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The Effect of Cross-Border E-Commerce on China's International Trade: An Empirical Study Based on Transaction Cost Analysis

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Abstract: Reducing transaction costs by means of policy intervention could generate comparative advantages and contribute to the growth of international trade. Chinese government agencies have introduced a number of policies in support of rapidly growing cross-border e-commerce to promote China's international trade. However, the previous literature has not empirically verified the precise effect of these policies on the growth of international trade while focusing on the impact of cross-border e-commerce on trade distance and consumer welfare. To address this gap, this paper investigates the impact of cross-border e-commerce on international trade in the context of China, mainly from the perspective of transaction cost economics in conjunction with the traditional comparative advantage model by analyzing information cost, negotiation cost, transportation cost, tariffs and middlemen cost separately. Firstly, the new theoretical model suggests that cross-border e-commerce may have a positive role in promoting international trade only when the negative impact caused by tariff cost and transportation cost is offset. Secondly, our result shows that cross-border e-commerce has a positive effect on the growth of China's international trade in each year. However, the positive effect does not show incremental growth over time, possibly as a result of the weak implementation of favorable policies in trade, in addition to global trade shrinking.

Keywords: cross-border e-commerce; international trade; transaction costs; comparative advantage; China

1. Introduction

With the advance of Internet technology, e-commerce has earned an accelerated growth over the past ten years. According to the report released by the China Electronic Commerce Research Center, China's e-commerce transactions amounted to 10.5 trillion Yuan in the first half of 2016, accounting for about 30% of GDP. China's e-commerce industry provides more than 2.85 million jobs, making e-commerce a new engine of growth in the "new normal" economy (the new normal is a relatively stable state of low growth that is different from the past business cycle due to a fundamental restructuring of the economic order.). While e-commerce is booming, China's international trade has been suffering from a continuous decrease since the global financial crisis in 2008. Therefore, the question of how to promote China's international trade has become an important concern for the government. In this context, cross-border e-commerce began to rise, and it is considered a new way of expanding international trade. Cross-border e-commerce refers to transactions between customers and suppliers in different countries through electronic trading platforms, using cross-border logistics for the delivery of goods [1]. With the aim of promoting imports and exports through cross-border e-commerce, the *Guidance by the General Office of the State Council on the Promotion of Cross-Border E-Commerce in a Healthy and Rapid Way* points out that supporting cross-border e-commerce is conducive to achieving an excellent performance in imports and exports with "Internet + International Trade",

taking advantages of China's manufacturing power, expanding overseas marketing channels, and encouraging a reasonable increase in imports [2]. The *Guidance* suggests that sustainable growth of China's international trade can be achieved through the development of cross-border e-commerce.

China's cross-border e-commerce has been gradually increasing since 2008 as a lot of cross-border e-commerce platforms, such as XIAOHONGSHU (http://www.xiaohongshu.com/) and YANGMATOU (http://www.ymatou.com/), were established. The annual growth rate of transaction volumes rapidly increased from less than 10% in 2010 to 40% in 2015. The proportion of cross-border e-commerce in total import and export trade volume also increased over the years, from less than 5% in 2008 to 19.5% in 2015. In the first half of 2016, China's cross-border e-commerce reached a scale of 2.6 trillion Yuan with a year-on-year growth of 30%, accounting for 23% of the total import and export trade of China. It is estimated that by 2020, the revenue of China's cross-border e-commerce transactions will reach 12 trillion Yuan, accounting for 37.6% of total import and export. (Data from China E-Commerce Research Center.)

As the booming of cross-border e-commerce draws increasing attention from the government, many policies for supporting cross-border e-commerce have been introduced with the aim of propelling the further growth of international trade. However, the existing literature has not empirically verified the precise effect of these policies on the growth of international trade while focusing on the impact of cross-border e-commerce on trade distance and consumer welfare. Therefore, further empirical research is warranted to discover whether cross-border e-commerce promotes international trade, and whether recent government policies have been effective in trade promotion. In this study, we propose a new theoretical framework of international trade by incorporating various types of transaction costs with the traditional model of comparative advantage to provide an empirical analysis for explaining the relationship between cross-border e-commerce and international trade in the context of China.

