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Study on the Trade Impact of Transportation Infrastructure Construction on ASEAN Free Trade Area

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Abstract. The level of transportation infrastructure construction plays an increasingly prominent role in international trade. This paper chooses the cross-sectional data of ASEAN Free Trade Area in 2017 and introduces the variables of transport infrastructure on the basis of Trade gravity model to analyze the synergy between transport infrastructure and trade. It further analyzes the promoting role of Economic Integration. The empirical results show three aspects results. The first is that the boundary effect of ASEAN Free Trade Area ranges from 11 to 34. the second is there is a positive relationship between the transport infrastructure and the trade volume of ASEAN Free Trade Area. The third is that the more developed the transport infrastructure, the lower the boundary effect, thus promoting the development of ASEAN regional economic integration.

Keywords: ASEAN; Transportation Infrastructure; Regional Economic Integration; Gravity Model; Boundary Effect.

1. Introduction

With the progress of globalization and the rapid development of economic cooperation zones, the scale of trade between countries has increased rapidly. The pace of upgrading China ASEAN Free Trade Area has been further accelerated along with the continuous development of "one belt and one road" construction. The core issue of economic cooperation area is essentially a boundary issue. The main purpose of the study of cross-border economic cooperation areas is to find feasible ways to transform the adverse effects on regional economy into beneficial ones. As early as the middle and late 20th century, this issue has attracted the attention of Western scholars. Scholars mainly use the neoclassical trade theory, believing that increasing investment in infrastructure in border areas can reduce the barriers of border to trade and capital flows. For example, Alan Winters and Maurice Schiff (2002) analyzed the trust and other factors between neighboring countries, then they found out the relevant factors affecting the development of national cross-border economic cooperation areas. Based on this, as to the issue of China-ASEAN FTA, domestic scholars such as Li Wentao (2012) pointed out that the regional economic integration strategy with East Asian cooperation as the priority direction is more active and pragmatic, which will also have an important impact on future development. Wu Shenglan (2011) believed that it can strengthen bilateral political mutual trust and communication by promoting industrial restructuring, thereby developing intra-industry trade,and improving cooperation mechanism. Liu Shenglong and Hu Angang (2011) constructed the corresponding border effect model to test the impact of transport infrastructure on regional economic integration in China. The results show that the boundary effect of China's inter-provincial trade is between 6-21, close to that of developed countries.

Accordingly, based on the background of "one belt and one road" initiative, this paper focuses on the empirical study of infrastructure construction and trade of ASEAN Free Trade Area, and explores the role of infrastructure in the process of upgrading trade level in the economic integration area. Based on the original trade gravity model, this paper extends the model and adds the variable of transportation infrastructure. The cross-sectional data of each ASEAN Free Trade Area country in 2017 are selected to estimate the corresponding boundary effect. Then the degree of economic and trade development is analyzed. This article also study the impact of transportation infrastructure on regional trade and even regional integration.

2. Gravity Model Construction and Data Description

2.1 Extended Gravitational Model

Since Tinbergen (1962) and Pyhnen (1963) studied the trade gravity model, the gravity model has been continuously expanded (Bergstrand, 1989; Deardorff and Allan, 1998; Anderson and Wincoop, 2003, etc.). On this basis, this paper extends the model.

Standard gravitational model expressions:

$$\ln trade_{ij} = \alpha_0 + \alpha_1 \ln gdp_i + \alpha_2 \ln gdp_j + \alpha_3 \ln D_{ij} + \varepsilon \quad (1)$$

Among them, $trade_{ij}$ is the export of national i to national j, gdp_i and gdp_j are the gross domestic product of national for the country i and country j respectively, D_{ij} is the distance between country i and country j, usually expressed by the distance between two national capitals.

This paper extends the gravitational model based on the first boundary effect of McCallum (1995) and the boundary effect of Concet (2003) based on Chinese data. The specific expression of the boundary effect model is as follows:

$$\ln trade_{ij} = \beta_0 + \beta_1 border + \beta_2 \ln gdp_i + \beta_3 \ln gdp_j + \beta_4 \ln D_{ij} + \varepsilon_{ij} \quad (2)$$

Among them, when border denotes domestic trade, border = 1. when border denotes international trade, when I = j, border = 0. the eβ1 with the coefficient of border's (β_1) represents the boundary effect, which indicates that domestic trade will be a multiple of international trade when the total economic volume and distance are fixed.

