

Article

Construction of the Belt and Road Trade Cooperation Network from the Multi-Distances Perspective

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Abstract: Based on the cooperation network formation theory, a Belt and Road trade cooperation network was constructed from the multi-distances perspective under the backdrop of the Belt and Road initiative. The geographic, factor endowment, cultural, and institutional distances were selected as variables from the aspects of geography, economy, culture, and politics to expand the gravity model. With this model, an empirical test was conducted using the data from China's export trade flows to Belt and Road countries from 2007 to 2016. The results showed that a Belt and Road country had greater trade flows from China when it had smaller geographic, factor endowment, and cultural distance and greater institutional distance from China. Based on the empirical results, we improved the comprehensive index method to measure the comprehensive distance indices between China and the Belt and Road countries. According to the comprehensive distance indices, these countries could be divided into four cooperation circles, in which the prioritized countries in the different phases were identified. Subsequently, the cooperation network construction was designed in four stages to gradually build an all-round, multi-level, and all-encompassing trade cooperation network between China and the Belt and Road countries. Eventually, based on the above consideration, policy suggestions are provided for the construction of such a network.

Keywords: Belt and Road; trade cooperation; cooperation network construction; gravity model; multiple distances

1. Introduction

In the 21st century, a new era marked by peace, development, cooperation, and mutual benefit, during his visit to Central and Southeast Asia in September and October 2013, Chinese President Xi Jinping successively introduced the initiative of jointly building the Silk Road Economic Belt and the 21st Century Maritime Silk Road, hereinafter referred to as the Belt and Road [1]. The Belt and Road Initiative is a new concept and mode of cooperation that will play an important role in optimizing the trade structure of China and the Belt and Road countries. However, China's current trade cooperation with the Belt and Road countries is still in its infancy, featured by some outstanding problems including loose cooperation, inadequate mechanism, and insufficient depth. Against this backdrop, studying the construction of the trade cooperation network with the Belt and Road countries is of great significance for China for deepening its trade cooperation with the Belt and Road countries and accelerating the accomplishment of the "strengthening China by trade" strategy for sustainable development.

Since the Belt and Road Initiative was proposed, an extensive research boom has occurred among scholars. These studies mainly focused on the basic connotations, practical obstacles, and the implementation of the Belt and Road [2]. When the Silk Road Economic Belt was first proposed by Xi Jinping in 2013, the Belt and Road initiative was to be conducted in five aspects: policy communication, road connectivity, unimpeded trade, currency circulation, and common people [3]. On this basis,

scholars generally believed that the Belt and Road is a new type of regional cooperation mechanism based on interconnection and interoperability, characterized by a diversified cooperation mechanism for the purpose of creating a destiny community [4]. However, advancing the construction of the Belt and Road has faced many obstacles and challenges in various fields. Some scholars believe that one of the biggest obstacles is the distrust of neighboring countries [5], whereas some scholars believe that the biggest concern is legal risk [6]. Scholars focused more on the implementation of the Belt and Road Initiative and achieved fruitful results in researching cooperation with a certain country or a specific industry. For example, a key area of cooperation between China and Central Asian countries is agricultural trade [7]. China and Pakistan should promote negotiations on free trade areas and strengthen cooperation on production capacity [8]. The Belt and Road construction should focus on strengthening cooperation in the fields of energy, capital output, and industrial integration [9]. However, research on trade cooperation among the Belt and Road countries has mostly focused on specific countries or industries. Investigations into the construction of a trade cooperation network among the Belt and Road countries are still rare.

The construction of a cooperation network needs to be based on the cooperation network formation theory. Four main methods are available to study cooperation network formation: case study [10], experimental research [11], game theory [12], and social network analysis [13]. Based on these research methods, two interpretation paths of the cooperation network formation theory have been formed: benefit-based antecedents and opportunity-based antecedents [14]. The benefit-based antecedents place special emphasis on explaining the necessity of cooperation network formation through cost minimization or benefit maximization. For example, geographic proximity or shared technical and transport infrastructure can reduce costs [15,16], and the cooperation between resource-complementary nodes increases social welfare [17]. Conversely, opportunity-based antecedents focus on the possibility of cooperation network formation. For instance, nodes with similar socio-cultural backgrounds are more likely to achieve cooperation [13], the quality of the relationship between the cooperation participants determines the mobility of the network resources [18], communication and coordination mechanisms stabilize symbiosis over time, and the centrality of the network benefits the formation of a corporate cooperation network [19,20].

Scholars have conducted extensive and in-depth studies on the impact of cooperation benefit factors and cooperation opportunity factors on international trade flows. In terms of cooperation benefit factors, based on the absolute advantage theory introduced by Smith [21], Heckscher [22] and Ohlin [23] proposed the factor endowment theory and emphasized that the factor endowment of various countries plays a decisive role in trade. Inspired by the law of universal gravitation in physics, Tinbergen [24] and Poyhonen [25] established a gravity model to study the factors influencing international trade flows, and concluded that economic strength and geographic distance are the main factors affecting trade flows. In terms of cooperation opportunity factors, scholars have explored the impact of cultural and institutional factors on trade flows. Firstly, more scholars are finding that cultural differences have a significant impact on trade flows [26]. Some scholars believed that cultural distance increases the difficulty of market transactions [27]. Cultural distance affects bilateral trade in two ways: reducing trade costs and increasing affinity parameters [28]. Some scholars also found that cultural distance has a significant and long-term negative influence on bilateral trade flows between China and the Belt and Road countries [29]. Simultaneously, some other scholars discovered that institutional factors affect international trade. Furthermore, the concept of institutional distance was proposed and defined as the differences between countries in terms of control, norms, and cognitive systems [30]. As for the influence of institutional distance on trade flows, no consensus has been reached due to variable selection and sample differences. Some scholars found that countries with similar systems are more active in bilateral trade [31], although trade was restricted by the trade and investment relationship [32]. However, some scholars believed that institutional distance drives international trade [33].