This study also provides guidance for the development and refinement of trade-related policies by government agencies. Our results show that cross-border e-commerce can play a positive role in the resurgence of China's international trade. On the other hand, China's cross-border e-commerce itself does not have sufficient power to buffer the current shock of declining international trade. Contrary to our expectation, the positive effect of cross-border e-commerce on international trade does not increase over time as a result of favorable policies, although the relationship is positive in each year. This may suggest that the desired effect of the policies was undermined due to poor implementation or regional disparity in trade infrastructure, in addition to trade shrinking caused by the global financial crisis.

The rest of the paper is structured as follows. Section 2 provides the literature review on cross-border e-commerce. Section 3 presents the theoretical foundation of transaction costs in cross-border e-commerce, the analytical model and propositions. Section 4 presents the results of the empirical analysis, including data description, measurement of variables and the econometric model. The paper concludes with the discussions of managerial implications, limitations of the study and the direction of further research in Section 5.

2. Literature Review

Previous research has studied cross-border e-commerce mainly from the perspectives of trade distance and consumer welfare. For example, as early as 2001, Cairncross [3] began to study whether online trade lived up to "the death of distance". Cowgill and Dorobantu [4] investigated the influence of cross-border e-commerce on international trade, using domestic trade data and cross-border data collected from Google AdWords. They found that the growth of cross-border e-commerce reduced distance-related trade cost by approximately two-thirds. Similarly, Gomez et al. [5] used data from the EU (European Union) member countries and found that B2C cross-border e-commerce contributed to the reduction of geographical distance-related trade cost by one-third. These studies have shown that cross-border e-commerce shortens trade distance and improves the ease of trade. Meanwhile, some studies (e.g., Gomez et al. [5]) also found that trade cost associated with overcoming language barriers doubled, because cross-border e-commerce shares basically the same infrastructure as that

of offline transactions. An empirical study by Alaveras et al. [6] using the EU data revealed that the geographical distance between two countries was still a significant factor influencing consumers' cross-border shopping through e-commerce platforms. Whether cross-border e-commerce can reduce distance-related trade cost remains uncertain and requires further empirical evidence.

There are also many studies examining the impact of cross-border e-commerce on consumer welfare from the perspectives of price, transaction cost and product diversity [7–11]. An investigation of the EU's cross-border e-commerce found that abundant options, more affordable prices, and lower search costs on the Internet have saved consumers €12 billion [7]. Lendle et al. [8] estimate the consumer welfare gains from an across-the-board reduction in offline trade costs to the level prevailing in online trade at a whopping 29 percent on average. Duch–Brown et al. [9] also estimated consumer welfare gains from lowering prices in cross-border trade. However, when the consumers are exposed to higher risks in online shopping, such as transaction security and logistics safety, they are likely to reduce consumer welfare [10]. Local shops offering a lot of variety may take a lot of consumer time and effort to assemble all that information in the offline world; much more so than online. Therefore, e-commerce may decrease time costs and information costs and increase consumer welfare [10,11].

In addition to the above studies, a considerable part of prior research has focused on the influential factors of cross-border e-commerce. Cardona et al. [12] and Cardona and Martens [13] identified the obstacles that consumers and suppliers would face when trying to buy or sell something on cross-border e-commerce platforms. In the study by Bas et al. [14], these obstacles of cross-border e-commerce include limited transparency on delivery, customs bottlenecks, complex and ambiguous return processes, and price opacity, and they thought these obstacles will eventually be removed by online retailers, carriers, and other service providers; cross-border e-commerce will create an effectively borderless business world. Kawa et al. [15] presented the conception of an integrator in cross-border e-commerce to solve the logistics problems of cross-border e-commerce by integrating the whole supply chain. Heikkurinen et al. [16] examined the influence of supply chain management on improving logistics systems to promote cross border e-commerce. Hsiao et al. [17], from a consumers' point of view, proposed a logistics service for cross-border e-commerce by applying Kansei engineering and data mining techniques. Zhou et al. [18] addressed a location-routing problem for the last mile distribution for e-commerce. They designed a hybrid evolutionary search algorithm based on a genetic algorithm and local search. They found a new path to get out of the traditional "comparative advantage trap", when the changes in transaction costs can form a new comparative advantage. Kim et al. [19,20] emphasized the importance of e-suppliers of cleverly designed delivery services to reduce the distance in order to attract online customers across borders. They confirmed the further growth of cross-border e-commerce requires improved express delivery services.

