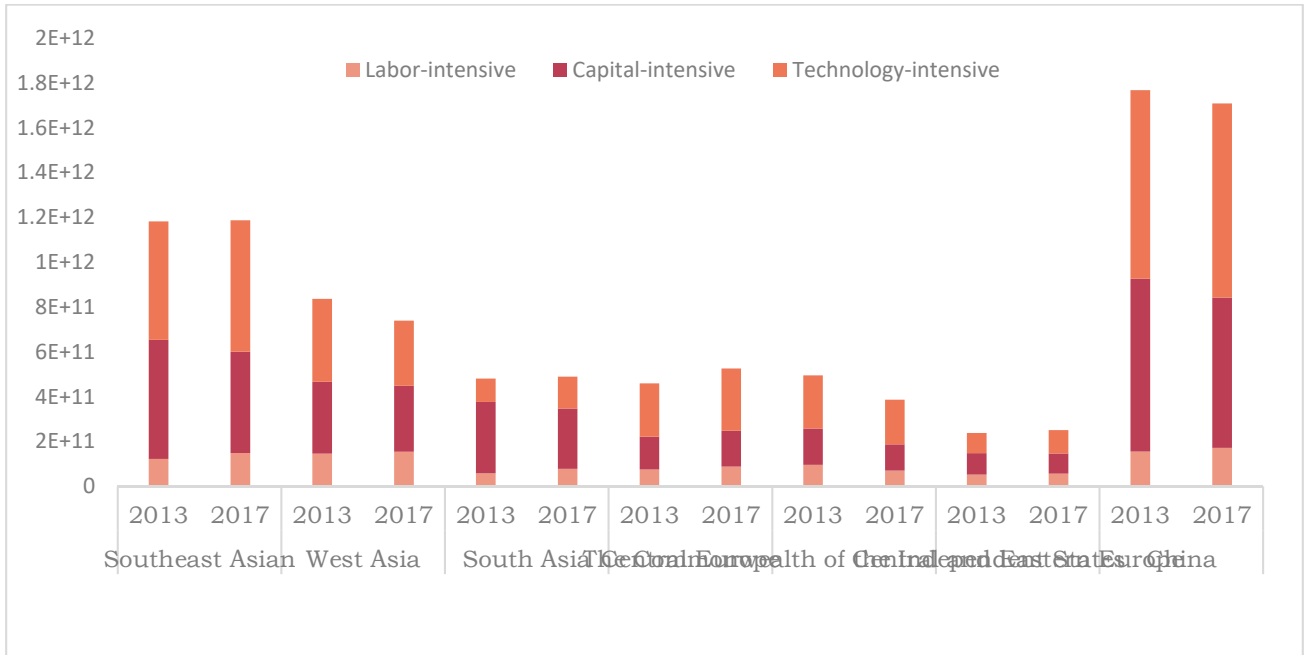


Figure 4. Import trade structure of China and countries along the Belt and Road
Source: UN Comtrade Database

4. Research Methodology

Symbiosis is an ecological concept first introduced by the German biologist Debarry (1879), which refers to multiple organisms living together in some kind of material association, forming relations of co-survival, co-evolution or suppression (Ahmadjian, 2000). Symbiosis is the way in which symbiotic units interact with each other, and can reflect either the exchange of material information or the exchange of energy between them (Yuan, 1998). Meanwhile it can form a relationship of interdependence, complementarity, cooperation and competition (Liu, 2006).

So the symbiosis trade relations between China and countries along the “Belt and Road” can be divided into the following four dimensions: Complementarity, Competitiveness, Dependence and Integration.