The above studies laid a solid theoretical foundation and method basis for the research of a cooperation network construction between China and the Belt and Road countries. Since the Belt and Road Initiative includes 65 countries with diversified cultural and institutional backgrounds, to study the cooperation network construction among them requires considering the cooperation benefit factors and the cooperation opportunity factors. Therefore, in this study, based on the principle of facilitation, friendliness, and complementarity of cooperation network formation theory [34], the geographic, factor endowment, cultural, and institutional distances were selected as variables to expand the gravity model from a multiple distances perspective. Then, using the extended gravity model, the impact of geographic, factor endowment, cultural, and institutional distances on China's exports to the Belt and Road countries was tested by choosing the data from China's export trade flows to the Belt and Road countries from 2007 to 2016. Based on the results of the empirical research, we designed and constructed a Belt and Road Trade cooperation network from a multi-distances perspective.

2. Variables and Model Expansion

2.1. Variables - Multiple Distances

Based on cooperation benefits, the cooperation network formation theory expounds the principle of facilitation and complementarity of cooperation. Facilitation can reduce trade costs and the complementarity of the production factors constitutes an interdependent economic relationship. Both are beneficial to the two parties in terms of the acquisition of trade benefits. However, convenient exchanges and strong complementarity of factors can only provide basic preconditions for cooperation, but not conditions sufficient for cooperation. Therefore, considering the friendly relationships among countries is necessary [35]. The cooperation network formation theory, based on cooperation opportunities, expounds the cooperation principle of friendliness. Therefore, from the two aspects of cooperation benefits and cooperation opportunities, we chose metrics for geographic, factor endowment, cultural, and institutional distances from the perspective of multiple distances to measure the comprehensive distance indices between China and the Belt and Road countries. The four distance variables are specified as follows:

- (1) Geographic Distance (*DIS*). Generally, the greater the geographic distance between two countries, the higher the trade risk and the transportation cost, which is not beneficial for the realization of trade cooperation between two countries. According to the distance calculation method introduced by Soloaga [36], the formula of relative geographic distance is:

$$DIS_{ijt} = GDP_{jt} / GDP_{wt} \times DIS \quad (1)$$

where DIS_{ijt} is the relative geographic distance between country i and its trading partner country j in year t , GDP_{jt} denotes the gross domestic product (GDP) of country j in year t , GDP_{wt} the world GDP in year t , and DIS the absolute distance between the capital of country i and the capital of its trading partner country j . The GDP data and the DIS data were separately obtained from the World Bank database and the Research and Expertise on the World Economy (CEPII) database. In this study, the geographic distance stands for relative geographic distance.

- (2) Factor Endowment Distance (DKL). When other conditions are constant, the stronger the factor complementarity between two countries, the greater the demand for each other's products, and the greater the possibility and necessity of cooperation [37]. In this study, we used the absolute value of the difference between the two economies' capital-to-labor ratios' logarithm to measure the factor endowment distance, in which the value of capital is the capital balance based on constant price. The figures were obtained from Penn World Table. As to the missing values for certain years, we interpolated the values by using the forecast function.
- (3) Cultural Distance (CD). Cultural distance is the distance between the export country and its trading partner country due to their differences in ideology, such as values or beliefs. Generally,

the smaller the cultural distance between two countries, the stronger the sense of identity and trust, creating a greater possibility of trade cooperation. To calculate cultural distance, we used the cultural data provided by Hofstede in the following four dimensions: Power Distance, Uncertainty Avoidance, Individualism-Collectivism, and Masculinity-Femininity. According to the calculation method of cultural distance proposed by Qi [38], the formula is as follows:

$$CD_j = \frac{\sum_{i=1}^n [(C_{ij} - C_{ih})^2 / CV_i]}{n} + (1/R_{jt}) \quad (2)$$

where j is the trading partner country, CD_j is the cultural distance between China and its trading partner country j , C_{ij} is the index of cultural dimension i of the trading partner country j , C_{ih} is the index of cultural dimension i of China, CV_i is the variance of the index of cultural dimension i , n is the number of cultural dimensions, and R_{jt} is the number of years since the Belt and Road country j established diplomatic ties with China in year t . The data were obtained from the Hofstede database. The missing data for calculating the cultural distance of a certain country were interpolated using the mean of the data of its neighboring countries.

- (4) Institutional Distance (ID). In general, the political differences and political distrust between countries increase the uncertainty and limit the development of trade cooperation. The Worldwide Governance Indicators released by the World Bank divide the national system into six dimensions: Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. The institutional distance in this study was computed according to the calculation method developed by Li and Liu [39] and quantified according to the World Bank's Worldwide Governance Indicators. The formula is as follows:

$$ID_t = \frac{1}{6} \sum_j \left| \frac{I_{ij} - I_{cj}}{\max I_{ij} - \min I_{ij}} \right| \quad (3)$$

where ID_t is the institutional distance between China and its trading partner country in year t , and the subscripts i , c , and j represent the Belt and Road country, China, and the different dimensions of the institutional indices of the Belt and Road country, respectively.

2.2. Expansion of Gravity Model Based on Multiple Distances

The main research method used in this study was the gravity model. The traditional gravity model is mainly used for analyzing the influencing factors of bilateral trade flows. In this study, we expanded the model to estimate the parameters for four distance variables: geographical, cultural distance, institutional distance, and differences in relative factor endowments. These parameters were used to improve the subjective weighting method to create comprehensive distance indices and evaluate the Belt and Road counties' cooperation potential. Based on this result, the cooperation network was constructed.