As Evgenia [21] discussed, network information technology has played an increasingly important role in the sustainable development of economy and society. Therefore, the rapid growth of cross-border e-commerce facilitated by technological advances has attracted increasing attention of government agencies and academia. The impact of cross-border e-commerce needs to be assessed not only in the formulation of the government's international trade policies, but also in terms of the sustainable development of the economy. However, the existing literature mainly analyzes the impact of cross-border e-commerce on trade distance and consumer welfare. Given this limitation, we are motivated to empirically examine the impact of cross-border e-commerce on international trade from the perspective of transaction costs economics.

3. Theoretical Framework

3.1. Changes in Transaction Costs in Cross-Border E-Commerce

In general, traditional international trade consists of three stages: searching for commodities or products, signing a contract, and delivering the commodities or products. However, with the help of e-commerce, these three stages have been greatly simplified. On a cross-border e-commerce platform,

people can directly search for information about a product, make an order, and then have the product delivered. Cross-border e-commerce is a breakthrough for international trade, including both B2B (business to business) and B2C (business to customer). Thus, we aim to focus on the varying effects of the transaction costs in both forms of cross-border e-commerce in this study.

Transaction cost is defined by Coase [22,23] as the cost that occurs to traders while getting accurate market information and negotiating contracts. Cheung [24] specifies different types of transaction costs including information cost, negotiation cost, defining and controlling cost, monitoring cost, etc. However, there is no clear consensus on defining the constituents of transaction costs. In this study, we define transaction costs on the basis of transaction technology and transaction systems [25]. Transaction technology refers to all basic technologies and equipment that support the flow of information, goods, money and other activities. It can be regarded as the "hardware" affecting transaction costs. Transaction systems mainly refer to all kinds of constraining systems such as laws, industry standards, and marketing regulations relative to transaction activities, which depend on the governing philosophy, measures and efficiency of a government. They can be regarded as the "software" that influences transaction costs. Based on the study of Wang et al. [26] that modified the variables developed by Butter and Mosch [27], we transfer the risk cost and payment cost into negotiation cost and tariffs cost for simplifying the analytical model. For international trade, the tariffs rate is an extremely influential variable. The negotiation cost is one of the main influential factors in traditional trade, but not in cross-border e-commerce. In addition, negotiation cost is more important than payment cost when calculating transaction cost, and risk cost is not significantly affected by transaction technology and transaction systems; this could be replaced by the tariffs cost. Therefore, we divide the transaction costs into five compositions, which are information cost, negotiation cost, transportation cost, tariffs cost and middlemen cost [26,27]. These types of costs are affected by transaction technology and transaction systems. We denote transaction cost ε as a function of variables t (transaction technology) and s (transaction systems), and information cost, negotiation cost, transportation cost, tariffs cost and middlemen cost are also a function of s and t; we therefore get the following Equation (1):

$$\varepsilon(t,s) = I(t,s) + N(t,s) + T(t,s) + C(t,s) + M(t,s) \quad (1)$$

where "t" and "s" imply transaction technology and transaction systems, respectively. I, N, T, C, and M represent information cost, negotiation cost, transportation cost, tariffs cost and middlemen cost. This research examines the effects of transaction costs on cross-border e-commerce by analyzing five kinds of transaction costs separately. Below, we will analyze the change of transaction cost after the cross-border e-commerce replacing the traditional trade. The difference between traditional international trade and cross-border e-commerce in transaction systems can be neglected. So we mainly discuss the impact of transaction technology on transaction costs.

