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Analysis of the Competitiveness of China's Transport Service Trade under the Belt and Road Initiative

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Abstract. Since the global economic crisis and the pandemic, protectionism has been on the rise worldwide. China's economy has entered a "new normal," facing downward pressure and structural transformation needs. Against this backdrop, the Belt and Road Initiative has promoted trade cooperation between China and countries along the route, becoming a new engine for economic growth. This study utilizes international databases such as OECD and the World Bank to measure the competitiveness indicators of China's transport service trade and employs Stata to analyze its influencing factors. The results indicate that China's transport service trade has maintained a long-term deficit, reflecting relatively weak international competitiveness. Based on these findings, targeted recommendations are proposed to foster the steady development of the sector.

Keywords: Transport Service Trade; Belt and Road Initiative; International Competitiveness.

1. Introduction

Since China's accession to the World Trade Organization in 2001, it has consistently expanded its opening-up policies and actively participated in global economic and trade cooperation. In the face of challenges posed by the recurring COVID-19 pandemic and increasing global economic fragility, China has focused on promoting regional cooperation platforms. Among these, the Belt and Road Initiative, as a key vehicle, has encompassed 65 countries since its proposal in 2013, creating new development opportunities for China and the participating nations. Although China's goods trade continues to expand in scale and its service trade shows a positive development trend, the transport service trade has long been in a deficit, with international competitiveness significantly lagging behind countries such as the United States, Germany, and Japan. Against the strategic goal of building China into a strong trader and a leader in transport services, enhancing the competitiveness of the transport service trade has become an urgent issue to address.

This paper focuses on the transport service trade, exploring the impact of the Belt and Road Initiative on its competitiveness. As a critical support for goods trade, transport services hold a foundational position. As a major global trader in goods, China has immense demand for transport services. However, its carriage capacity heavily relies on the international market. Enhancing its competitiveness is of urgent significance for safeguarding domestic and international economic stability and promoting dual circulation development. By examining the Belt and Road Initiative from the perspective of transport service trade, this study expands the existing analytical framework and provides a theoretical basis for improving regional service trade cooperation. The research findings will help unleash the potential of China's service trade, promote industrial upgrading and global resource allocation, and strengthen China's voice in international economic and trade governance.

2. Theoretical Basis and Transmission Mechanism

2.1. Theoretical Basis

To systematically enhance the competitiveness of China's transport service trade, this chapter adopts Porter's "Diamond Model" as the theoretical framework. Using STATA 16.0 statistical software and

Principal Component Analysis (PCA), we explore the factors influencing the competitiveness of China's transport service trade.

The theory of national competitive advantage proposes that in international competition, a country should allocate its resources from a holistic perspective, aiming to secure market share for its products in the global market. Porter summarized the competitive advantages of nations and industries into a combination of four key elements and two auxiliary elements. The key elements are: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. The auxiliary elements are: chance and government. These six elements constitute the "Porter Diamond Model." Michael Porter's theory of national competitive advantage provides a new perspective for studying international service trade from the demand side. Jin Bei argues that strong competitiveness implies a larger market share and higher profits. Therefore, when analyzing competitiveness, both direct indicators reflecting competitive strength and potential (such as product price and quality) and indirect indicators (such as cost, technology, management, and firm size) should be considered.

To comprehensively account for factors affecting trade competitiveness, this study selects data spanning 17 years from 2005 to 2021. The export value of China's transport services is used as the explained variable, while the explanatory variables are sourced from the National Bureau of Statistics. The logical structure for selecting each variable is illustrated in Figure 1.

