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Relationship Between Dry Ports and Regional Economy: Evidence from Yangtze River Economic Belt*

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Abstract

With the evolution of containerization and globalization of supply chains, aspects of port functions have made the transition from the sea to the inland region that forms the dry port. To explore the relationship between dry ports and regional economic development, this study uses a gravity model and forecast model to analyze 1,040 observations in 104 cities (22 dry port cities) along the Yangtze River Economic Belt (YREB) from 2008 to 2017. The model includes economic variables, logistics variables, foreign relations variables, and human capital variables. It was found that the dry port is positively correlated with trade volume. Compared with a city without a dry port, the trade volume of a city with a dry port will increase 0.099 times. It can be concluded that a dry port is crucial for the economic development of the YREB. It was also found that per capita GDP as an economic variable, road area and rail number as logistics variables, and foreign relation variables are positively correlated with trade volume, while the human capital variable has no significant effect on trade volume. In addition, governmental policy implications are addressed from the aspects of dry port and industry cluster caused by foreign investment.

Keywords: Dry Port, Regional Economic Development, Gravity Model, Forecast, Yangtze River Economic Belt, China

JEL Classification Code: L92, O18, P33, R41

1. Introduction

The development of containerization and supply chain globalization has promoted the growth of trade and has also led to an increase in the demand for transportation services and transportation facilities. At the same time, with the expansion of the scale of container ships, the space for saving costs through maritime transportation has gradually become smaller. Thus, optimizing the transportation efficiency of the hinterland has become the core issue for optimizing the entire maritime logistics chain (Rodrigue & Notteboom, 2009; Stopford, 2008). At the same time, due to the needs of inland regional economic development, all aspects of the port's functions have transitioned from the sea to the inland region to forms the dry port.

It has been nearly 20 years since the construction of China's first dry port, in 2002. Due to the overlapping competitive pressures of inland and neighboring ports, inland regions have shown great interest in inland ports, intending to improve the competitiveness of their local economies (Monios & Wang, 2013).

Pettit and Beresford (2010) proposed that the development of dry ports was consistent with the strategy of Go West, introduced in 2000, which could improve regional economies in the west of China. Dry ports are situated in inland areas and mainly act as freight distribution centers, temporary warehousing facilities, customs clearance, and container depots to relieve seaport congestion, reduce environmental pollution, and improve the efficiency of transport (Pettit & Beresford, 2010; Roso, Woxenius & Lumsden, 2009; Stopford, 2008). Except for being inland

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freight terminals for seaports, dry ports also act as starting points of cross-border land transportation for inland regions to improve service to shippers, generate new employment sources, and promote the regional economic development.

In China, concerning the current status of dry ports, there are three dry port groups: the northeast dry port group, led by Tianjin and Dalian; the middle-east dry port group, along the coastal areas of Jiangsu and Zhejiang provinces; and the southeast dry port group, led by Guangzhou (Wang, Chen, & Huang, 2018). The existing forms of dry port operators include a state-owned entity, a bridge organization of municipal government, and a privately-owned logistics company (Beresford et al., 2012). However, there are some challenges of dry port development in China. For example, Zeng et al. (2013) stressed that dry port development and operations required the coordination of many actors such as port authorities, terminal operators, rail operators, land developers, and so on. However, a lack of coordination and uncertainty and subsequent risk in investing in dry ports exist. Li, Dong, and Sun (2015) stressed that, in China, the development of dry ports lacks strategy linkage with the local economy development and insufficient investment due to no profits in the short term. Meanwhile, they summarized the strategic directions of dry ports' development in China. First, dry ports will evolve from being container centers to cargo centers to logistics bases. Second, based on the logistics base, dry ports will realize the evolution from a port industry area to a regional logistics center. Third, dry ports will develop from a regional logistics center to a new urban area for regional development. According to the above studies, it can be concluded that dry port strategy cannot promote the local economic development in a short enough time-period to attract investment from local governments. To offer policy implications for governments, our study intends to take one of the most active economic belts in China' Yangtze River Economic Belt (YREB) as an example to explore the relationships between dry ports and the regional economic development.