3.1.1. Cross-Border B2B E-Commerce

Unlike traditional international trade, cross-border e-commerce takes advantage of Internet technology, which brings convenience to both sellers and buyers in acquiring product information, causing information cost to decrease [26]. Negotiation becomes easy for both sellers and buyers to compare products and carry out transactions on a cross-border e-commerce platform. It decreases a large amount of time and money spent on negotiation. Therefore, the negotiation cost decreases. Transportation methods for both traditional trade and cross-border B2B e-commerce are very similar. Both deliver the goods by means of transportation by sea. Hence, there is no significant difference in transportation cost between B2B and traditional trade. Tariffs of B2B are almost the same as those in traditional trade. The General Administration of the People's Republic of China have implemented some regulations to integrate the information platforms of customs and the information platforms of cross-border e-commerce; cross-border e-commerce will be conducted on

the Internet, which leads to more stringent monitoring and management of cross-border e-commerce by customs [28–30], and therefore the tariffs cost of B2B increases. The middlemen cost decreases in cross-border e-commerce because the Internet technology connects sellers and buyers easily, reducing the intermediate steps of transactions and price differences among sellers [26].

Therefore, transaction cost will decline when and only when the increase of tariffs cost is less than the decreases of other costs.

3.1.2. Cross-Border B2C E-Commerce

The change of information cost, negotiation cost, tariffs cost and middlemen cost in B2C is similar to that in B2B. Therefore, in B2C part, we focus on the change of transaction cost. In B2C, as orders are small, and the goods are usually delivered by air, transportation cost is a serious burden for consumers [31]. Therefore, transportation cost will increase.

In short, transaction cost will decline when and only when the increases of tariffs cost and transportation cost are less than the decreases of other costs.

3.2. Theoretical Model

Based on the above analysis, the impact of e-commerce on transaction costs is uncertain in theory. In order to better illustrate the significance of such transaction cost changes in international trade, we incorporate transaction costs into a traditional comparative advantage model to explore the impact of cross-border e-commerce on international trade. Traditional trade theories did not consider transaction costs. However, as Ru and Jin [32] suggest, "Once the transaction cost is taken into account, the existence of technological differences and endowment differences in the two countries only provides a necessary condition for the development of international trade, rather than a sufficient condition." A country's comparative advantage from the "full cost" perspective is rebuilt based on the study of Yang et al. [33]. This study extends Wu's [34] study, which presents a model clearly reflecting the relationship between trade and transaction costs.

According to the comparative advantage theory, an international trade takes place between two countries or regions with different comparative advantages. By following traditional international trade theory, this research assumes (1) two countries, A and B; two products, X and Y; (2) that the two countries use the same currency; and (3) that the means of production of the two countries are fixed and can only flow within one country.

In order to simplify the analysis, we hypothesize that the production cost of X and Y of country A are P_A^X and P_A^Y, and the production cost of X and Y of country B are P_B^X and P_B^Y. A exports X, and imports Y, while B exports Y and imports X. When a trade between two countries exists, there will be a transaction cost. Production cost plus transaction cost are the total cost of the trade. Z is the good for trading; i is the exporting country; j is the importing country; TC_{ij}^z is the total cost of exporting to country j from country i; P_i^z is the cost of producing Z domestically; and ε_{ij}^z is the transaction cost of exporting a product from i to j. So the total cost of trade is expressed as

$$TC_{ij}^z = P_i^z + \varepsilon_{ij}^z = P_i^z\left(1 + \delta_{ij}^z\right) \tag{2}$$

where $\delta_{ij}^z = \varepsilon_{ij}^z / P_i^z$ and represents the ratio of transaction cost for exporting Z to j to production cost.

As the traditional theory of comparative advantage, X produced by A is exported to B. Y is imported to A from B. This relationship can be expressed as:

$$\frac{P_A^X\left(1 + \delta_{AB}^X\right)}{P_A^Y\left(1 + \delta_{AB}^Y\right)} < \frac{P_B^X\left(1 + \delta_{BA}^X\right)}{P_B^Y\left(1 + \delta_{BA}^Y\right)} \tag{3}$$

The above formula indicates that the relative total cost of producing X by A is lower than that by B, and the relative total cost of producing Y by B is lower than that by A. Therefore, international trades of X and Y between A and B will occur.

