

The Impact of Trade Facilitation on China's Cross-border E-Commerce Exports: A Focus on the Trade Facilitation Index in RCEP Member Countries

JKT 26(7)

Received 15 September 2022

Revised 30 October 2022

Accepted 4 November 2022

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Abstract

Purpose – Based on the relevant panel data for China and 13 of the RCEP countries from 2008-2019, this paper conducts an in-depth study on the impact of trade facilitation levels on China's cross-border e-commerce exports using the expanded trade gravity model.

Design/methodology – This study constructs a trade facilitation index (TFI) system, and uses the principal component analysis method to measure the trade facilitation levels of RCEP countries in 2008-2019. This result is then introduced into the extended gravity model to explore the effect of trade facilitation in RCEP countries on China's cross-border e-commerce export.

Findings – It is found that the overall trade facilitation level has a significant effect on China's cross-border e-commerce exports. Among the primary indicators, with the exception of infrastructure, the other four indicators demonstrate a significant impact. The findings show that China should strengthen its cooperation with RCEP countries in trade facilitation and cross-border e-commerce to better achieve complementary regional economic development.

Originality/value – This paper has three contributions: first, this paper builds a TFI system that includes five primary indicators based on the characteristics of cross-border e-commerce. Second, we explore the impact of trade facilitation levels of RCEP countries on China's cross-border e-commerce exports, which helps to fill the gap in existing studies of the impact of cross-border e-commerce exports. Third, this paper further analyzes the impact of five primary indicators on cross-border e-commerce exports; this thus provides more targeted measures to improve trade facilitation levels.

Keywords: Cross-border E-commerce, Gravity Model, RCEP, Trade Facilitation Index

JEL Classifications: P45, F14

1. Introduction

At the moment, globalization is fraught with uncertainty: the COVID-19 pandemic has aggravated the world economic recession, and the global industrial chain is at risk of disruption. Against the backdrop of the rise of the "counter-globalization" movement, the largest free trade agreement (FTA) in the world, the Regional Comprehensive Economic Partnership (RCEP) went into effect as planned in January 2022. It has 15 member countries,

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including 10 ASEAN countries, China, Japan, Korea, Australia, and New Zealand. The RCEP's signature has helped to advance regional economic integration, and played a positive role in promoting global trade. Despite continuous and in-depth development of international trade until now, there are still significant invisible trade barriers, such as cumbersome customs clearance procedures and inadequate government supervision. Many countries and regions have paid close attention to the negative impacts of these trade barriers. To get rid of these "trade inconvenience" factors, it is of great significance to explore measures to enhance the trade facilitation levels of RCEP countries in order to achieve smooth trade flows.

The COVID-19 pandemic has impacted the economies to varying degrees. Cross-border e-commerce, however, as a combination of the import/export industry and e-business, has opened up huge development opportunities. In contrast to traditional global trade, cross-border e-commerce breaks through time and space restrictions and opens up a wider range of merchandise sales channels. With the advantages of fewer links, lower costs, and greater convenience and speed, the volume of e-commerce transactions continues to grow. In recent years, the volume of China's traditional foreign trade has been declining. However, China's cross-border e-commerce has been growing quickly, and in 2019, its market scale exceeded 10 trillion yuan. Gessner (2015), comparing the growth rate of traditional and e-commerce trades, found that the development of traditional trade lags far behind e-commerce trade. As a new type of international trade, however, cross-border e-commerce is also affected by various links in the international trade chain such as payments, logistics, inspections, quarantine, and customs clearance, which can greatly hinder its development. C. Zaki's (2013) research shows that developing countries are more need of trade facilitation than developed countries are. Trade facilitation is beneficial to export diversification and fosters intra- and inter-regional trade. Xie and Yue (2011) examined trade data from China and 50 other countries in 2008 in an empirical analysis. Their results show that tariff reductions are much less effective in promoting trade than trade facilitation. The literature shows that trade facilitation can significantly lower global trade costs by 10% to 18% while also having a positive impact on trade flows between countries.