The YREB covers 11 provinces/municipality, namely, Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Yunnan, and Guizhou, and owns seven seaports, 61 river ports, and 26 dry ports, which improve both the connectivity among regions and efficiency of logistics and thereby promote economic development. The YREB, connecting the most fertile coastal areas in the southeast and the underdeveloped western regions, is an economic artery spanning different regions in the east and west of China. It plays an important role in promoting regional economic development by penetrating production factors of the developed southeast regions into the western regions, which could coordinate and balance economic development among regions and then narrow the regional gap between the poor and the rich. Moreover, the YREB is connected to two of the six economic corridors of the BRI named the China-Central South Peninsula and Bangladesh-China-India-Myanmar Economic Corridor to strive to connect the world, improve the efficiency of transportation, and further promote international trade and economic development. With the implementation of the Belt and Road Initiative (BRI), a dry port has the potential to connect to the Silk Road Economic Belt and the 21st-Century Maritime Silk Road (Wei, Sheng, & Lee, 2018). To verify the importance of dry ports for the development of the YREB, the gravity model will be applied to analyze their relationships.

The remainder of this study is organized as follows. Section 2 reviews the literature on dry ports. Section 3 introduces the gravity model applied in our study. Section 4 presents the empirical analysis results, and Section 5 concludes this paper.

2. Literature Review

2.1. The Concept of Dry Port

The theory of port evolution can be traced back to the anyport model proposed by Bird (1980). The study proposes that the evolution of the port will go through three stages – setting, expansion, and specialization. The anyport model summarizes the process of traditional ports from scratch, however, lacks a description of the hinterland, and the connectivity between the port and the hinterland has become an important measure of today's port competitiveness (France & Horst, 2010; Notteboom, 2005). Therefore, the concept of port regionalization arises at the historic moment. Monios and Wilmsmeier (2012) believe that the three stages of the arbitrary port model are the fourth stage of development, the stage of port regionalization. Specifically, driven by the market, the hinterland will form one or more distribution centers. The development of the port has changed due to the intensified competition in the marine transportation service market and the changes in the transportation service environment (Kim & Kim, 2020; Moldabekova et al., 2021; Rahman, 2018). Rodrigue and Notteboom (2010) proposed to incorporate the maritime operations part of the foreland of the seaport into the concept of port regionalization to realize the integrated operation of offshore operations, terminal operations, and hinterland operations.

Regarding the concept of dry ports, the increasing number of concepts to appear in the literature has rendered the understanding of dry ports rather vague (Cullinane, Bergqvist, & Wilmsmeier, 2012). Based on these existing concepts, Witte, Wiegmans, and Ng (2019) captured the broad understanding of dry ports in what follows:

"(a dry port is) an inland facility with or without an intermodal terminal and logistics companies, which is directly connected to seaport(s) with high-capacity transport mean(s) either via rail, road or inland waterways, where

customers can leave/pick up their standardized units as if directly to a seaport."

2.2. Function and Classification of Dry Ports

Although scholars have different explanations about the functions of inland ports, they have similar conclusions about the role of inland ports in the process of port regionalization. The inland port is an important support for the port to extend to the hinterland, and it is also a component of the port's regionalization. The specific manifestations are as follows: (1) Increases the cargo-handling capacity of the entire transportation system; (2) Expands the entire logistics area; (3) Makes the conversion of consolidation and distribution more flexible; (4) Is more conducive to the handling of empty boxes; (5) Is more friendly to the environment (Hanaoka & Regmi, 2011; Henttu & Hilmola, 2011; Iannone, 2013; Roso, Woxenius, & Lumsden, 2009).

First, Nguyen, and Notteboom (2019) concluded dry port classification. Among them, the most representative classification is proposed by [18]. Based on the distance between seaports and dry ports, they divided the latter into three categories – distant, mid-range, and close – and proposed their main different functions. Distant dry ports are located in the vicinity of end markets to consolidate or deconsolidate cargo. Mid-range dry ports function as consolidation points that are located immediately between end markets and seaports and generally covered by road and rail transport. Close dry ports, as extensions of seaports, are located close to seaports mainly to shift freight volumes, relieve seaport congestion, and improve the efficiency of goods handling in seaports. Except for the functional and distance perspective, Monios and Wilmsmeier (2012) divided dry ports into two categories – sea-driven and land-driven – by considering their respective orientations. The sea-driven ones can be considered as Outside-In-driven, and they are developed by maritime-related activities. The land-driven can be considered as Inside-Out-driven, and they are developed by regional economic development.

