Research on the Impact of the Belt and Road Initiative on the Foreign Trade and Economic Development of Countries Along the Route

——Based on Entropy Method

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Abstract-The "Belt and Road" initiative provides a strategic basis for promoting economic and trade exchanges between China and countries along the route and achieving common prosperity and development. We used the entropy method to quantitatively evaluate the impact of the "Belt and Road" initiative on the foreign trade and economic development of the countries along the route from the perspective of economics. We found that the construction of the "Belt and Road" has the greatest effect on promoting trade on areas adjacent to China, which provides support for future policy making.

Keywords-the Belt and Road Initiative, Foreign Trade, Economic Development

1 INTRODUCTION

In September and October 2013, President Xi Jinping respectively proposed the construction of the "Silk Road Economic Belt" and the "21st Century Maritime Silk Road" (collectively known as the" The Belt and Road") initiative. This initiative is a large-scale international practice of the Chinese concept, "Integration, Coexistence and Harmony". International trade is one of the three pillars of national economic development, The Belt and Road Initiative has promoted the free trade of countries along the China-Europe Corridor, and has significantly affected the international trade of countries along the route. With the policy guarantee of the "Belt and Road" construction and the support of international finance, the trade barriers between the countries along the route and China are lowered, and the infrastructure construction is gradually complete, which provides superior conditions for promoting the trade development of countries along the route.

With the impulse of the "Belt and Road" initiative, what is the extent to which the construction of "the Belt and Road" initiative affected the economic development and foreign trade development of the countries along the route? There is still a lack of research on this issue. Therefore, this article uses economic data from 33 countries along the route, using entropy method to quantitatively study the impact of the "Belt and Road" initiative, and to provide suggestions for future policy directions.

2 ANALYSIS OF THE FOREIGN TRADE AND ECONOMIC DEVELOPMENT LEVEL OF THE COUNTRIES ALONG THE ROUTE

2.1 Construction of Evaluation Indicator System for Foreign Trade and Economic Development

In terms of measuring the level of foreign trade development, we selected three first-level evaluation indicators, respectively the scale of foreign trade, the competitiveness of foreign trade, and the degree of openness. The three first-level indicators are positive indicators[1], that is, the greater the index value, the better the foreign trade situation of the country or region. Then, in order to evaluate the level of regional foreign trade mor accurately, we set up second-level indicators under the first-level indicators, all of them are positive indicators. The detailed explanation of each indicators are in table 1.

Table 1. Foreign Trade Evaluation Indicator System

First-level indicators	*Second-level indicators*	*Explanation*	*Property*
The Scale Of Foreign Trade	China's imports from this country (One million U.S. dollars)	China's total foreign trade in goods and services imported from the country	+
	China's exports to the country (One million U.S. dollars)	China's total foreign trade in goods and services exported to the country	+
The Competitive ness Of Foreign Trade	Efficiency indicator	Efficiency refers to six specific indicators: higher education and training, technological readiness, financial market development degree, labor market efficiency, commodity market efficiency, comprehensive strength of market size	+
	Basic needs indicator	Basic demand indicators mainly include the following four points: health and basic education, macroeconomic environment, infrastructure and administrative institutions. The total index is the weighted value of the four items	+
	Innovation indicator	The strength of a country's degree of innovation mainly considers innovation development, input, output, effectiveness, etc.	+
The Degree Of Openness	Freedom of foreign trade	The degree of government intervention in the country's foreign trade market. The higher the value, the more free the country's foreign trade.	+

Economic development evaluation indicators are designed to measure the level of regional economic development. We selected three first-level indicators of economic development, including scale, structure and quality. We also set up five second-level indicators. The detailed explanation of each indicators are in table 2.

Table 2. Economic Development Evaluation Indicator System

First-level indicators	Second-level indicators	Explanation	Property
Economic Scale Indicator	GDP	Gross national product	+
	Household consumption expenditure	Resident consumption expenditure refers to all expenditures of urban and rural residents and households for daily consumption and collectives for personal consumption.	+
Economic Structure Indicator	Industrial Upgrading Indicator	Proportion of added value of primary industry in GDP × 1 + proportion of added value of secondary industry in GDP × 2 + increase in tertiary industry add value × three	+
Economic Quality Indicator	Labor freedom	It refers to the degree of alternative labor opportunities. The more alternative opportunities, the higher the degree of labor freedom	+
	Per capita GDP	Measure the quality of people's economic life	+

3 DATA

We collected all the second-level indicator data of 33 countries along the route from 2012 to 2017 from the CSMAR database and the World Bank database.