The impact of trade facilitation reforms on trade flows has been recognized all over the world. These reforms aim to increase the efficiency of all links in the global trade chain through policy optimization. The advantages of "Internet + foreign trade" have helped cross-border e-commerce grow significantly. However, the development of trade facilitation has been hampered and transaction costs have risen as a result of factors like cumbersome customs clearance procedures, opaque policies, and long transportation times. So now that the RCEP agreement has been in effect for six months, are China's cross-border e-commerce exports to RCEP countries experiencing these aforementioned inconveniences? What impact have the trade facilitation initiatives of the RCEP countries had on China's cross-border e-commerce exports? At present, the trade facilitation environment and the development level of cross-border e-commerce between China and other RCEP countries are extremely unbalanced. Promoting the development of international trade through cross-border e-commerce is an area of great concern and expectation among RCEP countries. In order to provide valuable reference material for RCEP governments to develop better trade facilitation policies, this paper intends to examine the impact of trade facilitation in RCEP countries on China's cross-border e-commerce exports.

The specific content of this paper is as follows. First, referring to previous studies and combining the characteristics of current cross-border e-commerce, a Trade Facilitation Index (TFI) system comprising five primary indicators and 19 secondary indicators is constructed. The more scientific principal component analysis method is used to assign the weights of each

primary indicator and each secondary indicator to measure the trade facilitation levels of each RCEP country. Using relevant panel data for China and 13 of the RCEP countries from 2008 to 2019, we conduct an extensive study on the impact of trade facilitation levels on China's cross-border e-commerce exports through the expanded trade gravity model. In the model, the dependent variable is China's cross-border e-commerce exports, and the core independent variable is the TFI. Other independent variables include the GDP per capita of China and other RCEP countries, the cultural distance between countries, and whether China has signed FTAs with the RCEP countries.

This paper has three contributions: firstly, we have developed a TFI system based on the characteristics of cross-border e-commerce. It directly reflects the trade facilitation levels of RCEP countries through quantitative calculation. We further compare the trade facilitation level of each country, which will help identify the shortcomings of trade facilitation reform and provide important reference materials for governments seeking to solve the stated shortcomings.

Secondly, previous studies have focused more on the impact of trade facilitation on traditional trade flows, while few studies have been done on the impact of cross-border e-commerce exports. This paper explores the impact of trade facilitation levels of RCEP countries on China's cross-border e-commerce exports, thus helping to fill this gap in the existing literature.

Third, RCEP countries have begun implementing a series of trade facilitation policy measures since the agreement was signed, but many of these initiatives still require gradual improvement. To put forward more targeted measures to improve trade facilitation levels, this paper further analyzes the impact of five primary indicators on cross-border e-commerce exports, namely, regulatory environment, infrastructure development, customs environment, e-commerce, and financial services. In this way, guidelines for future construction of bilateral or even multilateral interconnection infrastructure are provided, and barriers to the growth of cross-border e-commerce are removed.

2. Literature Review

2.1. Studies on Trade Facilitation

Even though scholars around the world have studied it extensively, there is still no consistently formed concept of trade facilitation internationally. Wilson et al. (2003) first proposed a TFI (trade facilitation index) system which incorporates the regulatory environment, customs environment, port efficiency, and e-commerce. They used the TFI to measure the level of trade facilitation in the Asia-Pacific region, and then analyzed the relationship between the TFI and trade flows in the region. Wilson's TFI system is relatively complete, and as such, most of the subsequent TFI systems have been developed on the basis of Wilson's. Kong and Dong (2015) used 22 secondary indicators to measure the trade facilitation level and grouped them into four primary indicators: finance and e-commerce, customs and border management, regulatory environment, and port and logistics efficiency, making their TFI system more scientific. Tansakul et al. (2013) proposed a trade facilitation framework specifically for assessing East-West economic corridor routes, suggesting that time, cost, and complexity of transaction processes are all likely factors affecting trade facilitation in East-West economic corridors. Nora (2014) analyzed and identified the main forces that contributed to the formation of regional trade facilitation.