2.3. Location Selection of Inland Ports

Second, the location selection of dry ports is critical for improving transport efficiency, reducing environmental pollution, promoting regional economic development, and having effects on the competitive advantage of served hinterlands and port competitiveness (Zeng et al., 2013). Researchers establish models for a seaport by considering influential factors on dry ports to solve the optimal dry port location selection (Chang, Notteboom, & Lu, 2015; Ka, 2011; Li, Shi, & Hu, 2011; Nguyen & Notteboom, 2016; Van Nguyen et al., 2020; Wang, Chen, & Huang, 2018). For example, Ka (2011) listed transportation, economic level, infrastructure facilities, trade level, policy environment and cost as the determining factors for dry port location, and combined the methodologies of multi-criteria decision making (MCDM) and multi-attribute decision making (MADM) to make decisions on the dry port location of the New Eurasia Continental Bridges (NECB) in China region. Van Nguyen (2020) applied data mining and complex network to find optimal locations of dry ports in China under the BRI by mainly considering transactional databases and inland regions' foreign trade data.

2.4. Regional Economic Development

Some researchers discussed the dry port influences on transport costs, emission reduction, and regional economic development. For example, Cullinane, Bergqvist, and Wilmsmeier (2012) believe that the establishment of inland ports in the hinterland is an effective means to solve the contradiction between port congestion, regional economic development, and environmental protection. Yang, Luo, and Ji (2016) indicate that the construction of the transportation system in the hinterland of the port has played a positive role in enhancing the attractiveness of the port.

Henttu and Hilmola (2011) applied gravitational models to analyze how relative transport costs behave by increasing the number of dry port distribution locations in Finland and verified that Finland benefited from the dry port. Furthermore, it was found that implementing dry ports could decrease CO2 emissions Lättilä, Henttu, and Hilmola (2013). Similarly, Carboni and Orsini (2020) applied a simulation-based method to prove that dry ports have positive effects on emission reduction.

Referring to the relationship between dry ports and regional economic development, as Witte, Wiegmans, and Ng (2019) proposed, the economic dimension of dry port development has received relatively modest attention. However, Witte, Wiegmans, and Ng (2019) proposed that little systematic local and regional attention is conducted on the regional-economic dimension of dry port development. To fill this gap, considering the strong dry port development taking place in the YREB (Rodrigue & Notteboom, 2011) Monios 2013 as the largest economic zone with the greatest density, except for certain coastal areas in China our study intends to verify the importance of dry ports for the regional economic development of the YREB.

3. Methodology

3.1. Analysis Method

The gravity model has been widely applied to predict bilateral trade flows (Anderson, 2011). For example, Bensassi et al. (2015) use gravity model to evaluate the effects of improvements in logistics on Spanish regional exports. Wei, Sheng, and Lee (2018) collected the data of 39 dry ports in

the context of the BRI and applied the gravity model to verify whether dry ports have the potential to participate in the BRI. The model originates from Newton's Law of Universal Gravitation. It describes that particles in the universe are mutually attracted to each other in proportion to their sizes and distance. In economics, the basic gravity model for trade between two units (i and j) is described as follows.