4 MODEL AND METHODS

We use the entropy method in the objective valuation method to calculate the weight. Entropy is a physical concept in thermodynamics and a measure of the chaos of the entire system. The greater the entropy, the more chaotic the system, and the less information the system carries; conversely, the greater the entropy, the more orderly the system and the more information the system carries. Information entropy draws on the concept of entropy in thermodynamics and is used to describe the average amount of information of the information source. The formula is as follows:

$$H(x) = E[\log(\frac{\pi}{2} - \theta)\frac{1}{P(\alpha_i)}] = -\sum_{i=1}^{q} P(\alpha_i)\log P(\alpha_i) \tag{1}$$

1.There are two kinds of indicators: positive (+) and negative (-), in which the larger the positive indicator value, the better, and the smaller the negative indicator value, the better.

In addition, the entropy method is a mathematical method used to measure the degree of dispersion of indicators. The larger the entropy value, the greater the degree of dispersion of the indicator data, and the greater the impact on the indicator during comprehensive evaluation. Therefore, it is determined to use entropy The value method is used to determine the weight of the indicator system, and the following five steps are used to calculate the data of each indicator from 2012 to 2017.

Firstly, Since the dimensions of each index are different, it cannot be directly evaluated, so dimensionless processing is required. We standardize the data of all indicators, transform the absolute value of the indicator into a relative value through standardization, and make $x_{ij}=|x_{ij}|$ to make the characteristics of different attributes comparable. The calculation formulas of positive and negative indicators are shown in formula (2) and formulas (3) respectively:

$$x'_{ij} = \frac{x_{ij} - \min\{x_{ij,...,}x_{nj}\}}{\max\{x_{ij,...,}x_{nj}\} - \min\{x_{ij,...,}x_{nj}\}} \tag{2}$$

$$x'_{ij} = \frac{\max\{x_{ij,...,}x_{nj}\} - x_{ij}}{\max\{x_{ij,...,}x_{nj}\} - \min\{x_{ij,...,}x_{nj}\}} \tag{3}$$

Wherein, x'_{ij} is the value of the j-th indicator in the i-th region.

Secondly, we use formula (4) to calculate the proportion of the i-th region under the j-th indicator in the indicator Pij :

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}}, i = 1,...,n; j = 1,...,m \tag{4}$$

Then, we use formula (5) to calculate the entropy value of the j-th indicator e_j:

$$e_j = -k \sum_{i=1}^{n} p_{ij} \ln(p_{ij}) \tag{5}$$

Among them, k=1/ln(n), satisfying $ej \geq 0$, i=1,…,n; j=1,…,m

Fourthly, we use formula (6) to calculate information redundancy d_j :

$$d_j = 1 - e_j \tag{6}$$

Finally, we use formula (7) to calculate the indicator weight w_j :

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j} \tag{7}$$

On the basis of calculating the weights of the indicator system, we use the dimensionless indicator matrix and weights to perform weighted summation to calculate the comprehensive scores of the foreign trade and economic development of 33 countries from 2012 to 2017:

$$S_i = \sum_{j=1}^{m} w_j x'_{ij} \tag{8}$$

Among them, x'_{ij} is the above-mentioned standardized value, the value of the j-th indicator in the i-th region, and w_j is the indicator weight.

5 ANALYSIS OF EVALUATION RESULTS OF FOREIGN TRADE AND ECONOMIC DEVELOPMENT OF COUNTRIES ALONG THE BELT AND ROAD

Table 3. Evaluation results of foreign trade level of Countries along the Belt and Road

Country	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Albania	0.0038	0.0035	0.0035	0.0037	0.0051	0.0053
Poland	0.0297	0.0309	0.0327	0.0335	0.0343	0.0300
Kyrgyzstan	0.0014	0.0020	0.0021	0.0024	0.0025	0.0034
Malaysia	0.0988	0.1047	0.0990	0.1106	0.1054	0.1018

This table only intercepts part of the results

Table 4. Evaluation results of the economic development level of countries along the Belt and Road

Country	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Albania	0.0031	0.0031	0.0034	0.0032	0.0032	0.0032
Poland	0.0346	0.0360	0.0371	0.0372	0.0359	0.0381
Montenegro	0.0070	0.0061	0.0061	0.0064	0.0061	0.0056
Malaysia	0.0219	0.0223	0.0237	0.0238	0.0233	0.0234