Trade facilitation is widely recognized as a “sum” game by both scholars and international economic organizations, with the goal of reducing the complexity of international trade, simplifying trade processes, and improving trade efficiency. In this regard, Walkenhorst and Yasui (2004) argued that the important benefit of trade facilitation is reducing transaction costs and cumbersome customs clearance procedures in international trade activities, and developing countries benefit more from implementing trade facilitation measures (Francois, 2006). Repeatedly using the CGE model in experiments in 1997, 1999, and 2002, APEC came to the following conclusions: firstly, that trade facilitation can reduce commodity prices across all countries; and secondly, for every 1% reduction in the price of imported goods in the more industrialized member countries, there is a 2% reduction for the less developed member countries, resulting in a significant increase in trade volumes of about 3.3%. Meanwhile, Lionel, Gianluca, and Roberta (2020) argued that trade facilitation policies can reduce exporters’ fixed and variable costs, which in turn affect the size and composition of trade. Fontagné L et al. (2020) analyzed that different facets of trade facilitation may impact heterogeneously exporters of different size and productivity, and trade facilitation policies like advance ruling, appeal procedures and the automation of border formalities tend to favor large exporters than small exports.

2.2. Research on Cross-Border E-commerce

As a new form of international trade, the influencing factors of cross-border e-commerce and its economic benefits are receiving increasing attentions.

Some scholars have studied its influencing factors from the perspective of cross-border e-commerce processes such as enterprise, payment, and logistics. Ghorbani and Bonab (2013) argued that upstream international enterprises are more willing to participate in international trade and that e-commerce is having a significant impact on the globalization process. In terms of cross-border payment, Chu (2016) analyzed a series of problems which exist in the process of financial interconnection between China and the countries and regions involved in the Belt and Road Initiative. He proposed that a financial service network or investment-financing linkage system should be built to form a cross-border e-commerce financial support system. With regard to cross-border logistics, Cho et al. (2008) discussed the impact of logistics on firm performance in the context of cross-border e-commerce. They found that in the computer and consumer electronics retail industries, logistics capacities are positively correlated with firm performance, while there is no significant correlation between logistics outsourcing and firm performance. Other scholars believe that poor logistics is the main factor hindering cross-border e-commerce, such as Kim (2016), whose research has shown that good logistics speed can expand the volume of cross-border trade.

Some scholars have studied the factors influencing the growth of cross-border e-commerce from the perspective of consumer behavior. Valarezo (2018) studied the factors such as an individual’s education level and internet skills, which have a significant positive impact on the transaction behavior of cross-border e-commerce. Han and Kim (2019) developed a cross-border e-commerce research model that explain the impact of consumer awareness by linking cross-border e-commerce motivation, information technology usage patterns, consumer awareness and purchase intention. Cardona and Duch-Brown (2016) studied the effect of delivery costs on cross-border e-commerce flows in the EU. They found that consumers’ concerns about long delivery times reduce their spending on cross-border e-commerce consumption, while eliminating consumers’ concerns about delivery cost increases cross-border e-commerce transactions by 5%.

A number of studies have also been conducted to investigate the economic benefits of cross-border e-commerce. Mesut (2011) found that e-commerce can mitigate the negative impacts of economic crisis on trade by increasing efficiency and lowering costs. Terzi (2011) found that cross-border e-commerce can promote fine division of labor in industry and improve product price regulation through coordinating the supply chain, which improves manufacturer productivity and has a positive effect on trade facilitation. Nielson and Morris (2001) analyzed the relationship between cross-border e-commerce and international trade. They discovered that the characteristics of cross-border e-commerce can significantly affect marketing, supply chain, and distribution in international trade, and also impact the supply and demand relationship between the two trade parties. He et al. (2011) clarified that e-commerce has an impact on product quality, prices, and imports and exports.