4.1. Trade Complementarity Index (TCI)

This paper uses the Trade Complementarity Index (TCI), based on the empirical approach of Drysdale et al. (1969), to provide a specific measure of the degree to which China's trade structure matches that of the Belt and Road countries. The formula is:

$$TCI_{ij} = \sum \frac{x_i^k/x_i}{x_w^k/x_w} \times \frac{M_j^k/M_j}{x_w^k/x_w} \times \frac{x_w^k}{x_w} \quad (1)$$

Where x_i^k/x_i denotes the share of exports of product k of country i in total exports of country i; M_j^k/M_j denotes the share of imports of product k of country j in total imports of country j; x_w^k/x_w denotes the share of total exports of product k of the world in total exports of the world. When $TCI > 0.5$, it indicates that trade between two countries have strong complementarities; conversely, when $TCI < 0.5$, it indicates that trade between two countries have weak complementarities.

4.2. Trade and Export Similarity Index (ESI)

The Export Similarity Index (ESI) was first proposed by Finger and Kreinin (1979) and subsequently modified by Glick and Rose (1998) and others to reflect the degree of similarity in the commodity structure of exports from two countries (regions) to the same destination market. The formula is:

$$ESI_{ij} = \left\{ \sum_{i=0}^n \left[\left(\frac{x_i^k/x_i + x_j^k/x_j}{2} \right) \times \left(1 - \left| \frac{x_i^k/x_i - x_j^k/x_j}{x_i^k/x_i + x_j^k/x_j} \right| \right) \right] \right\} \times 100 \quad (2)$$

Where x_i^k/x_i denotes the share of exports of product k of country i in total exports of country i; x_j^k/x_j denotes the share of exports of product k of country j in total exports of country j. The export similarity index takes values in the range [0,100], with higher values indicating a more similar and competitive export structure between the two countries.

4.3. Trade Intensity Index (TII)

The Trade Intensity Index (TII) was constructed based on the empirical approach of Brown et al. (1947). It reflects the degree of closeness of bilateral trade relations. The formula is:

$$TII_{ij} = \frac{x_{ij}/x_i}{M_j/(M_w - M_i)} \quad (3)$$

Where x_{ij}/x_i denotes the share of exports of country i to country j in total exports of country i; M_i denotes the value of imports of country i; M_j the value of imports of country j; M_w denotes total world imports. In trade flow analysis, a larger TII value indicates a closer trade relation between two countries.

4.4. Trade Symbiosis Degree Index (TSDI)

According to symbiosis theory, the qualitative parameters reflect the intrinsic nature of the symbiotic units, while the symbiosis degree reflects the correlation between the changes

in qualitative parameters among the symbiotic units (Hu, 2008). This paper take China and the Belt and Road countries as symbiotic units and construct the corresponding Trade Symbiosis Degree Index (TSDI).The formula is:

$$TSDI_{ij} = \frac{dX_i/X_i}{dX_j/X_j} \quad (4)$$

Where dX_k/X_k denotes the rate of change in total exports of country k. In trade flow analysis, a higher TSDI value indicates a greater degree of mutual influence of trade volumes between two countries and a more integrated trade relation.

5. Trade Symbiosis Relations Analysis

5.1. Trade Complementarity Relations Analysis

In terms of trade complementarity, we can clearly see in

Table 1: 1.China's trade with West Asia is most complementary. West Asia is the world's largest exporter of energy, with more than 90% of the oil produced for export. Most West Asian countries have a relatively low level of industrialization, and industries such as processing and manufacturing of machinery and equipment are underdeveloped. 2. China's trade with the CIS is highly complementary. The CIS countries, represented by Russia, mainly export mineral products such as oil and gas, metals, wood and paper pulp. They mainly import machinery and equipment and transport, food and agricultural raw materials products, chemicals and rubber, textile and clothing goods, etc. 3.There was a strong trade complementarity between China and Southeast Asia in the early years, which has declined in recent years. 4.China's trade complementarity with Central Europe is the weakest. Although China is Europe's second largest trading partner, Central Europe has a more developed manufacturing sector and has a relatively small volume of trade with China.