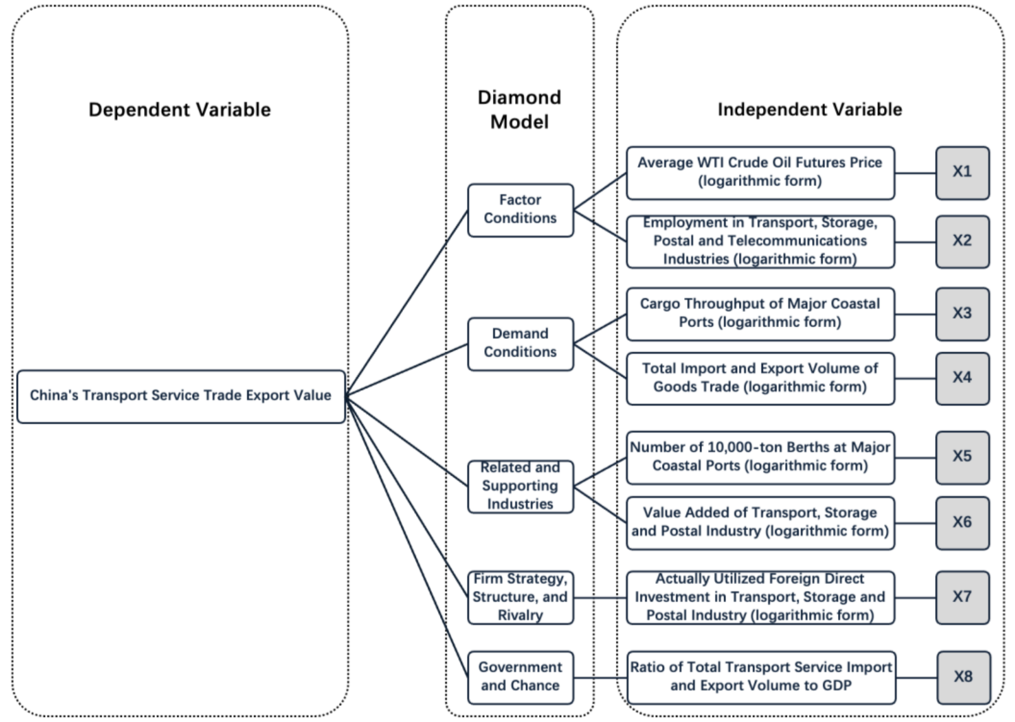

Figure 1. Logical Structure Diagram of Variable Selection

2.2. Transmission Mechanism

The influence of factor conditions and related/supporting industries on the transport service sector is primarily reflected in its output capacity. The level of port infrastructure, vessel carrying capacity, and economies of scale resulting from the increase in talent within transport service enterprises collectively enhance the sector's production capacity.

In terms of demand conditions, as transport service trade is derived from goods trade, the demand for transport services is inevitably influenced by the expansion or contraction of goods exports.

Regarding competition, foreign shipping companies inject capital into China's transport sector through FDI. Through competitive effects and technology spillovers, domestic enterprises can learn advanced management expertise and service knowledge, thereby promoting the development of China's transport industry and influencing the competitiveness of its transport service trade.

In the context of government and opportunity, China is progressively establishing a comprehensive, multi-level, broad-ranging, and three-dimensional opening-up pattern. As opening-up continues to deepen, China's three major shipping companies—COSCO, China Shipping, and Sinotrans—are continuously building integrated logistics chains and global agency networks. FOB supply sources are steadily increasing, and international competitiveness is continuously strengthening. In summary, the transmission mechanism of this study is illustrated in Figure 2.

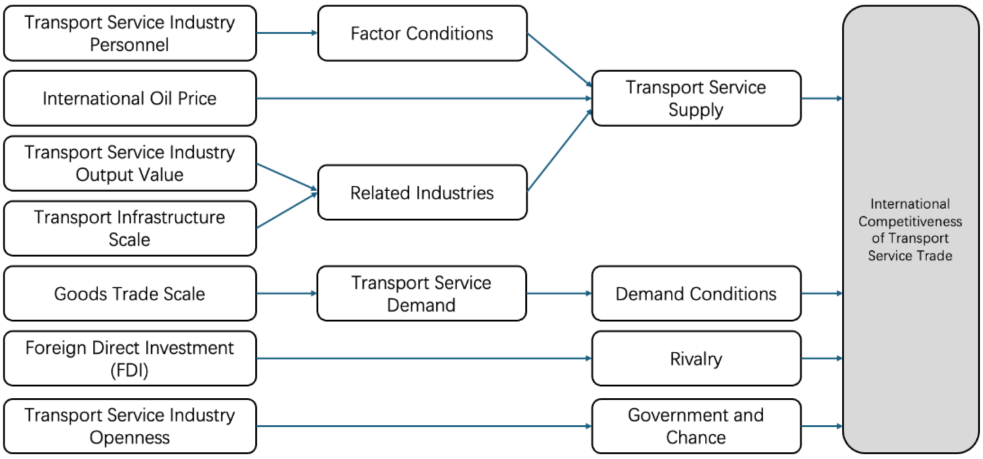

Figure 2. Transmission Mechanism

3. Empirical Analysis

3.1. Principal Component Analysis

Given the relatively short time span of the selected data and the presence of multiple independent variables with strong intercorrelation, potential multicollinearity issues exist. Direct application of conventional regression analysis could lead to model instability and meaningless significance tests between variables. To address these issues among variables, this study employs Principal Component Analysis (PCA) for dimensionality reduction. The statistical software used for this analysis is STATA 16.0.

