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Research on the Impact of International Traffic on China's Import and Export Trade

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ABSTRACT. *The development level of a country's foreign transportation will directly affect the scale and circulation efficiency of its import and export commodities. A modern international transportation system will lay a solid foundation for China to enhance its international trade competitiveness. Based on the data from the National Bureau of Statistics of China and the China Communications Yearbook from 1979 to 2016, this paper selects civil aviation international routes, pipeline oil (gas) mileage, coastal construction investment, and transportation fixed asset investment as the influencing factors of China's total import and export trade. The Almon estimation method constructs the measurement model. The results show that coastal construction investment has the greatest stimulus effect on China's international trade, and the impact of port berths on import and export commodities is lagging. The development of air transportation and pipeline transportation will rapidly promote the expansion of trade in the short term.*

KEYWORDS: *China's import and export trade; international transportation; multiple linear regression; lagged variable model*

1. Introduction

As the trend of economic globalization continues to deepen, international trade has gradually become an important indicator to measure the level of economic development of a country and the world. According to the "Global Trade Data and Outlook" report released by the World Trade Organization, the total global trade volume in 2018 was approximately US$39.342 trillion, and China surpassed the United States to become the world's number one trading nation. International transportation is the prerequisite and foundation for international trade, and it is also the hub of trade information transmission. During the Han Dynasty, Zhang Qian's envoy to the Western Regions opened up the "Silk Road", allowing China to develop trade with Central Asia and West Asia through land transportation; the Ming Dynasty Zheng He's voyages to the West marked the "Maritime Silk Road"

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development to its heyday. Large quantities of tea, silk, and porcelain were exported to East Africa and Europe; the advent of air transportation enabled people on the other side of the ocean to taste fresh beef from the Pampas. Whether it is the import or export of goods and services, it must be transported by land, sea or air to complete the spatial transfer and realize the flow and exchange on an international scale. Therefore, international transportation capacity has a huge impact on international trade. On the one hand, it affects the efficiency of the circulation of import and export commodities. On the other hand, the investment in international transportation construction reflects the strength of the two countries' trade demand and the degree of economic closeness.

In the factor endowment theory, Heckscher-Olin proposed that international transportation costs are an important consideration for the two countries' commodity trade; Jiang Nan (2010) pointed out that coastal ports must adapt to the development of the national economy; Wang Hongwei (2011)) Suggest that all countries in the world should strategically attach importance to the development of the transportation industry, and fundamentally ensure that the transportation industry plays a fundamental and strategic role in the development of the world economy; Zhang Shangsheng (2018) studied modern logistics and foreign trade It is believed that the internationalization of logistics plays an important role in promoting the development of the world economy; Cai Weiyi (2018) confirmed that the financial crisis has caused structural changes in China's import and export trade. Judging from the existing research, scholars rarely study the impact of international transportation capacity on China's international trade.

Therefore, based on the perspective of international traffic, this article selects the number of civil aviation international routes, the number of berths in major coastal ports in China, pipeline oil (gas) mileage, coastal construction investment, and investment in fixed transportation assets as the main influencing factors. Lag variable. Based on the data from the National Bureau of Statistics and the China Transportation Yearbook from 1979 to 2016, a multiple linear regression was performed, and a lagged variable model was constructed to quantitatively analyze the factors affecting China's total import and export volume.

2. Research Design

(1) Typical facts and theoretical analysis

International routes are the routes used by planes to fly between two countries, and the planes travelling to and from them need to fly on designated routes. According to statistics from the US Department of Transportation, there were 46 routes between China and the United States in 2017, which accounted for the largest proportion of China's international routes, and the United States was also China's largest trading partner. Lu Wei (2014) confirmed that there is indeed an interdependent relationship between import and export trade and international aviation, especially the opening of international routes has expanded the air transportation network. Freund (2010) analyzed the import and export trade data of

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Africa and found that every day the transportation time is shortened on average, the export volume increases by 0.7%. The more China's international routes mean the number of aircraft that can take off and land in a unit time. The more the number, the shorter the overall transportation time. Rodrik's (2003) research found that the actual distance between trading countries will be affected by the mode of transportation. The fast international air transport can effectively shorten the geographic and psychological distance between the two countries. According to the statistics of the International Civil Aviation Organization (ICAO), the volume of international air transport in 2015 was 5,712 billion US dollars, accounting for 35% of the total value of world trade. International air transport is playing an increasingly important role in world trade.