Assuming the original comparative advantage was given ($\frac{P_A^X}{P_A^Y} < \frac{P_B^X}{P_B^Y}$), Formula (3) will be established when $\frac{\left(1+\delta_{AB}^X\right)}{\left(1+\delta_{AB}^Y\right)} \leq \frac{\left(1+\delta_{BA}^X\right)}{\left(1+\delta_{BA}^Y\right)}$ or $\frac{\left(1+\delta_{AB}^X\right)}{\left(1+\delta_{AB}^Y\right)} / \frac{\left(1+\delta_{BA}^X\right)}{\left(1+\delta_{BA}^Y\right)} < \frac{P_B^X}{P_B^Y} / \frac{P_A^X}{P_A^Y}$, and international trade will occur as before. In order to better reflect the role of cross-border e-commerce, we hypothesize that (4): X of A is traded through cross-border e-commerce, and products of other countries are traded in traditional trade.

Although the decrease of δ_{AB}^X will promote trades between the two countries, according to the analysis of Section 3.1, we find it is uncertain whether the δ_{AB}^X can decline in B2B or B2C. Therefore, the role of cross-border e-commerce in international trade is not fixed and may vary in different circumstances.

In recent years, central ministries and local provinces in China have adopted many policies to support cross-border e-commerce. Many official documents such as *Guidance by General Office of the State Council on the Promotion of Cross-Border E-Commerce in a Healthy and Rapid Way* show a clear desire that the development of cross-border e-commerce will stimulate China's international trade. For example, tariff incentives for cross-border e-commerce can help to significantly reduce tariffs cost, resulting in the reduction of the total transaction cost and generating comparative advantage. Therefore, we propose the following proposition:

Proposition 1. *The growth of cross-border e-commerce in China will increase the scale of international trade.*

Since 2012, China's cross-border e-commerce has grown at the annual rate of nearly 30%, far higher than the growth rate of total international trade. Recently, government policies in support of cross-border e-commerce has increased year by year, with the aim of promoting international trade. We found 230 favorable policies in e-commerce and trade from every provincial government websites, the number of policies is increasing year by year. Therefore, we propose the following proposition:

Proposition 2. *The promotional effect of China's cross-border e-commerce on the scale of international trade will show an upward trend year by year.*

4. Empirical Analysis

4.1. Data Sources

The time span of data in this study is five years, from 2011 to 2015, involving all provinces of China except Hong Kong, Macao and Taiwan. We collected data for international trade and cross-border e-commerce from China's Foreign Trade and Economic Social Development Database, the National Bureau of Statistics, the Provincial Bureau of Statistics, the Provincial Department of Commerce, and China E-Commerce Research Center. In terms of sample size and data availability, this study used pooled panel data for several reasons. First, using pooled panel data can increase the sample size to get more accurate estimates and more effective test statistics [35]. Second, the introduction of dummy time variables, which were used as explanatory variables, allows the metrological model to have different intercept terms at different time points. This can solve the problem of uneven distribution of overall data at different time points. In addition, in this model, interactive items that consist of dummy and explanatory variables are used to verify whether parameter coefficients of the variables will change at different points in time. Therefore, in this paper, we used empirical tests to verify whether the impact of cross-border e-commerce on international trade has changed in recent years, which may be attributable to increasing policy support.

4.2. Variable Selection and Econometric Model

According to the analysis in Section 3, the effect of cross-border e-commerce on international trade is uncertain. The growth of cross-border e-commerce can promote the growth of international trade only if the increase of tariff cost and transportation cost could be offset. In order to test the above hypothesis, we choose the total value of import and export trade (denoted as em) of 31 provinces in China as the dependent variable, and growth of cross-border e-commerce (denoted as pec) as the core explanatory variable. Considering that statistical data of cross-border e-commerce among provinces are lacking, we use the trading volume of e-commerce per capita that was available as a measure of the growth rate of cross-border e-commerce. We also took other independent variables including GDP per capita (pgdp), region variable (reg), and time trend (denoted as t, the variable equal to one if the observation was generated in 2011, and two if it was 2012 and so on). Due to the difficulty of data collection, some factors that may affect international trade could not be included in the model of this paper; the coefficient of the time trend can represent the influence of these omitted factors on the international trade. In order to reduce the impact of inflation factors, we use the natural logarithm of the total value of import and export trade as the actual dependent variable. The descriptive statistics are shown in Table 1.