This table only intercepts part of the results

The scores of foreign trade and economic development of the countries along the route are shown in Table 3 and Table 4. After the "Belt and Road" initiative was put forward in 2013, most countries have made significant improvements in 2014, indicating that the introduction of the "Belt and Road" initiative has a great impact on foreign trade. However, after the formal implementation of the "Belt and Road" initiative in 2015, the promotion of some countries in 2016 and 2017 was not very obvious. Observation found that after the implementation of the initiative, the promotion effect is more obvious for the economically powerful countries, and other domestic factors fluctuate less, but for some relatively backward developing countries, the promotion effect is not obvious. This may be because the domestic initiative situation of these backward countries is unstable, starting late, and there are more factors that will offset the positive promotion of China's the "Belt and Road" initiative.

In this situation, for a country, its foreign trade and economic impact are also related to its own internal factors. For example, developing countries and other countries with a late economic start will suffer from diseases, wars and other negative factors.

In order to more intuitively reflect the impact of the Belt and Road policy on regional trade and regional economy, we subdivided the 33 countries along the route into seven regional sectors[2],

2. East Asia (Mongolia, Japan, South Korea); Southeast Asia (Cambodia, Indonesia, Malaysia, Philippines); South Asia (India, Nepal, Pakistan); Central Asia (Kyrgyzstan); Central and Eastern Europe (Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary), Latvia, Lithuania, Montenegro, Poland, Romania); West Asia and North Africa (Georgia, Armenia, Bahrain, Egypt, Iran, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar); Russia, based on the CSMAR database

and analyzed the level of foreign trade and economic development of these seven sectors in terms of time and space.

5.1 Time and regional characteristics of foreign trade
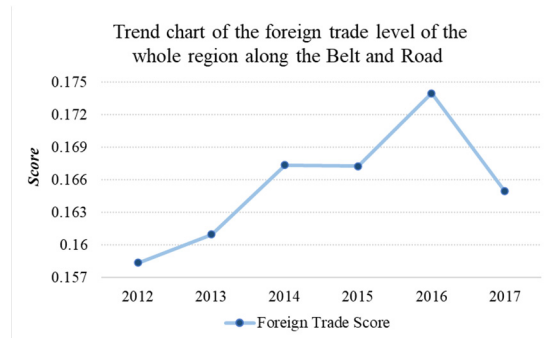
Figure.1 Trend chart of the foreign trade level of the whole region
along the Belt and Road

Since 2012, especially after the "Belt and Road" initiative was put forward in 2013, the overall level of foreign trade along the "Belt and Road" has shown an upward trend (Figure 1). Among them, the overall foreign trade level has increased since 2013, and the overall foreign trade level has shown an upward trend before 2016. Until 2016, the foreign trade level reached the highest value in six years. Due to the impact of the global market economy downturn, countries along the route will be affected in 2017. The overall level of foreign trade has declined slightly, but it is still rising compared with 2013 when the initiative just starts.
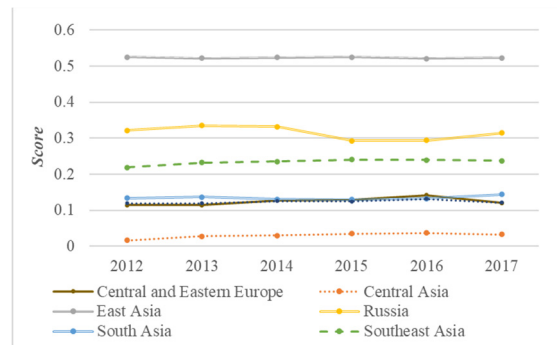

Figure.2 Trend chart of the average foreign trade level of the seven
geographic regions along the Belt and Road

From the perspective of the average foreign trade level of the seven geographical regions along the "Belt and Road", Southeast Asia and Central Asia are in a trend of large fluctuation and growth. The base period growth rates of foreign trade are 31.85% and 101.83%, respectively. Southeast Asia is the main route and construction site of the "Road" (21st Century Maritime Silk Road), and Central Asia is the main route and construction site of the "Belt"(Silk Road Economic Belt), therefore, the foreign trade growth are more obvious in these regions. The construction of

the "Belt and Road" has brought significant business opportunities for foreign trade of these countries along the route.