$$X_{ij} = GS_i M_j \varphi_{ij} \quad (1)$$

where X_{ij} represents trade flow from unit i to unit j, G is the constant, S_i represents the total volume of exports that the exporter is willing to supply (e.g., GDP), M_j represents total demands from the importer (e.g., GDP), and φ_{ij} represents the degree of trade facilitation of exporter i entering into the market of importer j (e.g., distance). As Eq. (1) is not linear in parameter, the traditional approach to estimate the gravity model is based on a log-linear transformation of different versions of Eq. (1). The linear form is given by the following expression:

$$\ln X_{ij} = \ln G + \ln S_i + \ln M_j + \ln \varphi_{ij} \quad (2)$$

In our study, we intend to evaluate the impact of dry ports on the YREB, covering 104 analyzed cities. In our model, the distance is described as a straight-line distance between a city and the Yangtze River Estuary, which is measured by Google maps. Except for the variable of distance, other variables that also have an influence on trade facilitation, namely economic variables (Chang, Notteboom, & Lu, 2015; Ka, 2011; Rahman, 2003), logistics variables (Bensssi et al., 2015; Falzarano et al., 2007; Prasai, 2014; Zhang & Zhang, 2016), foreign relation variables (Bellos & Subasat, 2012; Hamada, 1974; Hegre, 2009), and the human capital variable, are considered (see Table 1). The natural logarithm of distance has been included as a proxy for transportation costs that has a negative effect on trade transportation, as expected. Apart from the distance, other coefficients that affect trade transportation are expected to be positive.

3.2. Variables

In terms of the above-mentioned indicators to measure the degree of trade facilitation, the augmented gravity model is as shown in eq. (3):

$$\begin{aligned} \ln X_{it} = {} & \beta_0 + \beta_1 \ln \mathrm{PGDP}_{it} + \beta_2 \ln \mathrm{HWFT}_{it} + \beta_3 \ln \mathrm{FDI}_{it} \\ & + \beta_4 \ln \mathrm{DEFT}_{it} + \beta_5 \ln \mathrm{DIFT}_{it} + \beta_6 \ln \mathrm{SCHOOL}_{it} \\ & + \beta_7 \ln \mathrm{ROAD}_{it} + \beta_8 \ln \mathrm{RN}_{it} + \beta_9 \ln \mathrm{DIS}_i \\ & + \beta_{10} \mathrm{TAX}_i + \beta_{11} \mathrm{DP}_i + \varepsilon_i \end{aligned} \quad (3)$$

where $\ln X_{it}$ denotes the logarithm of import and export volume of city i in the year of t.

$\ln \mathrm{PGDP}_{it}$ is the logarithm of per capita GDP of city i in the year of t.

$\ln \mathrm{HWFT}_{it}$ is the logarithm of highway and waterway freight traffic of city i in the year of t.

$\ln \mathrm{FDI}_{it}$ is the logarithm of foreign direct investment of city i in the year of t.

$\ln \mathrm{DEFT}_{it}$ is the logarithm of degree of dependence on export of city i in the year of t.

$\ln \mathrm{DIFT}_{it}$ is the logarithm of degree of dependence on import of city i in the year of t.

$\ln \mathrm{SCHOOL}_{it}$ is the logarithm of people in regular secondary schools of city i in the year of t.

$\ln \mathrm{ROAD}_{it}$ is the logarithm of the area of city i paved roads in the year of t.

$\ln \mathrm{RN}_{it}$ is the rail number of city i in the year of t.

$\ln \mathrm{DIS}_i$ denotes the distance from city i to Yangtze River Estuary.

TAX_i and DP_i are binary dummy variables, respectively denoting whether or not city i has a tax-protected zone or a dry port.

For a detailed list of variables' descriptions in equations, see Table 1.

4. Empirical Results

4.1. Data Collection

The YREB covers 26 dry ports. Due to the fact that Yiwu, Yuyao, Cixi, and Longquanyi are county-level city dry ports belonging to Jinhua, Ningbo, and Chengdu, 22 dry ports in prefecture-level cities will be considered (see Figure 1).

Since the world financial crisis broke out in 2008, the Shanghai Port began to carry out the dry port layout along the Yangtze River (Li, Dong, & Sun, 2015). Therefore, to evaluate the impact of dry ports on the economic development of the YREB and understand the impact comprehensively, data of 104 prefecture-level cities in the YREB from 2008 to 2017 will be selected from the Statistical Yearbook of Chinese Cities (see Table 1).