3.1.1. Feasibility and Correlation Tests.

To assess the feasibility of PCA, correlation tests were conducted among the original variables. The results of the correlation tests are presented in Table 1.

As shown in Table 1, the original variables exhibit high autocorrelation, with most correlation coefficients exceeding 0.9. Therefore, this study conducted the KMO test to examine the relative magnitudes of the simple correlation coefficients and partial correlation coefficients among the original variables. The test yielded a comprehensive KMO value of 0.797, confirming the feasibility of applying PCA analysis.

Table 1. Correlation Coefficient

	X1	X2	X3	X4	X5	X6	X7	X8
X1	1							
X2	-0.429*	1						
X3	-0.284	0.955***	1					
X4	-0.0850	0.902***	0.971***	1				
X5	-0.353	0.964***	0.994***	0.952***	1			
X6	-0.352	0.973***	0.986***	0.951***	0.992***	1		
X7	-0.313	0.939***	0.954***	0.914***	0.946***	0.953***	1	
X8	0.726***	-0.779***	-0.737***	-0.559**	-0.766***	-0.743***	-0.739***	1

3.1.2. Total Variance Explained.

Principal Component Analysis (PCA) achieves dimensionality reduction through mathematical transformation, converting a multidimensional variable system into a lower-dimensional system with high precision. The fundamental principle involves projecting multidimensional variables onto a lower-dimensional orthogonal subspace, transforming the original random vector with correlated components into a new random vector with uncorrelated components. The projected data should retain as much of the variance of the original data as possible. In PCA, the eigenvalues of the covariance matrix of the original variables represent the variances of the principal components. Using the PCA command in STATA 16.0 statistical software, the total variance explanation table for the principal component analysis was obtained, as shown in Table 2.

As presented in Table 2, the first principal component has an eigenvalue of 6.524, explaining 81.6% of the information from X1 to X8. The second principal component has an eigenvalue of 1.206, explaining 15.1% of the information from all indicators. The cumulative variance explained by the first two eigenvalues, C1 and C2, accounts for 96.6% of the information from all indicators (X1–X8). Therefore, the principal components selected for this study are C1 and C2.

Table 2. Total Variance Explained

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	6.524	5.318	0.816	0.816
Comp2	1.206	1.064	0.151	0.966
Comp3	0.142	0.0697	0.0178	0.984
Comp4	0.0724	0.0323	0.00910	0.993
Comp5	0.0401	0.0294	0.00500	0.998
Comp6	0.0107	0.00686	0.00130	0.999
Comp7	0.00385	0.00321	0.000500	1.000
Comp8	0.000640		0.000100	1

3.1.3. Principal Component Score Coefficients.

Using the predict command following the PCA command, the principal component score coefficient matrix can be directly obtained, as shown in Table 3. From the principal component score coefficient matrix, the expressions for the principal component functions can be derived as follows:

$$C1=-0.168*X1+0.384*X2+0.385*X3+0.361*X4+0.388*X5+0.387*X6+0.377*X7-0.321*X8 \quad (1)$$

$$C2=0.803*X1+0.00053*X2+0.142*X3+0.336*X4+0.0789X5+0.0875*X6+0.0985*X7+0.446*X8 \quad (2)$$

Table 3. Score Coefficient Matrix

Variable	C1	C2
X1	-0.168	0.803
X2	0.384	0.00053
X3	0.385	0.142
X4	0.361	0.336
X5	0.388	0.0789
X6	0.387	0.0875
X7	0.377	0.0985
X8	-0.321	0.446

3.2. Principal Component Regression Analysis

This section analyzes the relationship between China's transport service trade export value and the principal components. The export value of China's transport service trade is used as the dependent variable, while C1 and C2 serve as independent variables in the regression analysis. The regression results are presented in Table 4 and Table 5. Based on the regression results, the following equation is obtained:

$$logEXP= 0.1257*C1+0.1685* C2 \quad (3)$$

$$C1=-0.168*X1+0.384*X2+0.385*X3+0.361*X4+0.388*X5+0.387*X6+0.377*X7-0.321*X8 \quad (4)$$

$$C2=0.803*X1+0.00053*X2+0.142*X3+0.336*X4+0.0789X5+0.0875*X6+0.0985*X7+0.446*X8 \quad (5)$$

By comprehensively utilizing the expressions for C1 and C2 from the principal component scores and substituting them into the solution, the final regression coefficient table is obtained, as shown in Table 6.