Considering the influence of geographical location on trade, this chapter also introduces the variables that reflect geographical adjacency based on the boundary effect model. The specific expressions are as follows:

$$\ln trade_{ij} = \gamma_0 + \gamma_1 border + \gamma_2 adjacent + \gamma_3 \ln gdp_i + \gamma_4 \ln gdp_j + \gamma_5 \ln D_{ij} + \varepsilon_{ij} \quad (3)$$

Among them, when country i and country j have common land boundary, adjacent = 1; when there is no common boundary, adjacent = 0.

This paper mainly studies the impact of transport infrastructure on inter-country trade in regional economic integration. Therefore, it is necessary to add transport infrastructure to the border effect. Based on this, a boundary effect model considering transport infrastructure can be obtained, which can be expressed as follows:

$$\ln traade_{ij} = \lambda_0 + \lambda_1 border + \lambda_2 adjacent + \lambda_3 \ln gdpi + \lambda_4 \ln gdpj + \lambda_5 \ln D_{ij} + \lambda_6 \ln T_{ij} + \varepsilon_{ij} \quad (4)$$

Among them, T_{ij} represents the average level of transportation infrastructure of country i and country j, which is expressed here by the ratio of the sum of transportation infrastructure stock of two countries to the sum of their territorial area. Through empirical test, if the coefficient T_{ij} of average transport infrastructure level is positive, it can be explained that increasing the stock of transport infrastructure will promote trade volume.

2.2 Data

The main explanatory variables in this paper include GDP per capita, distance and transportation infrastructure, and the relevant data in 2017 are selected. The distance between countries is measured by the shortest railway distance between capitals. The trade distance within a country is estimated by Poncet (2003) method, that is, the trade distance within a country is related to the area of the country. Its formula is: $D_{ii} = \sqrt{\frac{A}{\pi}}$. A represents the area of a country's territory, D_{ii} represents the distance

between domestic trade. In terms of transport infrastructure, this paper mainly uses the average level of transport infrastructure of two countries to measure, that is, the ratio of the sum of data of road, railway, aviation and port of two countries to the sum of the area of two countries.

3. Empirical Results

Based on the empirical analysis of the above research, we can get the results as shown in Table 1. Among them, model 2 adds traffic infrastructure variables on the basis of model 1 (standard gravity model), model 3 adds boundary effects on the basis of model 1, model 4 adds traffic infrastructure variables on the basis of boundary effect model, model 5 and Model 6 add adjacent variables on the basis of model 3 and model 4, respectively. The empirical results are shown in Table 1.

Table 1. Results

	Model(1)	Model(2)	Model(3)	Model(4)	Model(5)	Model(6)
lngdpi	1.24711***	1.27138***	1.29413***	1.30117***	1.30971***	1.31065***
	(11.78132)	(12.16728)	(13.24710)	(13.17209)	(13.78031)	(14.01272)
lngdpj	1.14632***	1.19254***	1.21803***	1.23412***	1.25435***	1.26035***
	(12.12431)	(12.37852)	(12.27365)	(12.91234)	(13.01723)	(13.28752)
lnDij	-1.9877***	-1.8432***	-1.6748***	-1.5423***	-1.3652***	-1.2013***
	(-11.3572)	(-11.0513)	(-6.8432)	(-6.0241)	(-4.7629)	(-3.9802)
lnTij		0.52367***		0.57851***		0.63116***
		(3.12013)		(3.13427)		(3.28902)
border			2.46241*	3.27341**	3.31452***	3.50124***
			(2.10267)	(2.45289)	(3.02981)	(3.47623)
adjacent					1.50134**	1.91325**
					(2.81365)	(3.27819)
R-squared	0.67219	0.74132	0.74102	0.67313	0.68459	0.65326
F-statistic	103.2132	105.1825	103.1623	98.5369	102.1647	92.1738
Border effect			11.73305	26.40121	27.50918	33.15654

***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % level.

According to the results in the table, we can know that the empirical results are consistent with the expected results of the variables in the gravity model. The coefficients of the total economic lngdpi and lngdpj are positive, that is, they are positively correlated with the volume of trade. The coefficient of the distance lnDij is negative, that is, they are negatively correlated with the volume of trade. And the total economic output and the distance are all at a significant level of 1% in the empirical results of each model. The estimated boundary effect of empirical results under each model ranges from 11 to 34. When adjacent variables are added to model 5 and model 6, the coefficients are 1.50134 and 1.91325, respectively, which are positive. This shows that there is a positive correlation between adjacent variables and trade volume, and it is significant at the level of 5%. After adding traffic infrastructure variables, in the empirical results of model 2, model 4 and model 6, the lnTij coefficients of transport infrastructure are 0.52367, 0.57851 and 0.63116, respectively, indicating that there is a positive correlation between transport infrastructure and trade volume, that is, improving transport infrastructure will promote the increase of international trade volume.

