Frontiers in Traffic and Transportation Engineering (2022)
Clausius Scientific Press, Canada

DOI: 10.23977/ftte.2022.020104
ISSN 2616-2334 Vol. 2 Num. 1

Land Transportation Construction and Foreign Trade: Take Shandong Province of China as an Example

Zhongyi Li*, Shuaiqi Wang

Shandong Women's University, Economy University, Jinan, Shandong, China
**Corresponding author*

Keywords: Foreign Trade, Land Transportation Construction, Highway Construction, Railway Construction, Co-integration Test

Abstract: The 19th National Congress of China put forward the major strategic decision of "transportation power", Shandong Province took the lead in pilot work under this background. This paper examine the impact of land transportation construction on foreign trade in Shandong Province using the time series of Shandong Province from 1999 to 2020 to. The correlation test is conducted by ADF test, cointegration test, Granger causality test and impulse response function based on the construction of the VAR model. The empirical results show that there is a long-term equilibrium relationship between land transport construction and foreign trade, and there is a two-way Granger causality between them. Compared with railway construction, road traffic construction has a greater effect on trade promotion. The research results provide empirical evidence from different perspectives for the relevant research of land transport construction, and also have important practical significance for China to promote high-quality trade development.

1. Introduction

The construction of transportation infrastructure is the fundamental condition of a country's economic development. As the most populous country in the word, transportation construction is of vital significance to China's economic development, people's livelihood and trade development. China's transport facilities construction has developed rapidly, and its transport infrastructure construction has achieved leapfrog development in the past 60 year. A comprehensive transport network mainly composed of roads, railways, air and water transport has taken shape, enabling China to carry more than 3 billion passengers annually during the Spring Festival. China has also had its share of sad transportation history. 400,000 people were stranded at Guangzhou Railway Station during the 2008 Spring Festival travel rush. Since then, China has expanded its transportation infrastructure and become a major transportation country. In today's society, the developed economic level has higher requirements for infrastructure, and the perfect infrastructure plays a huge role in promoting the construction of social harmony and stability, the enhancement of national strength and the improvement of national quality. The 19th National Congress also put forward the major strategic decision of "transportation power", and put transport infrastructure development in a more important position.

When China launched reform and opening-up in 1978, China's total import and export trade was

only $20.64 billion. China's total import and export volume in 2021 has reached $6.06 trillion, a 30% year-on-year increase and nearly 294 times that of 1978.There are many factors affecting foreign trade. The level of international trade, foreign direct investment, urbanization level, environmental regulation and labor force all affect the trade process. However, trade cost is an important factor affecting import and export trade. Trade development should be carried out on the basis of adapting to national conditions. For landlocked countries, trade transport depends more on railway transport and road transport, while coastal countries mainly rely on water transport, high-cost air transport and pipeline transport. China is located by the sea and deep inland, among which Shandong Province is not only wedged into the land, but also a protrusion into the sea. Shandong also has four ports, including Qingdao, Weihai, Yantai and Rizhao. As a large economic province in China, Shandong attaches great importance to the construction of transportation infrastructure. Shandong implemented the reform plan as soon as possible in response to the national traffic requirements, and initially realized the spatial interconnectivity of sea, land and air traffic areas. Shandong has basically formed the trunk network of all levels of highways and provincial trunk roads, and continuously improved the high-speed rail, expressway and expressways in various cities. During the "14th Five-Year Plan", Shandong Expressway Group successfully won the "opening battle". Shandong Expressway became the first in China and created eight "National best". For example, the pilot project of "Reconstruction and Expansion + Smart Highway", which is the largest and longest in China, and the first pilot project of smart highway in Shandong Province -- the smart highway from Tai'an to Zaozhuang section of Beijing-Taiwan Expressway. Therefore, this paper examines the relationship between transportation infrastructure construction and import and export trade, and puts forward relevant countermeasures and suggestions, which is of great significance for the future construction of transportation infrastructure and the development of import and export trade in Shandong Province.