Table 1. Descriptive statistics.

Variable	Obs	Mean	Std. Dev	Min	Max
em	92	1.04×10^8	1.45×10^8	8.69×10^5	6.76×10^8
ec	92	6304.097	6138.352	142.3	28,100
t	92	3.413043	1.25927	1	5
pgdp	92	5.229323	2.275376	1.971	10.796

The basic econometric model is formulated as follows:

$$\log\ \mathrm{em} = \beta_0 + \beta_1 \mathrm{t} + \beta_2 \mathrm{logpec} + \beta_3 \mathrm{pgdp} + \beta_4 \mathrm{reg} + \varepsilon$$

With the increasing number of cross-border e-commerce policies over these years, the impact of cross-border e-commerce on international trade may increase accordingly. We introduce a new interactive item (t* logpec) as an independent variable to test whether the effect of cross-border e-commerce on international trade has improved significantly in recent years. The specific econometric model is as follows:

$$\log\ \mathrm{em} = \beta_0 + \beta_1 \mathrm{t} + \beta_2 \mathrm{logpec} + \beta_3 \mathrm{pgdp} + \beta_4 \mathrm{reg} + \beta_5 \mathrm{t} * \ \mathrm{logpec} + \varepsilon$$

where β_0 represents a constant term; β_1–β_5 are coefficients of variables; ε is a stochastic disturbance term.

4.3. Empirical Analysis

First, a least square regression was carried out to test the relationship between cross-border e-commerce and international trade.

As shown in Table 2, the growth rate of cross-border e-commerce is proportional to the total amount of international trade, and the coefficient is significant. When the growth rate of cross-border e-commerce increased 1%, total volume of international trade would increase by 0.678%.

This result shows that China's cross-border e-commerce has a significant promotional effect on the growth of international trade. China's cross-border e-commerce reduces traditional trade transaction costs. The reason why tax cost is not negatively affected is possibly due to China's effective tariff reduction policy for cross-border e-commerce. The gradual implementation of the "the belt and road" initiative and the "China–EU trains" and the establishment of the "China–Russia economic corridor" significantly reduce the trade transportation cost of inland provinces of China. With the help of

improvements in logistics, the positive effect of China's cross-border e-commerce would offset the negative effect of transport cost.

Moreover, the coefficient of t is −0.364, meaning that it is negative and significant, indicating changes in the amount of international trade that cannot be explained by the independent variables listed above. The negative effect increases year by year. This may have been largely due to the impact of the market shrinking after the global financial crisis in 2008.

Table 2. Ordinary least square (OLS) estimates.

	(1)	(2)
	Logem	**Logem**
t	−0.364 ***	−0.366 ***
	(0.0831)	(0.0836)
logpec	0.678 ***	0.572 **
	(0.147)	(0.244)
pgdp	0.0419	0.0380
	(0.0661)	(0.0668)
t * logpec		0.0373
		(0.0684)
region	**control**	**control**
cons	28.56 ***	28.56 ***
	(0.518)	(0.521)
N	92	92

Note: number in parentheses are standard errors. Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The absolute value of the coefficient of logpec (0.678) is only greater than the absolute value of the coefficient of t if it was in 2011 (−0.364), which means that the positive impact of cross-border e-commerce cannot sufficiently offset the negative impact of the financial crisis. Thus, cross-border e-commerce has not really become a new source of growth for international trade.

In recent years, promotional policies for cross-border e-commerce by government agencies such as the State Council, the Ministry of Commerce and the Ministry of Finance have been enacted to stimulate international trade. In our sample, we found 230 favorable policies in e-commerce and trade from every provincial government website. 60% of policies have been issued by the provinces along the land and maritime Silk Roads, 40% of policies have been issued by other provinces. On the basis of Model 1, we introduce an interaction item of cross-border e-commerce and time trend to test whether the coefficient of cross-border e-commerce has significant changes across different years. According to the regression results of Model 2 shown in Table 2, the coefficient of the interactive item is positive, which is 0.0373, meaning that it is very small and insignificant. The result shows that, although the impact of cross-border e-commerce on international trade each year was positive, the impact does not change significantly year by year. This may imply that the intended effects of the policies did not occur due to ineffective implementation or regional disparity in trade infrastructure.