4.2. Main Results

Based on the model using panel data, we evaluate the impact of dry ports on the regional economic development of the Yangtze River by using Eviews 10.0. At the same time, we measure the influence of other logistics factors, foreign relation factors, and human capital factors on the import and export trade volume.

Table 2 shows the descriptive statistics of a log of variables and dummy variables. The total number of

Table 1: Variables' Description in Equations

Categories	Variables	Abbreviations	Unit
Economic variables	Import and export trade volume	*X*	USD
	Per capita GDP	PGDP	Yuan
Logistics variables	Highway and waterway freight traffic	HWFT	Tons
	Area of city paved roads	ROAD	Sq.m
	Rail	RN	No.
	Distance	DIS	Km
	Dry port	DP	/
Foreign relation variables	Foreign direct investment	FDI	USD
	Degree of dependence on export of foreign trade	DEFT	%
	Degree of dependence on import of foreign trade	DIFT	%
	Tax-protected zone	TAX	/
Human capital variable	People in regular secondary schools	SCHOOL	No.

Note: TAX and DP are binary dummy variables; therefore, their units are shown as /.

Figure 1: Analyzed Dry Ports Belonging to the YREB

Table 2: Descriptive Statistics of Variables

Variables		Obs	Mean	Std. Dev.	Min	Max
Log of import and export trade volume	$\ln X_{it}$	1040	5.28	0.84	2.50	7.68
Log of highway and waterway freight traffic	$\ln HWFT_{it}$	1040	4.00	0.39	1.26	5.47
Log of per capita GDP	$\ln PGDP_{it}$	1040	4.48	0.33	3.48	5.36
Log of foreign direct investment	$\ln FDI_{it}$	1040	4.48	0.73	0.48	6.51
Log of degree of dependence on export	$\ln DEFT_{it}$	1040	–1.17	0.60	–4.90	0.68
Log of degree of dependence on import	$\ln DIFT_{it}$	1040	–1.70	0.80	–5.63	0.69
Log of people in regular secondary schools	$\ln SCHOOL_{it}$	1040	4.63	0.55	2.36	5.99
Log of area of city containing paved roads	$\ln ROAD_{it}$	1040	0.48	0.06	0.28	0.63
Log of rail number	$\ln RN_{it}$	1040	0.40	0.26	0.00	1.11
Log of distance	$\ln DIS_{i}$	1040	2.87	0.38	1.40	3.45
Tax-protected zones	TAX_{i}	1040	0.13	0.34	0.00	1.00
Dry ports	DP_{i}	1040	0.21	0.41	0.00	1.00

observation values is 1040, taken from 104 cities in the past ten years. Except for observation value, the mean, standard deviation (Std. Dev.), and min. and max. of variables are calculated.

According to Table 3, it can be concluded that our target variable, the dry port, is positively correlated with the volume of import and export trade. If a city has a dry port, its trade volume will increase 0.099 times, meaning that dry ports are crucial for the economic development of the YREB. Apart from the dry port, the logistics variables of road area and rail number are positively significant with the volume of import and export trade. It is worth noting that if the log of area of city-paved roads is doubled, the city's trade volume will increase by 1.668 times. The influence of rail number on trade volume is lower than that of road area, which only makes a city's trade volume increase by 0.119 times when the log of rail number doubled. This finding can be explained by the condition of Chinese intermodal transport. In China, roads account for around 90% of container movements between seaports and the hinterland (Monios & Wang, 2013). In addition, the highway and waterway freight traffic are positively and significantly correlated with the import and export of foreign trade, which is consistent with the results of inter-country trade, indicating that the road transport and water transport in the YREB play an important role in international trade. Therefore, the infrastructure construction of logistics is conducive to improving the development of international trade so as to promote regional economic development. Besides, the logistics variable of distance is negatively significant with the trade volume, which is consistent with the expectation of the gravity model; in particular, when the distance from a city to the Yangtze River Estuary is doubled, the trade volume will decrease by 0.107 times.