Table 1. TCI between China and Countries along the "Belt and Road"

YEAR	ASEAN	West Asia	South Asia	Central Europe	CIS	CEE
2011	0.63	0.6	0.57	0.64	0.65	0.63
2012	0.64	0.58	0.58	0.63	0.66	0.62
2013	0.64	0.58	0.56	0.62	0.64	0.62
2014	0.74	0.68	0.72	0.71	0.77	0.73
2015	0.71	0.67	0.73	0.68	0.72	0.72
2016	0.79	0.74	0.83	0.76	0.83	0.78
2017	0.66	0.62	0.71	0.65	0.69	0.63
2018	0.66	0.63	0.7	0.66	0.68	0.63
2019	0.64	0.62	0.68	0.65	0.66	0.62
2020	0.63	0.6	0.85	0.63	0.64	0.62

Source: UN Comtrade Database, calculated by the author

5.2. Trade Competitiveness Relations Analysis

In terms of trade competitiveness, we can clearly see in Table 2: 1.China's trade with Central and Eastern Europe is the most competitive, and its trade with Central and Eastern Europe is the second most competitive. From the commodity structure of China-EU trade in 2020, China's exports to the EU are mainly medical supplies, electronic products and machinery and equipment; while the EU's exports to China are mainly mechanical and electrical products, transport

equipment and chemical products. 2.The trade Competitiveness between China and Southeast Asia has steadily increased. The first is the similarity of export markets, with the US, EU and Japan being the main exporters to both China and Southeast Asian countries, making both sides compete fiercely for market share. Secondly, the structure of export products is similar. Southeast Asian countries are mostly developing countries and have a highly similar structure to China in terms of agriculture, textiles, processed electrical and mechanical products.

Table 2. ESI between China and Countries along the "Belt and Road"

YEAR	ASEAN	West Asia	South Asia	Central Europe	CIS	CEE
2011	0.57	0.44	0.4	0.87	0.44	0.62
2012	0.58	0.44	0.41	0.87	0.47	0.61
2013	0.60	0.44	0.39	0.87	0.47	0.62
2014	0.61	0.47	0.4	0.87	0.47	0.65
2015	0.63	0.51	0.4	0.87	0.46	0.66
2016	0.65	0.52	0.41	0.87	0.48	0.68
2017	0.65	0.49	0.41	0.87	0.49	0.68
2018	0.64	0.49	0.4	0.87	0.49	0.68
2019	0.65	0.49	0.4	0.86	0.50	0.68
2020	0.65	0.50	0.38	0.86	0.48	0.67

Source: UN Comtrade Database, calculated by the author

5.3. Trade Dependence relations Analysis

In terms of trade Dependence, we can clearly see in Table 3: 1.China has the strongest trade dependency with Southeast Asia. As China's trade relations with ASEAN countries grows closer, bilateral trade in goods has increased rapidly and it has become China's top trading partner. The Trade cooperation between China and ASEAN has three characteristics. Firstly, it is growing at a faster rate. China-ASEAN trade has been maintaining positive year-on-year growth, unique among China's top five trading partners. Secondly, trade between imports and exports is balanced, with the growth rate of China's exports to ASEAN (6.7%) and imports from ASEAN

(6.6%) remaining more or less equal in 2020. Finally, the trade structure is similar. China-ASEAN trade ties in the electronics manufacturing industries will become stronger and the scale of imports and exports of integrated circuits and other products will continue to rise in the future. 2.China and CEE countries have a low level of trade dependence.Trade between China and Central and Eastern Europe faces internal and external trade risks. On the economic front, CEE countries have different national conditions and small markets, and there is a lack of coordinated economic development strategies at the regional level. On the political front, the trade between China and CEE may be influenced by the EU, the US and Russia.