5.2 Time and regional characteristics of economic development

Trend chart of the economic development level of the whole region along the Belt and Road
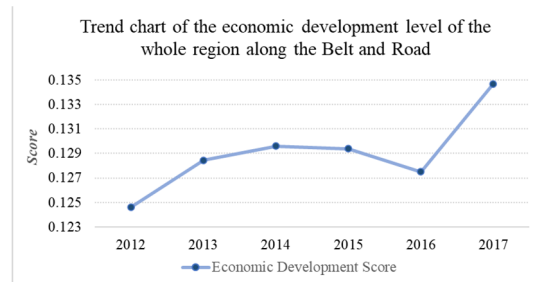
Figure.3 Trend chart of the economic development level of the whole region along the Belt and Road
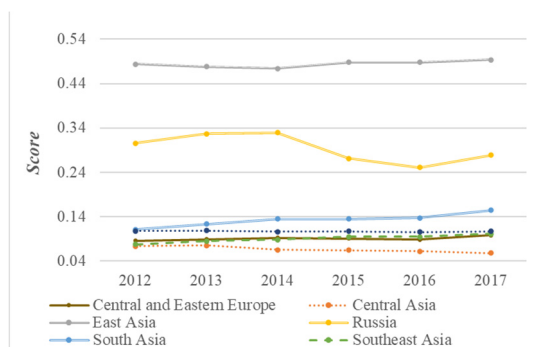
From 2012 to 2017, the average economic development level of the countries along the route showed a fluctuating growth. From 2012 to 2014, the economic development level of the countries along the route continued to grow, but the growth rate slowed down; from 2014 to 2016, it experienced a gradual and accelerated decline until it reached the lowest point in 2016; the overall economic development level of the countries along the route experienced another rapid growth, it reached a record high. Due to the lag in the implementation of policy bonus, we think that the decline in 2014-2016 was mainly due to the transition of policy adaptation.

From the perspective of the average economic development level of the seven geographic regions along the "Belt and Road", South Asia and Southeast Asia are the two regions with the highest base-period growth rate among the three regions where the average economic development level of the region has risen overall, reaching 39.84% and 30.90% respectively. , They are one of the most dynamic regions in the global economic development, and their economic growth momentum is rapid; while Central and Eastern Europe, although the economic growth momentum is not as strong as South Asia and Southeast Asia, is backed by established industrial countries such as Germany, and has a good location advantage and development potential in foreign trade, while being influenced by European welfare states and environmental protection culture, the quality of economic development in Central and Eastern Europe is relatively high.

The base-period growth rate of the average economic development level of East Asia along the route is only 2.00%, mainly because the East Asian regions selected in this study are Japan and Mongolia. Among them, Mongolia, as the world's largest landlocked country, has a weak economic development location advantage; while Japan is a developed country in East Asia with a large GDP base but insufficient economic growth potential. At the same time, it is also facing many social problems such as difficulty in employment and housing.

The base-period growth rate of West Asia and North Africa is -0.88%, the base-period growth rate of Central Asia is 21.7%, and the base-period growth rate of the regional average economic development level of Russia is -8.73%. The economic development of these three regions is similar. On the one hand, the economic scale is underdeveloped, and at the same time the

economic industrial structure is poor, resulting in low social employment rate and poor economic quality.

Figure.4 Trend chart of the average economic development level of
the seven geographic regions along the Belt and Road

6 CONCLUSION

From the above analysis, we can see that since the Belt and Road Initiative was put forward in 2013, Southeast Asia and Central Asia have received the most trade bonus, indicating that that the "Belt and Road" construction has brought the greatest trade promotion effect to the two regions adjacent to China. As an inland region, Central Asia has relatively weak industrial base, infrastructure construction and trade port resource, However, the analysis shows that the region's foreign trade growth has exceeded 100% since the "Belt and Road" initiative was proposed. In contrast, West Asia and North Africa, which have the same industrial endowments and poor trade location resources, are less affected by the Belt and Road initiative due to their long distance from China and higher transportation costs. Therefore, the trade growth rate is far lower than that of Southeast Asia and Central Asia. This also confirms the success of the Belt and Road initiative from the side.

In the future policy promotion, the Chinese government can increase the promotion of the actual results of the current "Belt and Road" construction, continue to strengthen trade with countries along the route, and attract countries in the middle and end regions of the route to strengthen the participation of the "Belt and Road" construction; Besides, the Chinese government can adjust the trade structure to allow more countries along the route to enjoy the bonus of the Belt and Road policy.

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