With reference to the variables of foreign trade relations, we divided the degree of dependence on foreign trade into the degree of dependence on export and on import by considering some cities relying on export or import. The results show that both degrees of dependence on foreign trade are positively significant to the volume of import and export volume. Furthermore, it can be observed that the degree of dependence on export has a greater influence on trade volume than the degree of dependence on import. Specifically, a city's trade volume will increase by 0.546 times if the log of the degree of dependence on the export of foreign trade is doubled, while a city's trade volume will increase by 0.259 times if the log of the degree of dependence on import is doubled. Besides, foreign direct investment has a positive effect on the volume of import and export of trade – and if the foreign direct investment is doubled, a city's trade volume will increase by 0.039 times. If a city has tax-protected zone, the city's trade volume will increase by 0.103 times.

It is worth highlighting that the per capita GDP has an absolute effect on the volume of import and export of trade. If the per capita GDP is doubled, the trade volume will increase by 0.527 times. However, as a human capital variable, education level has no significant impact on the volume of import and export trade in the YREB.

4.3. Forecast of YREB

As a connection between the eastern coastal, central inland and western border areas, YREB plays an important

Table 3: Empirical Results on the Gravity Model

Variables		Coefficient	Std. Error	*t*-Statistic	Prob.
Log of highway and waterway freight traffic	$\ln HWFT_{it}$	0.204	0.024	8.417	0.000***
Log of per capita GDP	$\ln PGDP_{it}$	0.527	0.031	16.995	0.000***
Log of foreign direct investment	$\ln FDI_{it}$	0.039	0.019	2.068	0.039**
Log of degree of dependence on export	$\ln DEFT_{it}$	0.546	0.018	31.126	0.000***
Log of degree of dependence on import	$\ln DIFT_{it}$	0.259	0.013	19.750	0.000***
Log of people in regular secondary schools	$\ln SCHOOL_{it}$	0.043	0.024	1.833	0.067*
Log of area of city containing paved roads	$\ln ROAD_{it}$	1.668	0.262	6.369	0.000***
Log of rail number	$\ln RN_{it}$	0.119	0.033	3.618	0.000***
Log of distance	$\ln DIS_{i}$	–0.107	0.028	–3.879	0.000***
Tax-protected zones	TAX_{i}	0.103	0.025	4.094	0.000***
Dry ports	DP_{i}	0.099	0.019	5.208	0.000***
R-squared	0.928	*F*-statistic			1202.140
Prob (*F*-statistic)	0.000				

Note: * Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level.

role in coordinating the balanced development of the region. In addition, YREB connects two of the six major economic corridors along BRI, and it is of great significance to the development of border trade and international trade as well as the strategic layout of national development. Dry ports provide the point support for the connectivity of the YREB. To further analyze the development trend of YREB's regional economy and international trade and verify our empirical analysis conclusion, the AUTO-ARIMA model is used to forecast the GDP and total import and export volume of the YREB.

The ARIMA model requires the model residuals to be white noise. We conducted a white noise test through the *Q* statistic test that is the residuals have no autocorrelation. Combining the AIC information criterion (the lower the value, the better) and the *Q* statistics results, the model meets the requirements.

The forecasts of this study indicate that the annual growth rate of GDP and import and export volume in the YREB will continue to grow positively, but the growth rate will be lower than that of 2008–2017. The impressive growth of GDP and total imports and exports are forecast to reach 63 trillion and 2.5 trillion US dollars, respectively, in 2025). Despite the negative impact of the economic crisis and the epidemic crisis on the regional economy, YREB will continue to achieve overall economic development.

4.4. Policy Implications

This article empirically analyzes the relationship between the import and export volume of YREB and the independent variable. Then we forecast the trend of YREB's economic volume and import and export volume through the forecast model. According to the above empirical analysis and forecast results, policy implications are formulated as follows.