4. Influences of Transportation Infrastructure on Boundary Effect

4.1 Estimation of the Border Effect of Countries

The above empirical research shows that transport infrastructure has a promoting effect on trade volume, which is of vital importance to the construction of regional economic integration. Generally speaking, the degree of regional economic integration can be measured by the boundary effect. When the value of the boundary effect is higher, the degree of regional economic integration is lower; on the contrary, the degree of regional economic integration is higher. If the empirical test shows that there is a negative correlation between the transport infrastructure and the boundary effect, it can

prove that improving the transport infrastructure will reduce the boundary effect and further promote the development of inter-country trade and regional integration.

Based on this, this paper use Poncet's(2003) method for reference and use equation (4) to study and analyze the boundary effect of each country in the ASEAN Free Trade Area. That is, when we analyze the border effect of a country, the selected data include the export volume of that country to other countries, the export volume of other countries to that country and the domestic trade volume of that country, totally 19 samples' data. The details are shown in the table below.

Table 2. boundary effect of different countries

country	Estimates	boundary effect
Indonesia	1.134	3.1081
Malaysia	1.062	2.8921
The Philippines	1.457	4.2931
Brunei	1.135	3.1112
Singapore	0.431	1.5388
Thailand	1.812	6.1227
Vietnam	2.539	12.6670
Laos	3.083	21.8238
Myanmar	3.752	42.6062

According to the results of the table, among the 10 countries of ASEAN Free Trade Area, Singapore has the smallest boundary effect (1.5388), while Cambodia has the largest boundary effect (52.3002). From small to large, Singapore < Malaysia < Indonesia < Brunei < Philippines < Thailand < Vietnam < Laos < Myanmar < Cambodia.

4.2 Empirical Study on the Impact of Transportation Infrastructure on Boundary Effect

In order to test the robustness of the negative correlation between traffic density and boundary effect, other control variables need to be added to the regression test. The established equation is:

$$Border\ -effect = \alpha + \beta \ln transport + \sum_{i=1}^{n} \theta_i X_i + \varepsilon$$

Among them, X is the control variable. This paper chooses three control variables: one is the Open Degree Variable, which is expressed by the ratio of total import and export to GDP; the other is the structure of industrial structure, which is expressed by the ratio of the number of employees in the first and second industries to the working population, reflecting the impact of industry on the boundary effect; the third is the Goverment variable. The ratio of government expenditure to GDP reflects the influence of government behavior on the boundary effect. The concrete empirical results are shown in Table 3.

Table 3. Impact of Transport Infrastructure on Boundary Effect in ASEAN Free Trade Area

	Model 1	Model 2
lntransport	-0.38726*** (-1.21434)	-0.41337** (-1.55117)
lngdp		0.323712 (0.89287)
Open		-0.13244** (-1.59845)
Industry		-0.14541*** (-0.72434)
Government		0.21572 (1.54028)
R-squared	0.75474	0.77443
F-statistic	82.6152	86.3162

According to the data in the table, the coefficient of transport infrastructure in ASEAN Free Trade Area is negative, which indicates that there is a negative correlation between transport infrastructure and boundary effect. That is to say, improving transport infrastructure can reduce the boundary effect and promote the development of regional economic integration in ASEAN Free Trade Area. In addition, the total economic output (lngdp) and government expenditure (government) have no significant impact on the boundary effect; the degree of openness (Open) and industry (Structure) have significant impact on the boundary effect, and both have a negative impact.

5. Conclusion

Based on gravity model, this paper empirically analyses the impact of transportation infrastructure on Trade and integration of ASEAN Free Trade Area. The empirical results show that the regional boundary effect is between 11 and 34, and the transport infrastructure has a positive impact on regional bilateral trade. Through empirical tests, it is found that there is a negative correlation between the transport infrastructure and the boundary effect, that is, by improving the transport infrastructure, the boundary effect can be reduced, thus promoting regional economic integration.

According to the above conclusions, we can realize that in the process of regional economic integration in China-ASEAN Free Trade Area, we need to improve the transport infrastructure, which can reduce transport costs, improve trade freedom, reduce boundary effects and promote regional economic integration. At the same time, it has further verified the importance of the "five links" in the construction of "one belt and one road". The interconnection of infrastructure has a positive and irreplaceable role in accelerating the development of trade in goods and achieving win-win cooperation.

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