2.2.1. Modeling

To determine the impact of geographic distance, factor endowment distance, cultural distance, and institutional distance on international trade flows, this study used the extended gravity model to complete positive research. The gravity model was first proposed by Tinbergen and Poyhonen [16,17], and then successfully applied to the positive research of international trade flows. Based on the assumptions of Constant Elasticity of Substitution (CES) and monopolistic competition in the single-sector economy, Anderson [40] theoretically introduced the multilateral trade resistance model, laying a theoretical foundation for the gravity model. On this basis, we expanded the gravity model as follows:

$$X_{ij} = \left(\frac{Y_i Y_j}{Y_w} \right) \left(\frac{\tau_{ij}}{P_i P_j} \right)^{1-\sigma} \quad (4)$$

The above formula shows that country i 's exports to country j are dependent on the economic scale of the two countries (Y_i and Y_j), the composite price indices of the two countries (P_i and P_j), the bilateral trade resistance (τ_{ij}), and the world nominal income (Y_w). The bilateral trade resistance τ_{ij} can be further explained as:

$$\tau_{ij} = \prod_{i=1}^m D_i^{\gamma^m} \times \exp\left(\sum_{k=1}^n \gamma_k V_{ij}\right) \quad (5)$$

where D_i is the m quantitative factors hindering the trade between the countries and V_{ij} is the n qualitative factors hindering the trade between the countries. These factors include natural and human barriers. Based on this, these natural and human barriers were further divided into geographic distance (DIS), factor endowment distance (DKL), cultural distance (CD), and institutional distance (ID) in Equation (5). After substituting Equation (5) into Equation (4) and performing logarithmical linearization, the formula could be changed into the following:

$$\begin{aligned} \ln X_{ij} = & -\ln Y_w + [\ln Y_i + (\sigma - 1)\ln P_i] + [\ln Y_j + (\sigma - 1)\ln P_j] + \gamma m(1 - \sigma)\ln DIS_{ij} \\ & + \gamma m(1 - \sigma)\ln DKL_{ij} + \gamma m(1 - \sigma)\ln CD_{ij} + \gamma m(1 - \sigma)\ln ID_{ij} \end{aligned} \quad (6)$$

Since the composite price index is usually not available, the above formula cannot be directly computed. Therefore, using the viewpoints expressed by Soloaga [36], we substituted it with the relative geographic distance between the two countries. The country with the farther geographic distance had a lower output and generally a higher composite price index. After the above treatment, we obtained the following equation:

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln DIS_{ijt} + \beta_4 \ln DKL_{ijt} + \beta_5 \ln CD_{ijt} + \beta_6 \ln ID_{ijt} + \mu_{ijt} \quad (7)$$

China is the only exporting country in the regressions, so China only varied in the time dimension and not across trading partners and could be identified by a time trend. Therefore, we eliminated China's GDP in the final regression equation as:

$$\ln X_{ijt} = \beta_0 + \beta_2 \ln Y_{jt} + \beta_3 \ln DIS_{ijt} + \beta_4 \ln DKL_{ijt} + \beta_5 \ln CD_{ijt} + \beta_6 \ln ID_{ijt} + \mu_{ijt} \quad (8)$$

where i , j , and t denote China, the Belt and Road country, and the year, respectively, and X_{ijt} is China's the export flows to country j in year t . Due to the serious lack of service trade data for the countries, the export data in this study only included the trade in goods. The data were obtained from the uncomtrade database. Y_{jt} denotes the economic scale of the Belt and Road country in year t . GDP was used to represent the economic scale of a country. The data were obtained from the World Bank. DIS_{ijt} , DKL_{ijt} , CD_{ijt} , and ID_{ijt} represent the geographic distance, factor endowment distance, cultural distance, and institutional distance between China and the Belt and Road country in year t , respectively.

2.2.2. Scope of Study

The Belt and Road is an open economic cooperation body. At present, its basic acknowledged scope encompasses 65 countries, including Mongolia-Russia, Central Asia, Southeast Asia, South Asia, Central and Eastern Europe, West Asia, and Middle East. Given the lack of data for Syria, Cyprus, and Palestine, we excluded these three countries and the final 62 countries were included in our study (Table 1).

Table 1. The Belt and Road countries.

Region	Countries
Mongolia-Russia	Russia, Mongolia
Central Asia 5 Countries	Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan
Southeast Asia 11 Countries	Vietnam, Lao Republic, Thailand, Malaysia, Singapore, Indonesia, Brunei, Philippines, Myanmar, East Timor
South Asia 8 Countries	India, Pakistan, Bangladesh, Afghanistan, Nepal, Bhutan, Sri Lanka, Maldives
Central and Eastern Europe 19 Countries	Poland, Czechia, Slovakia, Hungary, Slovenia, Croatia, Romania, Bulgaria, Serbia, Montenegro, Macedonia, Bosnia and Herzegovina, Albania, Estonia, Lithuania, Latvia, Ukraine, Belarus, Moldova
West Asia, Middle East 20 Countries	Turkey, Iran, <input type="checkbox"/> Syria, Iraq, the United Arab Emirates, Saudi Arabia, Qatar, Bahrain, Kuwait, <input type="checkbox"/> Cyprus, Lebanon, Oman, <input type="checkbox"/> Palestine, Yemen, Palestine, Jordan, Israel, Armenia, Georgia, Azerbaijan, Egypt

Note: indicates the countries that were excluded.