2. Review of the Literature

In the process of global economic integration, transportation conditions are very important. Many scholars have researched on transportation conditions. For the relationship between transport and trade, Min and Ye (2020) examined the relationship between transport and foreign trade by using panel data of 41 cities in the Yangtze River Delta, and the results showed that transport construction was positively correlated with foreign trade [1].As for the causal relationship between transport and foreign trade, some scholars have conducted relevant studies. At the national level, Stone and Strutt (2010) conducted an empirical study using trade data of 18 products in 6 countries, and the results showed that a country's improvement was conducive to promoting its foreign trade [2].Behrens (2011) analyzed the relationship between trade volume and transport cost with national data and found that transport cost played a key role in trade flow [3]. Fujimura and Edmonds (2006) conducted an empirical test with the trade data of countries in the Mekong River basin, and the results showed that the level of transport infrastructure construction in the Mekong River basin has a positive influence on the trade of main commodities [4].Fu and Zhu (2020) found that the improvement of transportation infrastructure between China and its trading partners is conducive to the development of trade scale [5]. At the provincial or city level, Jia (2016) examined the impact of transport infrastructure on trade using the data of the five northwestern provinces along the "Belt and Road" of China, and the results showed that the mileage of railway, road and air in the five northwestern provinces had a positive effect on import and export trade[6].Dai and Liu (2019) concluded that highway construction can shorten the actual transport distance of import and export trade using panel data of 20 Chinese cities, and then highway development has a positive role in promoting the city's foreign trade by reducing costs and increasing profits[7].

The above domestic and foreign scholars have studied the relationship between traffic

construction and trade at the national level, provincial level and city level, but there is a lack of research on traffic in the eastern coastal areas, especially the research on cities connecting the ocean and inland. This paper takes Shandong Province as an example to study the impact of land transport on foreign trade, which is helpful to find out the problems and deficiencies in the construction of land transport, clarify the future development direction of transport construction and the measures to be designated in the face of problems. It is of great significance to promote the coordinated development of transport and foreign trade between countries and regions.

3. Current Situation Analysis

3.1 Current Situation of Land Transport Construction

Trade costs are related to transportation costs, improving transportation network is conducive to reducing transportation time and trade costs. In order to better understand the land traffic situation of Shandong Province, this paper calculates the highway mileage and railway mileage in Shandong Province from 1999 to 2020.As can be seen from Figure 1, the railway mileage in Shandong Province is on the rise as a whole, which was relatively stable from 1999 to 2002 and grew slowly from 2003 to 2008. After 2008, the growth rate of railway construction in Shandong Province accelerated, which indicates that Shandong Province focused on economic construction and trade, and attached importance to railway construction after China's accession to the WTO.

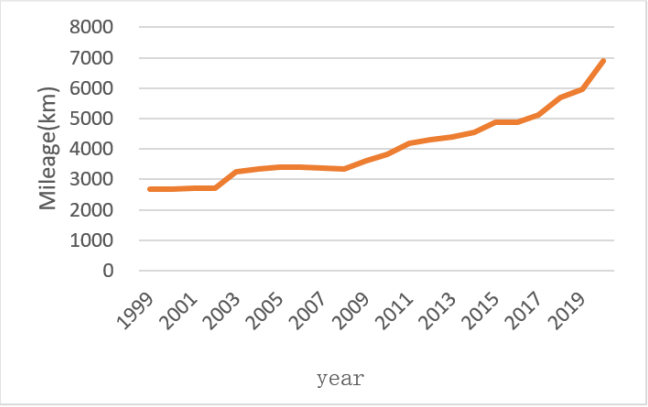

Figure 1: Railway mileage in Shandong

As can be seen from Figure 2, the overall road construction in Shandong Province rose slowly from 1999 to 2005, and the road construction made a rapid progress with an annual growth of nearly 140,000 km in 2005. The highway construction showed a rapid growth trend after 2006.The railway in Shandong Province takes Ji-Qing City as the center, forming a railway network spreading around. The Ji-Qing high-speed Railway and Weilai high-speed railway have been built successively, narrowing the distance between regions and forming a stable freight railway network. During the 14th Five-Year Plan period, Shandong Provincial Department of Transport has increased the speed of construction. The provincial traffic construction plans to invest 86.15 billion yuan, of which 80.7 billion yuan is planned to be invested in expressway construction, and 391 kilometers of new high-speed mileage will be opened to traffic.