First, the R-squared value is 0.7027, and the adjusted R-squared is 0.6602, indicating a high goodness of fit for the model. The overall regression is significant, yielding the final regression model as follows:

$$logEXP=5.9104+0.1141*X1+0.0483*X2+0.0723*X3+0.1021*X4+0.0620*X5+0.0634*X6+0.0348*X7 \quad (6)$$

Table 4. Indicators of Regression Data Variation Trends

Source	SS	df	MS	R2	R2*
Model	2.197	2	1.098		
Residual	0.929	14	0.0664	0.7027	0.6602
Total	3.126	16	0.195		

Table 5. Regression Results Table

logEXP	Coef.	Std.Err.	t	P>|t|	95% Conf.	Interval
c1	0.1257	0.0252	4.980	0	0.0716	0.180
c2	0.1685	0.0586	2.870	0.0120	0.0427	0.294
cons	5.9104	0.0625	94.58	0	5.776	6.044

Table 6. Regression Coefficient Table

Variable	Regression Coefficient
X1	0.1141
X2	0.0483
X3	0.0723
X4	0.1021
X5	0.0620
X6	0.0634
X7	0.0640
X8	0.0348
Intercept	5.9104

3.3. Analysis of Model Results

The selection of variables in this study's model is theoretically grounded in Porter's "Diamond Model." Based on the empirical results, the model is analyzed as follows:

Factor Conditions. Aligned with Porter's definition of factor conditions and the characteristics of the transport service industry, this study focuses on advanced factors, examining human capital and capital stock. "Employment in transport, postal, and storage sectors" and the "average price of WTI crude oil futures" are selected as proxies for human capital and capital stock, respectively. The empirical results indicate that both variables positively influence China's transport service trade competitiveness. Specifically, a one-unit increase in employment and WTI crude oil prices boosts competitiveness by 0.0483 and 0.1141 units, respectively.

Demand Conditions. Given the significant role of goods trade in driving transport service demand, "cargo throughput of major coastal ports" and "total import and export volume of goods trade" are selected as variables. The results show that a one-unit increase in these indicators enhances transport service trade competitiveness by 0.0723 and 0.1021 units, respectively, confirming their positive impact.

Related and Supporting Industries. Reflecting Porter's concept of "industrial clusters" in the context of China's transport services, "number of 10,000-ton berths in major coastal ports" and "value added of transport, storage, and postal sectors" are chosen as variables. The empirical results demonstrate that a one-unit increase in these factors raises competitiveness by 0.0620 and 0.0634 units, respectively.

Firm Strategy, Structure, and Rivalry. "Actual utilized FDI in transport, storage, and postal sectors" is used to represent competition within the industry. The regression results reveal that a one-unit increase in FDI leads to a 0.0640-unit rise in competitiveness. This suggests that increased foreign investment intensifies domestic competition, encouraging firms to enhance their competitiveness through technological learning and equipment upgrades.

Government and Chance. The "ratio of total transport service trade to GDP," representing the openness of transport service trade, exhibits a positive coefficient, indicating a significant positive correlation with competitiveness. A one-unit increase in openness raises competitiveness by 0.0348 units. This underscores how liberalized transport markets and a favorable trade environment stimulate industry development, consistent with findings in the firm strategy and rivalry dimension.

4. Conclusion

This study conducts an empirical analysis of the factors influencing the competitiveness of the transport service trade based on Porter's "Diamond Model." At the factor conditions level, both employment in the transport, postal, and storage sectors and WTI crude oil prices exhibit positive effects. In terms of demand conditions, port cargo throughput and total goods trade volume significantly enhance competitiveness. Regarding related and supporting industries, the number of port berths and the value added in transport, storage, and postal services positively contribute. At the firm strategy, structure, and rivalry level, foreign direct investment strengthens competitiveness through technology spillover effects. Moreover, the openness of the transport service trade demonstrates the most significant positive correlation, confirming the critical role of an open market environment in driving industry development.

To enhance the competitiveness of China's transport service trade, it is recommended to advance synergistically across four key areas: The government should strengthen policy and resource support by increasing capital and technology investment, optimizing industrial structure, assisting the development of related industries, and supporting financing for small and medium-sized enterprises to facilitate a transition toward technology-driven growth. Deepening Belt and Road cooperation through standardized norms, mutual recognition procedures, and reduced trade barriers will help establish a broader regional free trade network. Transport enterprises should enhance their capabilities through standardized operations, business expansion, mergers and acquisitions, and differentiated strategies to actively explore international markets. Simultaneously, promoting coordinated development across related industries such as manufacturing, logistics, and technical services will help build a complementary industrial ecosystem and form an integrated competitive advantage, thereby achieving balanced and sustainable development of the transport service trade.

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Due to limitations in my academic proficiency, any shortcomings in this thesis are sincerely open to criticism and correction from experts and peers.

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