2.2.3. Data Description

Descriptive statistics of the main variables in the model are shown in Table 2.

Table 2. Descriptive statistics of the main variables.

Variable	Sample	Mean	Standard Deviation	Maximum	Minimum
lnX	620	21.35425	1.960806	24.91318	14.27680
lnY _j	620	24.79791	1.646247	28.44794	20.14166
lnDIS	620	1.495190	1.690489	5.123532	−2.886556
lnDKL	620	−2.063136	1.073318	−0.209086	−7.555941
lnCD	620	0.546392	0.648607	1.841765	−0.856048
lnID	620	−1.626959	0.445997	−0.538377	−2.716474

3. Empirical Analysis

Before regression, the Variance Inflation Factor (VIF) of each variable was tested. The VIF of each variable was less than 10, indicating no serious multicollinearity in the model. To avoid the possible spurious regression problem in the model, the Levin-Lin-Chu (LLC) test (applicable to same roots) and the Fisher-ADF test (applicable to different roots) were both used to test the unit root of the data. The results showed that the level value, the first differencing value, and the second differencing value of each of the main variables in the model passed the unit root test, so the T statistic and F statistic of the estimates of the model were valid. To choose the proper estimation technique, we performed the F-test and Hausman test. The results showed that panel techniques with mixed effects were more applicable to the regressions than panel techniques with fixed effects or random effects, so we adopted panel techniques with mixed effects. To reduce the impact of heteroskedasticity on the model, the cross-sectionally weighted panel techniques with mixed effects was used for estimation. The results are shown in Table 3.

- (1) The control variable Y_j , the economic scale of the Belt and Road country, was significantly positive at the 1% level in all the regression results, supporting the basic conclusion of the gravity model that the trade flows between two economies are directly proportional to their economic scales.
- (2) Geographic Distance (DIS) was significantly negative at the 1% level in all the regression results, meaning the farther the geographic distance between two economies, the smaller their bilateral trade flows, further confirming the basic conclusion of the gravity model.
- (3) Factor Endowment Distance (DKL) was negative and passed the 1% significance test, indicating that the smaller the factor endowment distance between two economies, the greater the trade flows. This conclusion contradicts the Comparative Advantage theory. Zhou [41], in studying China and the Belt and Road countries, attributed a similar result to the Belt and Road

countries being mainly developing countries and emerging economies with relatively small factor endowment differences without fully tapping their comparative advantages. DKL was only an estimation of the factor endowment distance. In the future, more models and data tests will be needed to determine the reason for this relationship.

- (4) Cultural Distance (CD) was negative and significant at the 1% level, in line with the theoretical expectation that cultural distance has a negative effect on trade flows, as also reported by Qi [38] and Wan [42].
- (5) Institutional Distances (ID) was positive and significant at the 1% level, indicating that the greater the institutional distance between two economies, the greater the trade flows. This conclusion is counter to the findings of Wan and Gao [42], but is consistent with the conclusion of Li and Liu [39]. This is mainly due to the asymmetric effect of the institutional distance on trade flows. On one hand, for a trading partner with institutional risk, when the institutional distance between the two countries is small, the institutional environments of the two countries are similar and the experience gained by both parties in their respective countries can help effectively reduce their trade costs. As such, trade can easily occur. On the other hand, for a trading partner without institutional risk, a greater institutional distance means that the institution in this country is more developed and the institutional environment is better, which can provide an institutional guarantee for trade and help increase trade flows.
- (6) In model 4, the GDP of the trade target country, geographic distance, factor endowment, and cultural and institutional distance elasticity were 2.1235, 1.0964, 0.0720, 0.2569, and 0.3241, respectively. If the GDP of the trading target country or institutional distance increased by 1%, trade flows would increase by 2.1235% and 0.3241% respectively, whereas if the geographic, factor endowment, or cultural distance increased by 1%, trade flow would decrease by 1.0964%, 0.0720%, and 0.2569%, correspondingly. Geographical distance is the main factor affecting trade flow of the four distance variables, followed by institutional distance, cultural distance, and factor endowment distance.

Table 3. Estimates of panel techniques with mixed effects.

Variable	Model 1	Model 2	Model 3	Model 4
InYj	2.1588 *** (0.0287)	2.1185 *** (0.0326)	2.1032 *** (0.0462)	2.1235 *** (0.0488)
InDIS	−1.1530 *** (0.0276)	−1.1185 *** (0.0326)	−1.0938 *** (0.0461)	−1.0964 *** (0.0480)
InDKL		−0.0492 *** (0.0113)	−0.0759 *** (0.0118)	−0.0720 *** (0.0138)
InCD			−0.1312 *** (0.0284)	−0.2569 *** (0.0304)
InID				0.3241 *** (0.0312)
Constant	−30.4275 *** (0.6760)	−29.5956 *** (0.7569)	−29.2343 *** (1.0816)	−29.1151 *** (1.1395)
Adj- R^2	0.9628	0.9614	0.9560	0.9607
F stat.	8000.130 ***	5134.710 ***	3366.641 ***	3028.080 ***
Sample	620	620	620	620

Note: “***” stands for $p < 0.01$; the numbers in parentheses are standard errors.

In summary, the regression results verified that trade flows between two economies are greater when the geographic distance, the factor endowment distance, and the cultural distance are smaller and the institutional distance is greater. The regression results were still robust when using the Uncertainty Avoidance and Government Effectiveness as the proxy variable for cultural distance and institutional distance. We also ran robustness tests using the Poisson Pseudo-Maximum Likelihood (PPML) estimator and get the same conclusion.