From the comparison between highway and railway, highway mileage is much greater than railway mileage. This is because the coverage of highway is wider than that of railway, and the construction of railway is more difficult, which is greatly affected by weather, terrain, labor force, construction investment and other factors. Compared with railway construction, the construction of highway is less difficult. In addition, the road is more suitable for connecting short distance between

regions and the total mileage demand is large, while the railway is connected to the longer distance areas and the total mileage demand is smaller, so the growth of the road mileage is more than the railway.

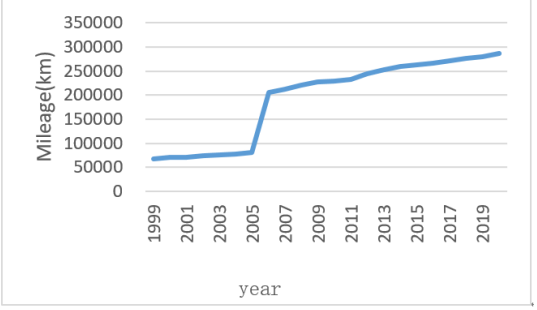

Figure 2: Highway mileage in Shandong Province

3.2 Current Situation of Foreign Trade

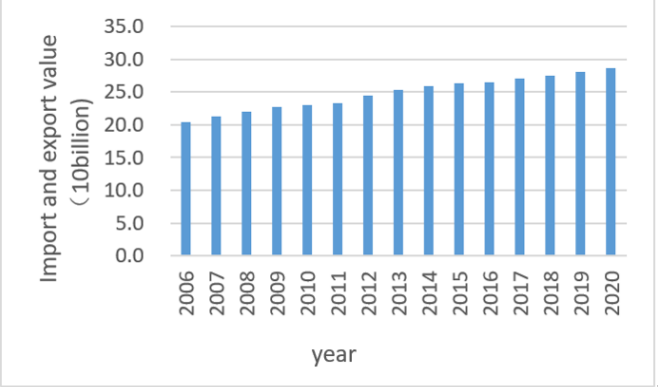

Figure 3: Trade volume in Shandong Province

After joining the WTO, China's trade opening has increased. In the face of a better trade environment, Shandong seized the opportunity to take advantage of its many coastal ports, coastal location, inland links, close to Japan and South Korea and other advantages to speed up the opening up. As can be seen from Figure 3, the trade volume of Shandong Province maintained a continuous rising trend during 2006-2020, and the trade scale constantly hit a record high. The foreign volume of Shandong Province reached $287 billion in 2020, and the growth rate ranked the fourth among the top 10 foreign provinces in China (a year-on-year growth of 7.5%).With the development of trade, the trade scale of three "economic circle “in Shandong Province has increased rapidly including the Provincial Capital Economic Circle (Jinan City, Zibo, Tai 'an City, Liaocheng City, Dezhou City, Binzhou City, Dongying City), Jiaodong economic circle (Qingdao City, Yantai City, Weihai City, Weifang City, Rizhao City) and Lunan Economic Circle (Linyi City, Zaozhuang City, Jining City, Heze City). Among the three major economic circles, the total trade volume of the Jiaodong Economic Circle accounted for the highest proportion, with the trade volume of Jiaodong Economic Circle accounting for 64.4% of the total trade volume of Shandong Province in 2020, while Lunan Economic Circle had the highest growth rate, with a growth rate of 3.3% in 2020.

4. Empirical Analysis

4.1. Econometric Model

In order to examine the relationship between land transport construction and foreign trade a linear regression model is constructed in this paper, which is as follows:

$$\ln FT = \alpha_1 + \alpha_2 \ln RM + \alpha_3 \ln HM + \varepsilon (1)$$

Where FT represents the total volume of Shandong Province and is the explained variable in this paper. RM represents railway construction mileage and HM represents highway construction mileage, both of which are core explanatory variables. Three variables are logarithmically processed. ε is a random error term.