According to statistics from the World Trade Organization (WTO), up to 10.7 billion tons of imported and exported goods were completed by sea in 2017, and sea transportation plays a vital role in international trade. A study by Guo Haoran (2014) pointed out that China's huge ocean transportation demand has a huge contradiction with the existing ocean transportation capacity, and has led to a deficit in service trade. When Wang Ying (2001) demonstrated the applicability of the theory of economies of scale to the shipping industry, he pointed out that the trend of large-scale container ships in the world has potential economies of scale. The dock berth is the basic unit that a ship can dock and operate. The construction of the port berth provides a prerequisite for the transportation of large container ships. Cheng Yingying and Li Rui (2011) pointed out that ocean transportation can reduce transportation costs and improve the competitiveness of export products from emerging market countries. Therefore, the increase in berths can enable more goods to be traded by sea, reduce export costs, and increase the export volume of Chinese products in the international market. Due to the characteristics of port construction, its berths cannot be put into use immediately after completion, so the three-phase lagging variable is selected.

Pipeline transportation is the main method for long-distance transportation of liquids and gases. Most energy materials such as oil and coal are imported or exported through this method. China's per capita energy consumption is relatively low. According to statistics from the National Energy Administration, China imported 57.18 million tons of liquefied natural gas equivalent through pipelines in 2018, and pipeline transportation has become one of China's important external transportation methods. Li Xianjia (1997) pointed out that long-distance pipelines are the main part that affects resource economy. The small mileage of pipelines means that the import or export of energy from distant countries will be subject to certain restrictions, which will increase energy prices and affect Energy trade.

Jiang Nan (2010) pointed out that there is a strong positive causal relationship between coastal construction investment and GDP, and it has a positive impact on China's international trade. Coastal provinces such as Fujian and Guangdong were China's earliest opening-up regions and important windows for China's foreign and international trade. On the one hand, investment in fixed assets in coastal areas can promote rapid economic development and attract more international trading partners to carry out economic and trade cooperation. On the other hand, they can help

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improve their infrastructure construction.

(2) Model Setting

Based on the selected variables and analysis above, the following model can be initially established:

$$MX_t = \beta_0 + \beta_1 INROU_t + \beta_2 BERTH + \beta_3 PIPE_t + \beta_4 COASTIN_t + \beta_5 TRAIN_t + \mu_t$$

Among them, t represents time, MX represents the total amount of China's import and export trade, INROU represents the number of international civil aviation routes, BERTH represents the number of berths in major coastal ports in China, PIPE represents pipeline oil (steam) mileage, COASTIN represents coastal construction investment , TRAIN represents investment in fixed assets for transportation, and μ is a random disturbance term representing other influencing factors.

(3) Source of Data

The research data in this article comes from the National Bureau of Statistics of China and the China Transportation Yearbook. Time series data from 1979 to 2016 are selected. This data counts the number of international civil aviation routes in China, the number of berths in major coastal ports, and the pipeline oil (steam) mileage. , Coastal construction investment, transportation fixed asset investment. The main coastal ports include 41 ports including Dalian Port, Tianjin Port, Qingdao Port, Lianyungang Port and Shanghai Port.