4. Construction of Trade Cooperation Network

4.1. Comprehensive Evaluation of Multiple Distances

The results of the positive research of the expanded gravity model showed that geographic, factor endowment, and cultural and institutional distance have significant impacts on trade flows, proving the correctness of constructing a trade cooperation network from a multiple-distance perspective. Based on the results of the positive verification, we assigned weights to geographic, factor endowment and cultural and institutional distance, and improved the comprehensive index method to evaluate the comprehensive distance indices between China and the Belt and Road countries. The countries were further divided into different trade cooperation circles to lay the foundation for the design and construction of a trade cooperation network.

The traditional methods used to determine the weights of indicators can be roughly divided into two categories: subjective weighting methods, such as the Analytical Hierarchy Process (AHP), the expert evaluation method, and comprehensive index method; and objective weighting methods, such as gray advantage analysis, principal component analysis, and factor analysis. The subjective weighting method is based on the rich experience of experts to determine the importance of properties, but is susceptible to human impact. The objective weighting method may result in the determined weights being inconsistent with the actual importance of the properties, although the weights may have a strong mathematical basis. Therefore, the comprehensive index method was modified based on the results of the positive verification of the gravity model to compute the comprehensive distance indices between China and the Belt and Road countries to overcome the shortcomings of both the subjective and objective weighting methods.

- (1) We chose 62 Belt and Road countries as samples and selected geographic, factor endowment, cultural distance, and institutional distance as four variables, so the sample matrix was $[X_{ij}]_{62 \times 4}$. The data for the calculating the four distances were the 10-year means of these countries.
- (2) We changed all the aforementioned data into positive and dimensionless data. Based on the positive research results, we changed three variables, geographic distance, factor endowment, and cultural distance, into positive data using the reverse conversion method. To preserve the variation information of the indicators, we adopted the averaging method to change the data into dimensionless data, and obtained the matrix $[X'_{ij}]_{62 \times 4}$.
- (3) According to the positive verification results of the gravity model, β_j , the coefficients of the geographic distance, factor endowment, cultural distance, and institutional distance were 1.0964, 0.0720, 0.2569, and 0.3241, respectively. Using Equation (9), we obtained f_j , or the weights of the geographic distance, factor endowment distance, cultural distance, and institutional distance as 0.6187, 0.0348, 0.1523, and 0.1942, respectively.

$$f_j = \beta_j / \sum_{j=1}^4 \beta_j \quad j = 1, 2, 3, 4. \quad (9)$$

- (4) Computation and ranking of comprehensive distance indices. We used Equation (10) to calculate the weighted mean of the geographic distance, the factor endowment distance, the cultural distance, and the institutional distance. We used the reverse conversion method to obtain the ranking of the comprehensive distance indices between China and the Belt and Road countries (Table 4).

$$y_i = \sum_{j=1}^4 X'_{ij} f_j / \sum_{j=1}^4 f_j \quad i = 1, 2, \dots, 62. \quad (10)$$

The comprehensive distance indices are not absolute distance in space. The indices only have relative meaning, so are only valuable when compared, so that the value could be negative. The country

with potentially negative smaller comprehensive distance indices from China would have the greater potential for deep cooperation, whereas a country with larger comprehensive distance indices from China would have a smaller potential for deep cooperation. In addition, the results in Table 4 suggest that Poland is comprehensively closer to China than Vietnam. According to the World Bank data, Poland (0.8) is higher than Vietnam (−0.5) in institutional quality from 2007 to 2016. Generally, countries with a good institutional environment can reduce the influence of uncertain factors on trade, reduce trade risks, and promote the development of trade cooperation. Although Vietnam’s geographical and cultural distance are closer to China, the institutional quality in Vietnam and Poland differ considerably. Therefore, the final result showed that Vietnam’s comprehensive distance indices were larger than those of Poland.

Table 4. Comprehensive distance indices between China and the Belt and Road countries.

Russia	India	Turkey	Indonesia	Saudi Arabia	Poland
−5.8483	−4.2089	−3.4218	−2.6759	−2.5834	−1.8998
Iran	The United Arab Emirates		Egypt	Singapore	Malaysia
−1.6267	−1.3038		−1.2573	−0.9991	−0.9593
Czechia	Thailand	Iraq	Romania	Qatar	Kuwait
−0.8672	−0.8031	−0.7823	−0.7410	−0.6542	−0.6408
Philippines	Pakistan	Israel	Bangladesh	Kazakhstan	Kyrgyzstan
−0.6331	−0.5914	−0.5630	−0.4771	−0.4618	−0.4176
Vietnam	Ukraine	Slovakia	Oman	Brunei	Lebanon
−0.4150	−0.3530	−0.3211	−0.3112	−0.2978	−0.2893
Myanmar	Yemen	Jordan	East Timor	Croatia	Nepal
−0.2588	−0.2555	−0.2515	−0.2487	−0.2301	−0.2234
Bulgaria	Bahrain	Albania	Azerbaijan	Uzbekistan	Cambodia
−0.2078	−0.2007	−0.1947	−0.1902	−0.1810	0.1772
Turkmenistan	Lao Republic	Slovenia	Afghanistan	Serbia	Sri Lanka
0.1715	0.1582	0.1314	0.1286	0.1273	0.1260
Tajikistan	Maldives	Macedonia	Bhutan	Hungary	Georgia
0.0653	0.0571	−0.0486	−0.0398	−0.0303	−0.0285
Armenia	Bosnia and Herzegovina		Montenegro	Belarus	Estonia
−0.0232	−0.0025		0.0454	0.1154	0.1319
Moldova	Mongolia	Lithuania	Latvia		
0.1364	0.2002	0.2047	0.4712		

4.2. Division of Trade Cooperation Circles

According to the computed results of the comprehensive distance indices between China and the Belt and Road countries, the comprehensive distance indices between China and the 62 Belt and Road countries were divided into four intervals: $(-\infty, -0.7)$, $(-0.7, -0.3)$, $(-0.3, 0.1)$, and $(0.1, \infty)$. As such, we obtained four trade cooperation circles, as shown in Table 5.