In short, the regression results of Models 1 and 2 verify Proposition 1: the growth of cross-border e-commerce enlarges the scale of international trade. However, they do not support Proposition 2: the promotional effect of China's cross-border e-commerce on the scale of international trade will show an upward trend year by year.

In order to test whether the impact of cross-border e-commerce on international trade is different across different regions, we divided China's 31 provinces into "the belt and road" and "non-belt and road" provinces. "The belt and road province" implies a province along the land and maritime Silk Roads, "non-belt and road province" implies a province not along the land and maritime Silk Roads. Due to the "the belt and road" initiative, favorable policies are leaning to some provinces that lie along the land and maritime Silk Roads. The impact of cross-border e-commerce on international trade in

these provinces may differ from other regions. The regression results of "the belt and road" provinces are presented in Models 1 and 2 in Table 3. Regression results of "non-belt and road" provinces are present in Models 3 and 4. The impact of cross-border e-commerce on international trade is still significant and positive in these models.

Comparing the results of Model 1 in Tables 2 and 3, the coefficient of growth rate of cross-border e-commerce in the "the belt and road" provinces is 0.897, which is 32% higher than the coefficient of all 31 provinces (0.678, the result in Table 2), while the impact of cross-border e-commerce on international trade in "non-belt and road" provinces (0.536) is 31% lower than the coefficient of all 31 provinces (0.678).

According to the results of Model 2 shown in Table 3, interaction item is positive but insignificant, which is 0.129. Meanwhile, the coefficient of the interaction item of the "non-belt and road" provinces is −0.0431. These imply that the impact of cross-border e-commerce in "the belt and road" or "non-belt and road" provinces also do not change year by year. Although both are insignificant, one is positive and one is negative.

Table 3. Ordinary least square (OLS) estimates by region.

	(1)	(2)	(3)	(4)
	Logem	**Logem**	**Logem**	**Logem**
t	−0.523 *** (0.144)	−0.538 *** (0.144)	−0.239 *** (0.0809)	−0.241 *** (0.0815)
logpec	0.897 *** (0.302)	0.515 (0.459)	0.536 *** (0.128)	0.659 *** (0.228)
pgdp	0.0845 (0.135)	0.0738 (0.135)	0.0905 (0.0606)	0.0964 (0.0617)
t * logpec		0.129 (0.117)		−0.0431 (0.0660)
region	**control**	**control**	**control**	**control**
cons	28.74 *** (0.976)	28.80 *** (0.975)	27.54 *** (0.515)	27.54 *** (0.518)
N	46	46	46	46

Note: we divided the regions into "the belt and road" and "non-belt and road" provinces. Number in parentheses are standard errors. Significance: * $p < 0.1$, *** $p < 0.01$.

These results demonstrate that cross-border e-commerce in "the belt and road" provinces has played a more significant role in the growth of international trade. The reason why this phenomenon appears is that transaction costs of international trade in the "the belt and road" provinces are much higher than those in other provinces. In order to match the Chinese government's policy goals about the "the belt and road" vision, these provinces have made a lot of improvement in facilitating cross-border e-commerce. Therefore, cross-border e-commerce contributes to the reduction of transaction costs in these provinces, and plays a stronger role in promoting international trade.

The increase of international trade may improve the GDP per capita in some provinces and not in others. This implies that endogeneity may be caused by simultaneity [36]. In order to solve this problem, we choose GDP per capita of one year and two years before the given year as an instrumental variable for "pgdp" in a generalized method of moments (GMM) regression analysis. These instruments pass the overidentification test ($p = 0.42$). The results are shown in Table 4:

Table 4. Generalized method of moments (GMM) estimates.

	(1)	(2)
	Logem	**Logem**
t	−0.392 ***	−0.486 ***
	(0.0375)	(0.0603)
logpec	0.782 ***	0.566 ***
	(0.0763)	(0.136)
pgdp	0.0158	0.0158
	(0.0375)	(0.0362)
t * logpec		0.0677
		(0.0589)
region	**control**	**control**
cons	26.5 ***	26.77 ***
	(0.356)	(0.367)
N	92	92

Note: number in parentheses are standard errors. Significance: * $p < 0.1$, *** $p < 0.01$.