3. Empirical analysis

(1) Almon parameter estimation

Since the berths of the wharf have a time lag from the completion to the formal use, the task of carrying goods and services is lagging. Therefore, the three-phase lagging variable of the berths of the main coastal ports can be used to obtain the third-order autoregressive formula:

$$BERTH_t = \rho_1 BERTH_{t-1} + \rho_2 BERTH_{t-2} + \rho_3 BERTH_{t-3} + \varepsilon_t$$

Due to the large difference in magnitude between the explanatory variable and the explained variable, if the original model is used, the parameter estimation results may be insignificant and the model fit is low. Therefore, the logarithmic model is used to reduce the magnitude of the variables, and the following benchmark estimation model is obtained:

$$\ln MX_t = \beta_0 + \beta_1 \ln INROU_t + \beta_2 \ln BERTH_t + \beta_3 \ln BERTH_{t-1} + \beta_4 \ln BERTH_{t-2} + \beta_5 \ln BERTH_{t-3} + \beta_6 \ln PIPE_t + \beta_7 \ln COASTIN_t + \beta_8 \ln TRAIN + \mu_t$$

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For the finitely distributed lagged variable model, on the one hand, there is often the problem of losing degrees of freedom. On the other hand, there is a large correlation between the number of berths in major coastal ports and their lag variables. Therefore, the Almon estimation method is used for parameter estimation. Use finite polynomials to reduce the number of parameters to be estimated and solve the loss of freedom and multicollinearity problems. Set 3 as the length of the lag period, the polynomial degree is 3, and there is no restriction on the parameter distribution. The EVIEW software is used to perform Almon estimation on the parameters of the model. The parameter estimation results are shown in Table 1.

Table 1 Almon parameter estimation results (dependent variable: lnMX)

variable	Parameter	St.D	T
lnINROU	0.102666	0.13573	0.756399
lnPIPE	0.428445***	0.133525	3.208728
lnCOASTIN	0.484733***	0.0712	6.808085
lnTRAIN	0.111305**	0.060845	1.829332
lnBERTH	-0.262487*	0.195275	-1.344194
lnBERTH(-1)	0.377297*	0.262257	1.438654
lnBERTH(-2)	0.426211*	0.294133	1.449039
lnBERTH(-3)	-0.264578*	0.179651	-1.472737
C	-0.649487	0.852944	-0.761464
R-squared	0.997244	Hannan-Quinn criter.	-1.580918
Adjusted R-squared	0.996395	Durbin-Watson stat	1.92684
Log likelihood	39.08214	F-statistic	1175.794***
Note: ***, **, * are significant at the levels of 5%, 10%, and 20%, respectively; all the following tables are the same.			

It can be seen from Table 1 that the regression coefficients of INROU (the number of civil aviation routes), PIPE (pipeline oil and gas mileage), COASTIN (coastal construction investment), and TRAIN (transportation fixed asset investment) are all positive, which means Because there is a positive correlation with China's total import and export trade, BERYH (the number of berths in major coastal ports) will only play a role in promoting the development of China's international trade after a two-year lag. The benchmark estimation results are consistent with the theoretical analysis, so the Almon parameter estimation passes the economic significance test.

The statistical quantity F of the model is 1175.794, which is significant at the 5% significance level, indicating that the selected explanatory variables have a high degree of linear correlation with China's import and export trade as a whole. The modified coefficient of determination (R^2) =0.996, the goodness of fit is high, which means that the model can explain 99.6% of the estimate. But the T statistic of INROU was 0.7563, which failed the test at the significance level of P=0.2. According to theoretical analysis, the position of air transportation in international trade is very important, and its routes play a fundamental role in the import and export of commodities and the transmission of trade information. Therefore, it is inferred that multicollinearity may cause the INROU variable to affect China’s import and export. The impact of total trade is not significant.

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(2) VIF Inspection

This paper uses the VIF variance expansion factor to test the multicollinearity of the model. First, build an auxiliary regression model for each explanatory variable. According to the goodness of fit of the model, the variance expansion factor of each explanatory variable can be calculated through VIF (see Table 2). The results show that the VIF value of each variable is greater than 10, indicating that the model has serious multicollinearity.