According to the comprehensive distance indices measurement results for China and the Belt and Road countries, a spatial distribution map of the four circles was obtained (Figure 1).

- (1) The first circle has the smallest comprehensive distance indices from China, encompassing Russia, Southeast Asia, West Asia, and some countries in the Middle East. Overall, these countries have the shortest or a relatively shorter geographic distance and cultural distance from China, bordering on or close to China. These countries have the least barriers to trade cooperation, the lowest transaction costs, and the greatest possibility for trade cooperation.
- (2) The second circle has relatively small comprehensive distance indices from China, mainly including Central Asian and South Asian countries. These countries have a relatively short

geographic distance, factor endowment distance, and cultural distance from China, hence a relatively higher possibility for trade cooperation.

- (3) The third circle has relatively large comprehensive distance indices from China, mainly including some countries in Southeast and South Asia. These countries feature larger cultural distance and shorter institutional distance from China, hence having relatively higher barriers to trade cooperation.
- (4) The fourth circle has the largest comprehensive distance indices from China, including Mongolia, and Central and Eastern European countries. Among them, Mongolia has a relatively greater cultural distance and smaller institutional distance from China, which has a greater negative impact on the opportunities for trade cooperation between China and Mongolia. The Central and Eastern European countries are mainly affected by their geographic distance from China, hence having relatively higher trade cooperation costs.

Table 5. Delineation of trade cooperation circles.

Classification	Country
First circle ($-\infty, -0.7$)	Russia, India, Turkey, Indonesia, Saudi Arabia, Poland, Iran, the United Arab Emirates, Egypt, Singapore, Malaysia, Czechia, Thailand, Iraq, Romania (15)
Second circle ($-0.7, -0.3$)	Qatar, Kuwait, Philippines, Pakistan, Israel, Bangladesh, Kazakhstan, Kyrgyzstan, Vietnam, Ukraine, Slovakia, Oman (12)
Third circle ($-0.3, 0.1$)	Brunei, Lebanon, Myanmar, Yemen, Jordan, East Timor, Croatia, Nepal, Bulgaria, Bahrain, Albania, Azerbaijan, Uzbekistan, Cambodia, Turkmenistan, Lao Republic, Slovenia, Afghanistan, Serbia, Sri Lanka (20)
Fourth circle ($0.1, \infty$)	Tajikistan, Maldives, Macedonia, Bhutan, Hungary, Georgia, Armenia, Bosnia and Herzegovina, Montenegro, Belarus, Estonia, Moldova, Mongolia, Lithuania, Latvia (15)

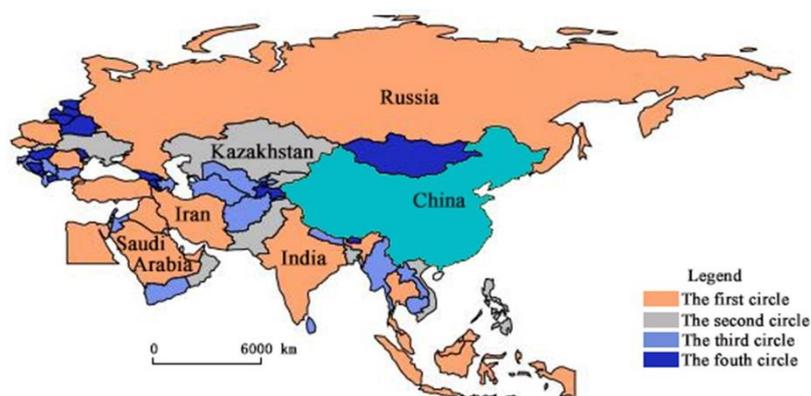


Figure 1. Trade cooperation circles of the Belt and Road countries.

From 2007 to 2016, the proportion of China's exports to the Belt and Road countries of the first, second, third, and fourth circle accounted for 67, 24, 6, and 3%, respectively. This effectively proves the rationality of the circle division.

4.3. Construction of Trade Cooperation Network

In the above two sections, we used the expanded gravity model to estimate the parameters of the four distance variables: geographical, factor endowments, cultural, and institutional distances. These parameters were used to create comprehensive distance indices that reflect the potential or possibility of trade cooperation between China and the Belt and Road countries and the time required. According to the comprehensive distance indices, the Belt and Road countries were divided into four circles of countries, each with different trade cooperation potential with China, and different amounts

of time required to reach cooperation, thus representing different cooperation network construction stages. Different work needs to be done according to the characteristics of each stage. Therefore, we divided the network construction process into four stages according to the delineation of the circle: the initial stage, the development stage, the formation stage, and the improvement stage (Figure 2). At each stage of the construction process, the density of the line in Figure 2 represents the development degree of the cooperative network construction. The larger the line density, the closer the cooperation. According to the thinking of “Progress from Point, Line, Plane to the whole Area, and gradually form the regional cooperation”, the trade cooperation networks between China and the Belt and Road countries can be promoted as follows:

- (1) **Initial Stage.** At the initial stage of the trade cooperation network construction, countries along the route have limited understanding of the Belt and Road Initiative, and only a few countries have a good foundation for cooperation to be involved in further in-depth cooperation. Therefore, the lines are sparse in Figure 2a. At this time, China should be the leader and publicizer in consulting with the Belt and Road countries of the first circle, which has the smallest comprehensive distance indices, to seek common interests and reach consensus on cooperation. To play a positive role in demonstrating and leading the trade cooperation, China should act as the “axis power”, and accelerate the construction of industrial parks and free trade zones with the first-circle countries, such as Russia, Kazakhstan, Indonesia, India, Poland, and Turkey. Thus, the circle can radiate to the six large regions, including Mongolia-Russia, Central Asia, Southeast Asia, South Asia, Central and Eastern Europe, and West Asia.
- (2) **Development Stage.** At the development stage of the trade cooperation network construction, the trade cooperation activities between the governments, the industries, and the people will experience a marked increase, so the lines of cooperative network are becoming increasingly dense in Figure 2b. Therefore, the trade cooperation between China and the Belt and Road countries will take shape and appeal to some countries in Central Asia and South Asia with relatively shorter geographic, factor endowment, and cultural distances from China. At this stage, China should further improve its trade cooperation mechanism that integrates economic, social, and ecological benefits so as to match cooperation planning with the national policies of the second-circle countries. Following this process, the second-circle countries, such as the Philippines, Qatar, Kuwait, Pakistan, and Israel, will be attracted to participate in the construction.
- (3) **Formation Stage.** Over time, more countries along the route will conduct further in-depth cooperation, reaching the formation stage of the trade cooperation network construction. At this time, the cooperation network lines are denser in Figure 2c. At this stage, the uncertainties about cooperation have been effectively reduced and the cooperation mechanism has been improved. Therefore, the trading activities with the previously constrained countries will increase as the conditions of cooperation mature. During this period, China should enrich the contents and diversify the methods of regional economic cooperation and introduce flexible and open platforms for trade cooperation so that the Belt and Road initiative will play an active role in mobilizing the third-circle countries such as Lebanon, Myanmar, East Timor, Jordan, and Yemen to promote the formation of trade cooperation network from line to area.
- (4) **Improvement Stage.** After a longer development time, more communication activities have been completed, shortening the comprehensive distance indices between China and more countries, meaning more countries have participated in the cooperation with China. As the improvement stage of the Belt and Road trade cooperation network is reached, the line density reaches a maximum in Figure 2d. According to the cooperation network formation theory, the important feature of the network is that it emphasizes the interaction among many nations and seeks common interests instead of merely mutual interests. The network’s competitiveness places emphasis on common interests, seeking coordinated development based on common interests, and establishing a high degree of mutual trust [43]. Therefore, at the improvement stage, the cooperation network construction should shift from the existing traditional cooperation concept

of combined use of resources among the countries to the formation and development of new resources, such as relations and networks for wider, deeper, and higher development of a trade cooperation network. At this stage, China should innovate cooperation elements and expand the use of resources to attract the fourth-circle countries such as Maldives, Macedonia, Bhutan, Tajikistan, and Armenia to participate in the improvement of the trade cooperation network so as to form “seamless” trade cooperation and achieve the global governance concept of sharing the cooperation benefits among the Belt and Road countries.

After the above four phases, a network of sustainable development from point to line, from line to area, and from area to region will be formed confer the advantages to the Belt and Road countries, such as geographic proximity, economic complementarity, political trust, and cultural compatibility, into drivers of pragmatic cooperation for sustained growth. This network will help realize the construction of an “all-round, multi-level, and all-encompassing” cooperation network between China and the Belt and Road countries to jointly create a sound environment of cooperation based on mutual benefits and a win-win situation to promote healthy and sustainable economic development. These concrete cooperation achievements will benefit the Belt and Road countries and their people.

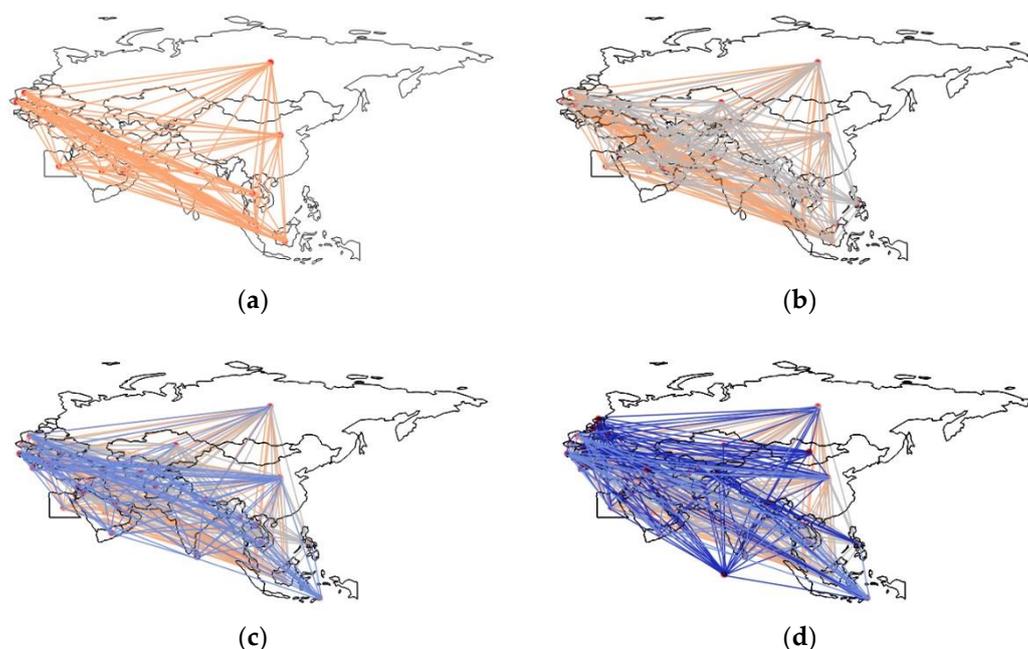


Figure 2. Construction of a cooperation network with the Belt and Road Countries. (a) Initial stage; (b) development stage; (c) formation stage; (d) improvement stage.