4.2. Data Selection and Descriptive Statistics

This paper adopts the data of Shandong time series from 1999 to 2020 to examine the relationship between land transport construction and foreign trade. The data of railway mileage, highway mileage and trade volume are all from Shandong Statistical Yearbook. Descriptive statistics of specific data are shown in Table 1.

Table 1: Descriptive Statistics

Variable	Observations	Average	Minimum	Maximum
Foreign trade (lnFT)	22	16.317	14.418	17.276
Railway mileage(lnRM)	22	8.270	7.89	8.836
Highway mileage (lnHM)	22	12.033	11.125	12.566

4.3. Empirical Analysis

4.3.1. Unit Root Test

This paper analyzes the relationship between land transport construction and foreign trade, and specifically studies the long-term and short-term relationships among variables as well as their causal relationships using the time series data of Shandong Province from 1999 to 2020. In order to prevent the non-stationarity of time series data from leading to pseudo-regression, ADF unit root was used to test the stationarity of variables lnFT, lnRM and lnHM. The test results are shown in Table 2.

Table 2: Results of Unit Root Test

Levels	ADF	critical value (5%)	First differences	ADF	critical value (5%)
lnFT	-0.932	-3.600	DlnFT	-4.435	-3.600
lnRM	-1.464	-3.600	DlnRM	-3.995	-3.600
lnHM	-1.452	-3.600	DlnHM	-4.431	-3.600

It can be seen from Table 2 that the ADF values of lnFT, lnHM and lnRM are all greater than the MacKinnon critical value at the 5% level, indicating that these three variables are non-stationary data. The first-order difference of time series lnFT, lnRM and lnHM is denoted as DlnFT, DlnRM and DlnHM respectively. The ADF values of DlnFT, DlnRM and DlnHM are all lower than the MacKinnon critical value at the 5% level, indicating that these variables are first order co-integration, that is, I(1).

4.3.2. Cointegration Test

In order to further reflect the short-term and long-term equilibrium relationship between variables, Johansen test was used for co-integration test. The lag order of the Var model should be determined by the lag order test before the Johansen co-integration test. The lag order test results show that the lag order is 3 based on the SBIC criterion. Next, the Johansen co-integration test is conducted and the results were reported in Table 3.

Table 3: Results of Johansen Test

Rank	eigenvalue	Trace statistic (preh.)	5%critical value
0	.	35.2853	34.55
1	0.75225	8.7740*	18.17
2	0.35705	0.3820	3.74

The results of Johansen test indicate that there is a co-integration relationship between highway mileage, railway mileage and international trade, which indicates that there is a long-term stable relationship between the three variables.

In order to test the short-term fluctuation relationship between the variables, the following vector error-correction model (VECM) is established:

$$\mathrm{DlnFT} = 4.31 + 0.43\mathrm{DlnRM} + 1.29\mathrm{DlnHM} \quad (2)$$

According to the above model, railway mileage and highway mileage have a positive impact on foreign trade. The short-term elasticity of railway mileage is 0.43, which means that every increase of one unit of railway construction in Shandong Province will increase foreign trade by 0.43 units. The short-term elasticity of road mileage is 1.29, which means that each additional unit of road construction in Shandong Province will increase foreign trade by 1.29 units. The short-term effect of road construction on trade is greater than that of railway construction.

4.3.3. VECM Stability Test

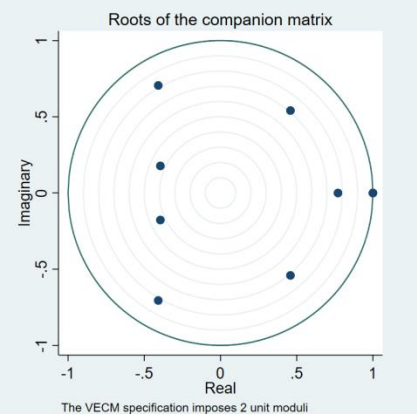

Figure 4: VECM Stability Test

The above research shows that there is a positive long-term equilibrium relationship between road and railway mileage and trade as well as between railway mileage and trade. In order to study the dynamic impact between the variables, VECM model stability test was carried out. As shown in Figure 4, except for the unit root assumed by VECM itself, all eigenvalues of the adjoint matrix are located in the unit circle, indicating that the established VECM model is stable and can be used for Granger causality test and impulse response analysis.