Table 2 VIF inspection results

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
lnINROU	0.018423	1832.369	80.86672
lnPIPE	0.017829	7858.753	43.51669
lnCOASTIN	0.005069	547.9699	49.11959
lnTRAIN	0.003702	876.1447	64.18704
C	0.727514	3014.281	NA
lnBERTH	0.038132	142726	1715.699
lnBERTH(-1)	0.068779	61251.01	843.8786
lnBERTH(-2)	0.086514	716599.4	8875.867
lnBERTH(-3)	0.032274	466697.3	6080.517

The reason is that, on the one hand, the value of INROU and other variables have the same trend. Since the reform and opening up, China's economic growth has been accelerating. In order to adapt to and promote the rapid economic growth, China has continuously strengthened the construction of air and water transportation infrastructure. On the other hand, there is an inherent economic connection between TRAIN and the variables of INROU, PIPE, and BERTH. The increase in investment in fixed assets in transportation means increased capital investment in the number of international routes, terminal berths, and pipeline construction. It is not only driving transportation infrastructure, but also Promote the growth of COASTIN (Coastal Construction Investment).

(3) Stepwise regression method to correct multicollinearity

First, analyze the correlation coefficients between the variables. The calculation shows that the correlation coefficient between COASTIN and MX is the largest, so COASTIN is selected as the first variable of the stepwise regression model. Set the maximum number of forward iterations to 50, and the stopping criterion P=0.15 to obtain the stepwise regression results (see Table 3). The revised model excludes TRAIN, indicating that INROU, PIPE, BERTH, and COASTIN have a more direct impact on China's total import and export trade. It can be seen from Table 5 that the signs of the revised parameters are consistent with the signs of the parameters estimated by the benchmark and still pass the economic significance test. The statistic F=1235.881, passing the test when the significance level is 5%, indicates that the revised model has a higher linear relationship as a whole. The adjusted coefficient of determination R^2=0.996, which is higher than the coefficient of determination estimated by the benchmark, and the model has a stronger ability to interpret sample data. The increase in the P value for each parameter means that the

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explanatory variable has a more significant impact on China's import and export trade.

Table 3 Stepwise regression results

Variable	Parameter	St.D	T
C	0.033418	0.799543	0.041796
INROU	0.298253***	0.087171	3.421485
PIPE	0.265857***	0.103887	2.559103
COASTIN	0.537391***	0.067892	7.915393
BERTH	-0.32443*	0.200499	-1.61812
BERTH(-1)	0.379989*	0.273411	1.389806
BERTH(-2)	0.529783**	0.300914	1.760582
BERTH(-3)	-0.30181*	0.186089	-1.62185
R-squared	0.996889	Schwarz criterion	-1.29954
Adjusted R-squared	0.996082	Hannan-Quinn criter.	-1.53233
Log likelihood	36.96332	F-statistic	1235.881***

(4) Test of partial correlation coefficient

In this paper, the autocorrelation test of the model is performed by calculating the partial correlation coefficient. It can be seen from Figure 1 that the PAC value of the residual lag variable is low, and they are all controlled within the dotted line, so it can be determined that the model does not have autocorrelation.