5. Conclusions and Policy Recommendations

In this study, under the backdrop of the Belt One Road Initiative, a Belt and Road Trade cooperation network was designed and constructed from a multi-distances perspective. Based on the cooperation network formation theory of benefit-based antecedents and opportunity-based antecedents, we selected four distance variables: geographic, factor endowment, cultural, and institutional distances, from the aspects of geography, economy, culture, and politics to expand the trade gravity model from the multi-distance research perspective. By using the data from China’s export trade flows to the Belt and Road countries from 2007 to 2016, we completed positive research resulting in the following conclusions. A Belt and Road country showed greater trade flows from China when it has smaller geographic, factor endowment, and cultural distances and a greater institutional distance from China. Subsequently, based on the positive research results, we improved the comprehensive index method to compute the comprehensive distance indices between China

and the Belt and Road countries. According to the calculated comprehensive distance indices, we divided the 62 Belt and Road countries into four trade cooperation circles and defined the four stages of trade cooperation network construction. During the initial stage, China is an “axis power” and the first-circle countries, such as Russia, Kazakhstan, Indonesia, India, Poland, and Turkey, are the nodes of the network, radiating to the six major regions of Mongolia-Russia, Central Asia, Southeast Asia, South Asia, Central and Eastern Europe, and West Asia. During the development stage, the second-circle countries, such as the Philippines, Qatar, Kuwait, Pakistan, and Israel, become expansion lines. During the formation stage, the first- and second-circle countries can attract the third-circle countries, such as Lebanon, Myanmar, East Timor, Jordan, and Yemen. During the improvement stage, the fourth-circle countries, such as Maldives, Macedonia, Bhutan, Tajikistan, and Armenia, are attracted to form a “seamless network”. Finally, an all-round, multi-level, and all-encompassing trade cooperation network would be gradually formed.

Based on the above conclusion, we recommend that China should formulate a differentiated promotion plan according to the development conditions and advantages of different countries to steadily promote the participation of countries in different circles in the cooperation network construction. For the countries in the first and second circles with smaller comprehensive distance indices, infrastructure construction and production cooperation could be conducted first. For the countries in the third and fourth circles with relatively bigger comprehensive distance indices, the cooperation network construction could be started with cultural exchanges and institutional development. The following specific recommendations are offered from the perspective of geographic, factor endowment, cultural, and institutional distances:

- (1) The transportation and communication infrastructures in the Belt and Road countries should be improved to remove geographic distance barriers. At present, in terms of the transportation infrastructure of the Silk Road Economic Belt, it is necessary to continue to strengthen the infrastructure constructions in terms of railways, highways, and aviation, thus forming an infrastructure network connecting countries along the route, and improving interregional transportation efficiency. In the 21st-Century Maritime Silk Road, we suggest promoting the construction of ports, strengthening the cooperation of maritime logistics channels, establishing a unified transportation management organization, standardizing transportation rules, and reducing customs clearance procedures to facilitate transportation by land and sea. In terms of communication infrastructure, to open up information channels for the Belt and Road countries, information network backbones should be constructed, such as cross-border optical fiber cables, intercontinental optical fiber cables, and satellite communications equipment.
- (2) The distribution of industrial divisions should be rationalized to optimize the allocation of production factors. China should comprehensively consider major issues, such as regional orientation and development direction, industrial layout and resource integration, and then determine regional development plans through dialogues and consultations with countries along the route. The regional development plans should aim at promoting the convergence of upstream and downstream industrial chains as well as the associated industries along the Belt and Road, to scientifically achieve regional function divisions. With respect to the law of market development, the industrial parks, cross-border e-commerce networks, and logistics centers should be jointly constructed to integrate demand and supply conditions along the Belt and Road. As such, the regional industrial division system could be formed and deepened. Eventually, the production factors would flow better and the regional production network would be gradually improved.
- (3) China should actively promote cultural exchanges with the Belt and Road countries to reduce the cultural distance between China and countries along the route. Firstly, China can hold various exchange activities, such as cultural events and arts festivals, to display the outstanding cultural resources of the countries along the route. These exchange activities would be beneficial for building cultural bridges and enhancing cultural identity. Secondly, to deepen the understanding and friendship among the people of different countries, civil exchanges should be encouraged

with activities, such as mutual friendship cities, non-governmental cooperation, and joint charity projects. Thirdly, the development of tourism resources should be strengthened by creating fine-silk tourism routes. At the same time, the level of convenience in tourism clearance should be improved to expand the exchange channels. Overall, cultural exchange and dissemination should be promoted to lay a solid foundation for the economic cooperation between countries.

- (4) The establishment of institutional systems should be strengthened to improve the facilitation and transparency of trade cooperation. At present, it is necessary to sign memorandums of intergovernmental cooperation or cooperation plans with countries along the route based on equal consultations and mutual benefits, to build an inter-governmental coordination system of economic and trade exchange and policy. Therefore, the Belt and Road construction will be more standardized, institutionalized, and legalized. On this basis, China should accelerate the establishment of free trade zones with the Belt and Road countries as soon as possible to reduce tariffs and non-tariff barriers and improve bilateral trade facilitation. Additionally, China can try to establish a mutual recognition system with the Belt and Road countries to save import clearance time and create a more convenient trading environment.

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