4.3.4. Granger Causality Test

Granger causality test was conducted on variables lnFT, lnRM and LnHM based on the VAR model, and the results were shown in Table 4. It can be seen from Table 4 that trade Granger causes road mileage and railway mileage Granger causes trade, that is, a mutual Granger causality. The results indicate that land transport construction and import and export trade are mutually promoting.

Table 4: Results of Granger Causality Test

Null hypothesis	P-value	Result
lnFT do not Granger-cause lnRM	0.045	Rejection
lnRM do not Granger-cause lnFT	0.062	Rejection
lnFT do not Granger-cause lnHM	0.019	Rejection
lnRM do not Granger-cause lnFT	0.000	Rejection

4.3.5 Impulse Response Function

The purpose of impulse response analysis is to study the impact of the error term changes or a variable is affected by some external impact on other variables in the system. The above research shows that there is a positive long-term equilibrium relationship between railway construction, highway construction and foreign trade. In order to study the dynamic impact between the three variables, the of impulse response function curve based on the VAR model established above is drawn. Figure 5 is the impulse response function curve.

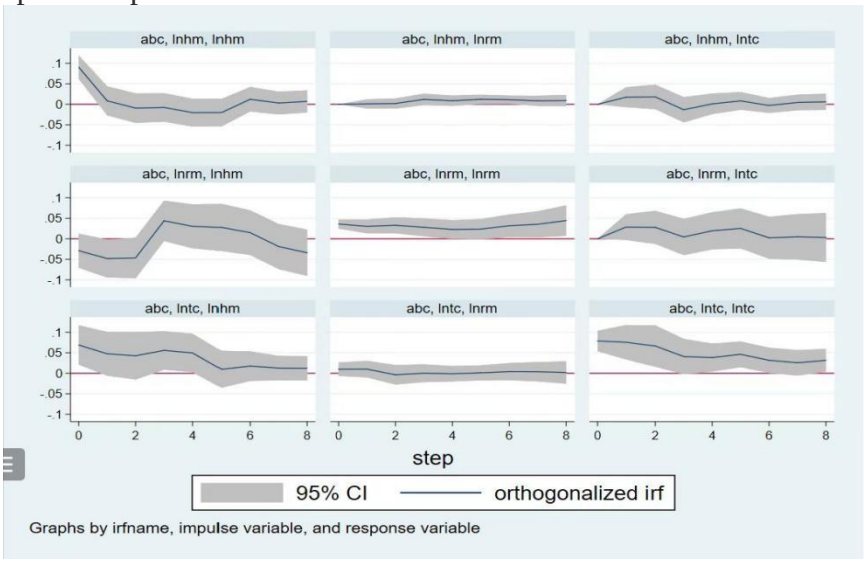

Figure 5: Impulse Response Function Curve

(1) When an external impact is given to railway construction, the impact on highway construction is that the impact of railway construction is the largest in the first phase and starts to decline, and then remains stable after the increase in the second phase. When an external impact is given to railway construction, the impact on highway construction is not obvious. When an external impact is given to railway construction, trade is affected by an upward trend, a decline in the second phase, and a steady trend after the fourth phase. This shows that the development of highway traffic has a certain positive effect on the influence of trade and railway traffic.

(2)When the railway mileage is given an external impact, the road construction is greatly affected, which decreases first to the second phase of rapid growth and then steadily decreases. The overall effect is negative, indicating that the development of road traffic will slow down the development of

railway traffic to a certain extent. When the railway mileage is given an external impact, the influence of railway mileage itself is slightly decreased, but steadily increased after the fifth stage, which is a significant positive influence. When an external impact is given to the railway mileage, the import and export trade fluctuates first and then becomes stable at last, showing a positive impact. This indicates that railway construction has a significant role in promoting trade.