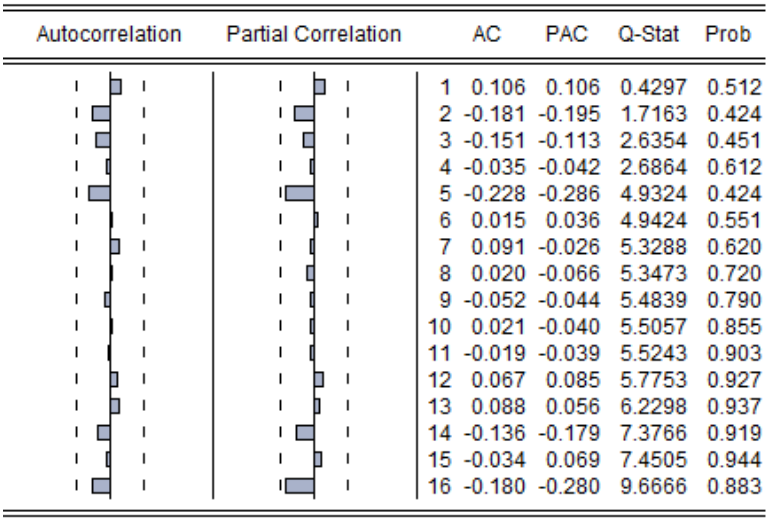

Figure 1 Test results of partial correlation coefficient

(5) ARCH Test

Heteroskedasticity not only exists in cross-sectional data, but also causes the

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same problem in time series. This article uses the ARCH test method (autoregressive conditional heteroscedasticity test), assuming 5 periods of lag to construct the auxiliary regression function of the residuals:

$$e_t^2 = a_0 + a_1 e_{t-1}^2 + a_2 e_{t-2}^2 + \cdots\cdots + a_5 e_{t-5}^2$$

From the auxiliary regression model, R^2=0.1089 can be obtained, and the goodness of fit is low, indicating that the auxiliary regression model on the residual e_t has a weak interpretation of the sample (see Table 4). The corresponding P=0.71>0.1 of the statistic F means that the model passes the significance test, that is, the null hypothesis H_0 is accepted: the original model does not have heteroscedasticity.

Table 4 ARCH Test Results

Variable	Coefficient	Std. Error	t-Statistic
C	0.006716	0.003689	1.820446
RESID^2(-1)	-0.027285	0.219115	-0.124525
RESID^2(-2)	0.337527	0.217779	1.549861
RESID^2(-3)	-0.132265	0.228486	-0.578873
RESID^2(-4)	-0.131073	0.217146	-0.603616
RESID^2(-5)	0.088519	0.218452	0.405213
R-squared	0.108889	Mean dependent var	0.00763
Adjusted R-squared	-0.076759	S.D. dependent var	0.012263
Log likelihood	91.70476	Akaike info criterion	-5.713651
F-statistic	0.586536	Schwarz criterion	-5.433411
Prob(F-statistic)	0.710132	Hannan-Quinn criter.	-5.624

(6) Result Analysis

After the above-mentioned Almon parameter estimation, VIF test, stepwise regression method modification, ARCH test and partial correlation coefficient test, the final measurement model of China's total import and export volume can be obtained:

$$\begin{aligned}\ln MX = {} & 0.0334 + 0.2983 \ln INROU + 0.2659 \ln PIPE + 0.5374 \ln COASTIN \\ & + 0.1272 \ln BERTH - 0.3244 \ln BERTH(-1) + 0.2835 \ln BERTH(-2) \\ & + 0.1402 \ln BERTH(-3) + e_t\end{aligned}$$

From the results of the regression, civil aviation international routes, oil and gasoline pipelines, terminal berths, and coastal investment and construction will all play a positive role in promoting the development of China's international trade. However, since terminal berths actually undertake the task of transporting import and export commodities, certain Time, so only berths that lag behind by two and three years can actually increase the international transportation capacity and promote the growth of China's import and export trade.

According to the parameters of the explanatory variables, every time the coastal

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construction investment increases by 100 million yuan, China's total import and export trade will increase by 537.4 million yuan, which is the largest stimulus for China's international trade among all the explanatory variables. This is because the geographical location and policy conditions of the coastal areas are unique. They are the earliest areas in China to reform and open up, and they are also the areas where China is most closely connected with the world economy. Foreign investment is an extremely important part of coastal construction investment, which directly promotes the rapid development of coastal cities, and even has an impact on economic growth that exceeds the impact on capital stock itself. The investment in Ningbo Zhoushan Port has made it the largest port in the world. It is expected that the cargo throughput will reach 817,000 TEUs, and the railway design capacity will reach 432,000 TEUs. This will greatly improve China’s shipping capacity. Lay the foundation for further expansion of the scale of international trade. It can be seen that further opening up coastal areas, strengthening coastal investment, and improving regional transportation infrastructure are of great significance to China’s transformation from a “big country” in world trade to a “power” in trade.