Comparing Table 2 with Table 4, we find the results are consistent. The results of the "the belt and road" provinces and "non-belt and Rroad" provinces also do not have substantial differences. The detailed results of GMM estimation are not reported here due to limited space.

5. Conclusions

This paper investigates the impact of cross-border e-commerce on international trade mainly from the perspective of information cost, negotiation cost, transportation cost, tariffs and middlemen cost. After incorporating transaction costs into the traditional comparative advantage model, we suggest that low transaction costs can contribute to the growth of international trade, as reducing transaction costs is one of the ways to gain comparative advantage. However, cross-border e-commerce could increase tariffs cost and transportation cost of international trade, and yet the change in total transaction costs is unknown. Therefore, the growth of cross-border e-commerce will not necessarily increase international trade in theory.

According to the results of our empirical analysis, there is a significant positive relationship between the growth rate of cross-border e-commerce and the scale of international trade. However, looking from the overall results of the partitioned samples of China's 31 regions, the positive effect of cross-border e-commerce does not offset the negative impact of other factors. This illustrates that cross-border e-commerce cannot really be considered a new or additional source of growth for international trade. Although the result of "the belt and road" provinces shows that coefficients of the interaction items are y positive, it is insignificant in the case of all regions. Nevertheless, cross-border e-commerce is still an effective means of generating new comparative advantages, as well as a potential driver for achieving the sustainable development of China's international trade.

The key findings of our empirical analysis suggest that China's expanding cross-border e-commerce has helped overcome some obstacles of transaction costs and improve the growth of international trade. We think that the positive effect is partly caused by favorable policies for cross-border e-commerce. On the one hand, the general results of the study imply that favorable policies are useful for trade promotion. On the other hand, the positive effect of cross-border e-commerce on international trade does not increase over time as a result of favorable policies, although it is positive in each year. This result means that increasing policies do not have an incrementally better effect. The desired effects of the policies may have been undercut by poor implementation or regional disparity in trade infrastructure in addition to trade shrinking caused by the global financial crisis.

5.1. Policy and Managerial Implications

The government should encourage enterprises to engage in cross-border e-commerce to take full advantage of the benefit of cost reduction, while continuing to increase favorable policies for cross-border e-commerce and supervising their effective implementation. The preferential tariff policies of cross-border e-commerce should be maintained to develop China's international trade. If these preferential policies are canceled, the positive effect of cross-border e-commerce on international trade is likely to diminish. The government should expedite the implementation of China's "the belt and road" initiative, while improving the establishment of infrastructure to reduce transportation cost of international trade with the countries located along the land and maritime Silk Roads. From the perspective of enterprises, cross-border e-commerce platforms should speed up their investment in new logistics infrastructures, such as overseas warehouse positions and fourth party logistics platforms in order to reduce the negative impact of transportation cost for using cross-border e-commerce.

5.2. Limitations and Implications for Future Research

In this paper, we focus on the effect of cross-border e-commerce on international trade at the macro-economic and regional levels. The key findings of this paper provide some important reference points to the government's policy formulation, but there is a lack of analysis on how enterprises actually develop cross-border e-commerce. Although the growth of cross-border e-commerce is rapid and explosive at present, the data is limited and collected in a short time span. For these reasons, the validity of our findings is limited to discovering general trends of cross-border e-commerce and implications for government policy-making.

In order to delineate the effects of different policies better, future research could introduce more policy variables, such as the number of favorable versus unfavorable policies, policies with financial versus non-financial incentives, and regulatory changes for reducing transaction costs. Furthermore, future research could use micro-level data to explore the effect of cross-border e-commerce on enterprise behavior. For example, the World Bank China's enterprise survey data could be used to measure the impact of cross-border e-commerce on enterprise-level welfare. Also, a questionnaire survey could be conducted to investigate cross-border e-commerce decisions in terms of the motivation, perception and experience of enterprise managers. These approaches are likely to yield new findings, not only valuable for policy-making, but which may also be important for organizational transformation. Of course, if researchers can get enough detailed data, they can test the relation of cross-border e-commerce and conventional trade.

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