Table 3. TII between China and Countries along the "Belt and Road"

YEAR	ASEAN	West Asia	South Asia	Central Europe	CIS	CEE
2011	1.96	0.74	1.06	0.42	1.6	0.35
2012	2.29	0.71	1.2	0.39	1.36	0.35
2013	2.43	0.75	1.2	0.38	1.21	0.32
2014	2.3	0.84	1.15	0.36	1.27	0.31
2015	2.07	0.76	1.06	0.36	1.2	0.3
2016	1.83	0.73	1.17	0.39	1.56	0.33
2017	1.81	0.72	1.08	0.39	1.45	0.32
2018	1.98	0.75	1.05	0.38	1.37	0.34
2019	2.05	0.77	1.09	0.42	1.49	0.33
2020	1.99	0.82	1.11	0.41	1.1	0.32

Source: UN Comtrade Database, calculated by the author

5.4. Trade Integration Relations Analysis

In terms of trade Dependence, we can clearly see in Table 4: 1.China has a high degree of trade integration with West Asia. West Asian countries are rich in mineral resources and are major energy importers for China. At the same time, the launch of the "Belt and Road" project has brought in sufficient capital, advanced technology and engineering labour for

infrastructure development in West Asia. Infrastructure investment can help West Asia break through bottlenecks in economic development and boost the development of the region's trade and investment sectors. 2.China has a high degree of trade integration with the CIS. The geographical proximity of the CIS countries to China and their good state and political relations provide a good basis for the development of bilateral trade and economic relations.

Table 4. TSDI between China and Countries along the "Belt and Road"

YEAR	ASEAN	West Asia	South Asia	Central Europe	CIS	CEE
2011	0.92	1.58	1.21	1	1.9	1.38
2012	1	3.12	1.35	0.54	1.1	0.76
2013	2.18	0.91	1.05	0.91	1.08	1.33
2014	0.92	1.72	1.34	0.75	0.98	0.83
2015	4.84	7.78	3.53	3.63	8.52	4.82
2016	0.99	1.47	0.59	0.31	1.11	0.52
2017	2.51	1.74	2.42	1.38	2.84	1.97
2018	1.19	1.89	0.64	1.24	1.55	1.43
2019	39.87	130.35	39.18	15.06	30.82	20.33
2020	4.28	5.14	12.72	0.67	3.47	1.05

Source: UN Comtrade Database, calculated by the author

6. Conclusion and Recommendations

6.1. Conclusion

Based on the symbiosis theory, this paper use UNCTAD data to analyse the trade symbiosis between China and the Belt and Road countries in terms of four aspects: Complementarity, Competitiveness, Dependence and Integration. The final conclusions are as follows:

First, at an overall level, the trade competitiveness between China and the "Belt and Road" countries is weak, the trade complementarity is at a medium level, the trade dependence is generally high, and they have relatively close trade contacts.

Second, at the regional level, China's trade with West Asia is more complementary and integrated. China's trade with Central Europe is the most competitive and least complementary. China has the weakest trade dependence and strongest trade competition with Central and Eastern Europe.

China has the strongest trade dependence and stronger trade complementarity and competitiveness with South East Asia. China and the CIS have a high degree of trade integration and strong trade complementarity.

6.2. Recommendations

Deepen trade cooperation: Promote the construction of major trade corridors such as the China-Europe Train and the New Land and Sea Corridor, build high-standard free trade zones with more countries and promote trade liberalization and facilitation to a higher level.

Exploiting comparative advantages: Increase exports of products in which each country has advantages, achieve complementary advantages and maximize benefits for each country, and accelerate the optimization of the structure of resource endowments.

Seeking new trade growth points: China and some of its trading partners have similar export product structures. Countries should join forces in scientific and technological research and development, transform technological achievements into actual product competitive advantages, develop technology-intensive industries.

Accelerate trade facilitation: vigorously promote international multilateral cooperation, raise the level of trade facilitation in regions along the route, lower tariff barriers through bilateral and regional negotiations, and expand the scale of bilateral trade.

Acknowledgment

This paper is supported by the Postgraduate Research Innovation Fund of Anhui University of Finance and Economics "The impact of trade symbiosis between China and 'the Belt and Road' countries on the status of manufacturing value chains" (ACYC2020090).

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