From the empirical results, the short-term impact multiplier of berths in major coastal ports is 0.1272, which reflects that the actual effect of the berths on stimulating import and export trade after the completion of the current period is weak. The long-term multiplier is 0.2265, which means that the lag effect formed by the berths will promote China's international trade more obviously in the long term. The construction of transportation infrastructure, especially large-scale fixed asset investment such as ports, has a lagging effect on promoting trade growth and economic development. In the short term, it may face the problems of large capital investment and low profitability. However, as the port and the outside world The establishment of effective communication channels and the improvement of supporting facilities such as port pipelines and outbound highways will continue to show economic benefits, and the marginal contribution rate will gradually rise.

In addition, international routes and pipeline transportation also have an important impact on China's imports and exports. The opening of air routes has strengthened the close ties between China and the world, especially the strengthening of aviation cooperation with developed countries such as the United States, the United Kingdom, and Germany, which are far away, will greatly improve the efficiency of trade information transmission and promote enterprises to establish closer partnerships. relationship. From a geographical perspective, pipeline transportation lays the foundation for China to strengthen trade cooperation with Northeast Asia, Central Asia, and West Asia, promotes the development of the “Belt and Road” in depth, amplifies the economic effects of energy, and promotes the common development of countries along the route through energy trade.

4. Policy recommendations

Based on the above research conclusions, this article puts forward four suggestions:

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First, increase investment in coastal areas, improve transportation infrastructure, and establish a comprehensive transportation system in line with international standards. The research in this paper shows that coastal investment has a more obvious driving effect on China's import and export trade, and it is the frontier of China's international transportation. Port construction in the Bohai Rim, the Yangtze River Delta, and the Guangdong-Hong Kong-Macao Greater Bay Area can be strengthened to create a modern international port. Promote the construction of the Asia-Europe railway, open up land transportation channels to form complementary advantages with coastal shipping, and strengthen the economic ties between China's coastal Asia and Europe, and increase China's total import and export trade.

Second, build a comprehensive port and promote the relocation of berths, navigation channels and docks. With the development of international trade, the port is not only required to transport import and export goods, but also to undertake the functions of commerce, integrated logistics, and international trade logistics. The relocation of berths is to meet the needs of large-scale international ships, reduce the time for ships to enter and exit the channel, reduce the amount of channel dredging, and improve port traffic efficiency. On the other hand, the expansion of ports in the economic hinterland such as Tianjin Port, Shanghai Port, Ningbo Zhoushan Port, etc., promote the professionalization of terminals, upgrade loading and unloading equipment, and continue to adapt to China's growing import and export needs. In the process of research, we found that the impact of ports on international trade has a time lag effect. Therefore, it is necessary to make reasonable predictions on the local future economic and trade demand and transaction volume, and rebuild the ports in advance to adapt to the possible increasing international cargo volume.

Third, open up international routes and improve international air transportation capabilities. Information is extremely important in international trade. Whether companies of the two countries can establish economic partnerships to carry out trade depends largely on whether the companies of the two countries can communicate effectively. The development of aviation technology has played a vital role in promoting the transmission of trade information. Therefore, opening up international routes and increasing international flights can promote Chinese companies to develop more extensive international trade communications. Under the premise of establishing economic and trade relations, the increase in international routes has expanded the supply of air transportation, objectively reduced transportation costs, reduced the transaction costs of international trade, and stimulated imports and exports.

Fourth, increase investment in pipeline facilities to improve China's pipeline transportation capacity. China's per capita energy consumption is relatively low, and a large number of strategic energy materials such as oil and natural gas need to be imported. On the one hand, relying solely on sea or air transportation does not have the transportation conditions, on the other hand, the transportation capacity is limited and cannot afford the huge import demand for energy. Therefore, it is necessary to expand pipelines, use multiple lines to spread the pressure of energy imports, and increase potential capacity to lay the foundation for China to strengthen energy trade with North Asia, Central Asia, and West Asia.

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