(3)When an external shock is given to trade, the road construction is affected by the continuous decline of road construction, and then tends to be stable, showing the impact is also positive. When an external shock is given to trade, the railway mileage is affected by a small decrease, after a slight increase and stable. When an external shock is given to trade, the impact on trade itself is that trade gradually declines in the current period, slowly picks up in the third period, and then declines and rises again, showing a positive impact on the trade. This shows that the development of import and export trade will promote the development of provincial highway and railway traffic.

5. Conclusions

This paper uses ADF test, Johansen test, error correction model and impulse response analysis to examine the relationship between land transport and foreign trade based on the time series of Shandong Province from 1999 to 2020.The results are as follows:

(1) There is a long-term stable relationship between highway mileage and railway mileage and their foreign trade, that is, there is a co-integration relationship between these three variables.

(2) Highway mileage and railway mileage have a positive impact on the foreign trade in Shandong Province. The increase of highway mileage and railway mileage promotes the improvement of foreign trade, and highways have a bigger impact on trade than railways.

(3) From the perspective of impulse response function, the impact of the development of foreign trade in Shandong Province on the highway and railway traffic was more or less decreased in the early stage, and then gradually recovered to be positive, indicating that the development of the total distance of highway and railway in a short time is conducive to the development of the foreign trade in Shandong Province.

The following revelations are obtained based on the research of this paper:

The government should reasonably construct all kinds of , take into account their complementarity, coordinate the construction of all kinds of , further strengthen the transportation network, effectively improve the construction level of "four good rural highways", and constantly deepen the construction of rural highway management and maintenance system during the 14th Five-Year Plan period of China. The government will formulate corresponding development measures for each prefecture-level city and consider the construction and development of transportation in the early, middle and late stages, and combine them to play their respective roles. For Qingdao City, Yantai City, Weihai City, Rizhao City and other port cities, the government should give full play to the advantages of port cities, increase the development of sea transportation on the basis of land transportation, and jointly promote foreign trade. For inland cities, the Jiqing urban rail transit network should be continuously improved, and the existing highways, national highways, provincial highways and other land areas should be upgraded and widened to lay a solid foundation for the construction of a comprehensive hub system. These policies help to realize the seamless connection of different modes of transportation at the same time, further improve the throughput of goods, reduce the transportation cost of trade.

In addition, the government attaches great importance to the development of foreign trade. It is necessary to strengthen the trade with neighboring countries, and ensure the development of foreign economy as much as possible, and improve the political stance in the development of foreign trade. The government further clarified the work arrangement of speeding up the pilot construction of the

transportation power, and promoted the construction of the trade power by focusing on the work and combining the construction of the transportation power.

References

[1] Min, S and Ye, C. (2020). The Impact of Construction on Foreign Trade in the Yangtze River Delta. Journal of Tongling College, 5, 8-13.

[2] Stone, S. and Strutt, A. (2010) Transport and Trade Facilitation in the Greater Mekong Subregion. Trade Facilitation and Regional Cooperation in Asia. Cheltenham: Edward Elgar Publishing.

[3] Behrens, K. (2011) International Integration and Regional Inequalities: How Important Is National? The Manchester School, 5, 952-971.

[4] Fujimura, M. and Edmonds, C. (2006) Impact of Cross-border Transport on Trade and Investment in the GMS.ADB Institute Discussion Paper, 48. 87-91.

[5] Fu, X. and Zhu, X. (2020) The impact of China's Transportation Investment on International Trade - an Inter-provincial Panel Data-based Test. Economic Research Reference, 3, 97-109.

[6] Jia, T. (2016) The Relationship Between Transportation Construction and Foreign Trade in Five Provinces in Northwest China Under the Context of "One Belt, One Highway" an Analysis of Eviews-Based Data Model. Journal of Chifeng College (Natural Science Edition), 21, 57-59.

[7] Dai, X. and Liu, N. (2019) Can Highway Construction Boost Foreign Trade? --Evidence from a Panel of 20 Chinese Cities. Beijing-Tianjin-Hebei Free Trade Zone Construction Workshop - 5th Public Policy Think Tank Forum.