First, the improvement of logistics infrastructure could increase trade volume and then promote the economic development of the YREB. Therefore, it is necessary to further strengthen the logistics infrastructure construction of the YREB by increasing the allocation of dry ports scientifically and rationally; after all, only 22 dry ports exist among the 104 prefecture-level cities in the YREB. In addition, as the YREB covers the eastern, central, and western regions of China, the geographical advantage of dry ports is that they can be built in cross-border regions; therefore, how to distinguish and define the function of dry ports and select appropriate locations for them has become increasingly important. Considering the characteristics of regional segmentation and decentralized management, it is necessary to coordinate the relations between provinces and cities to discuss the construction of dry ports. Once cooperation is carried out among provinces and cities, it would provide a good opportunity for deep cooperation between the seaports

Table 4: Forecast Results of YREB

Year	GDP (Trillion)	Growth Rate (%)	Import And Export Trade Volume (Trillion)	Growth Rate (%)
2008	12.44	–	1.03	–
2012	22.76	11.27	1.59	5.7
2016	32.72	9.61	1.64	34.0
2019	45.59	7.77	2.03	0.2
2020	48.45	6.27	2.11	3.9
2021	51.55	6.40	2.20	4.3
2022	54.52	5.75	2.29	4.1
2023	57.56	5.58	2.38	3.9
2024	60.55	5.21	2.47	3.8
2025	63.58	4.99	2.56	3.7
Information criterion	AIC: 461.85		AIC: 450.08	
	BIC: 463.05		BIC: 451.54	
	Q-sta: 0.030(0.863)		*Q*-sta: 0.121(0.728)	

and cities with sufficient allocations of resources (Li, Dong, & Sun, 2015). Apart from the improvement of dry ports, strengthening the interconnection and intercommunication of road, railway, and water transportation are crucial to improve the transport efficiency so as to form the unique multimodal transport of the YREB. Because the sources of goods in the YREB mainly come from the inland areas, the improvement of multi-modal transportation and infrastructure connectivity of various transportation modes, including water transportation and land transportation, could give shippers more choices in terms of transportation mode according to the characteristics of goods to reduce the freight cost and improve the transportation efficiency and capacity.

Second, in terms of the foreign relation variables, which have positive effects on the volume of import and export volume, it is beneficial for regional economic development by implementing preferential policy to attract foreign direct investment and establish tax-protected zones in the YREB, including discounted land, tax deductions and inland port usage subsidy, especially for cities in the central and western regions of the YREB. For example, Jinhua inland port received 50% reductions on the purchase price of the land in 2002 and Quzhou inland port reduced its land purchase price by 38% in 2007 (Fujian Port Office, 2010). As costs in the southern, Pearl River region increased, some production moved to the YREB in central China. If the preferential policy for foreign direct investment is introduced, the formation and development of industry clusters would benefit from it. Meanwhile, the demand for raw materials, semi-finished products, and finished goods will increase as the industry develops, which will cause a great need for dry ports.

5. Discussion and Conclusion

The rise of dry port construction in the YREB provides the possibility for relieving the pressure on the seaport, improve the efficiency of the logistics supply chain and regional development. In our study, to evaluate the impact of dry ports on the economic development of the YREB, we collect the panel data of 104 prefecture-level cities from 2008 to 2017 and establish a gravity model by considering economic variables, logistics variables, foreign relation variables, and the human capital variable.

Through empirical analysis, we found that dry ports play an important role in the economic development of the YREB. The forecast analysis indicates that YREB's economy and foreign trade have a continuous positive growth. Meanwhile, economic variables have a positive significant influence on the volume of import and export trade in the YREB, logistics infrastructure variables such as the area of city containing paved roads and rail number have significantly promoted the import and export foreign trade of the YREB, and in foreign relation variables, the results show that both of the degrees of dependence on export and on import foreign trade are positively significant to the volume of import and export volume, while the human capital variable has no significant impact thereon.

Nevertheless, due to data limitations, we cannot analyze the impact of the dry port on the YREB directly and comprehensively by considering such factors as the size and freight volume of and the number of firms in the dry port. Because it is also difficult to collect the established time of all the dry ports along the YREB, we take the year of 2008

– the introduction of the Shanghai Port – to carry out the dry port layout along the Yangtze River and dry port as a dummy variable, without distinguishing each established time, and apply the gravity model to analyze the impact of dry ports on the economic development of the YREB. In the future, we intend to conduct surveys to investigate aspects of dry ports such as the categories and number of firms in a dry port and deeply explore their influences on regional economic development.

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