2.3. Nexus of Trade Facilitation and Cross-Border E-commerce

There have been few studies on the impact of trade facilitation on cross-border e-commerce both domestically and internationally. Scholars have studied the impact of trade facilitation on international trade flows more frequently through actual surveys, construction of Global Trade Analysis Project (GTAP) models, and gravity models. Freund and Weinhold (2004) proved that e-commerce has a significant impact on trade growth through time series and cross-sectional regressions. Their results showed that e-commerce, port efficiency, customs environment, and policy environment are measurable trade facilitation indicators. Thomas, Terrie, and Ken (2001) examined the factors influencing the trade scale between Japan and Singapore using the dynamic GTAP model, and found that trade facilitation, especially the degree of customs networking and the prevalence of online transactions, played an important role in driving the growth of commodity trade. Through quantitative analysis of digital products, Hoekman and Shepherd (2015) found that, compared to the geographical distance of offline transactions, the regulatory environment and business environment in trade facilitation had a greater impact on the trade flows of cross-border e-commerce. By analyzing the unbalanced panel data from 1992 to 2009, Sithanonxay et al. (2016) calculated that the trade volume of ASEAN countries is affected by factors such as transportation costs, import tariffs, and e-commerce level on both sides. Chai and Dong (2019) argued that trade facilitation levels in Asian countries have a positive correlation with Chinese cross-border e-commerce exports, and that different trade facilitation indicators have different effects. Gomez-Herrera et al. (2013) studied 27 European Union member countries, and discovered that although there are great differences in language and geographical distance between the different countries, online trade can significantly reduce transaction costs caused by geographical distance due to technical and informational advantages. Jiang (2017) pointed out that the Internet allows for lower transaction and resource allocation costs, thus promoting the growth of e-commerce trade.

Other scholars have studied the impact of trade facilitation on cross-border e-commerce using a single indicator, such as digital technology, credit, or logistics. Elia and Giuffrida (2021) examined the role of digital technology in cross-border e-commerce according to the firm resource-based view. They found that enterprises using digital technology are more likely to increase their exports through cross-border e-commerce. Shi (2016) discovered that the internet has increased the export volume of Chinese firms, which can increase export probability and improve the sustainable export capacity of enterprises (Li & Li, 2017).

In summary, research findings indicate that “trade facilitation can promote the growth of

global trade and economy by reducing costs, simplifying customs clearance procedures and improving trade efficiency". Cross-border e-commerce is an inevitable product of international trade development, and its economic benefits have been noticed in countries all over the world. Cross-border e-commerce logistics, payment, and trade policies are all closely related to the trade facilitation level. These aspects are not only specific to trade facilitation development, but they are also the main factors influencing the development of cross-border e-commerce. Therefore, this paper will further explore the impact of trade facilitation level on China's cross-border e-commerce exports, as well as the countermeasures and suggestions for further improvements in the context of the RCEP.

3. Construction and Measurement of TFI System

3.1. Construction of Trade Facilitation Index (TFI) System

Trade facilitation involves a wide range of dimensions. Trade facilitation level is usually measured by specific relevant indicators. As previously mentioned, development of current trade facilitation indices are most often done by adding, subtracting or modifying relevant dimensions on the basis of Wilson's original indicators. As a result, based on Wilson's initial index, this paper inserts financial services into the primary indicators of trade facilitation, resulting in five primary indicators-regulatory environment, infrastructure development, customs environment, financial services, and e-commerce-and 19 secondary indicators (Yang, 2019). See Table 1 for details.

Table1. Indicator Composition of TFI System

Primary Indicators	Secondary Indicators	Score Range for Indicators	Data Source
Regulatory Environment	Burden of government regulation(R_1)	1-7	GCR
	Transparency of government policymaking(R_2)	1-7	GCR
	Efficiency of legal framework in settling disputes(R_3)	1-7	GCR
	Judicial independence(R_4)	1-7	GCR
	CPI(R_5)	1-100	CPI
Infrastructure Development	Quality of roads(I_1)	1-7	GCR
	Quality of railroad infrastructure(I_2)	1-7	GCR
	Quality of port infrastructure(I_3)	1-7	GCR
	Quality of air transport infrastructure(I_4)	1-7	GCR
Customs Environment	Prevalence of trade barriers(C_1)	1-7	GCR
	Irregular payments and bribes(C_2)	1-7	GCR
	Burden of customs procedures(C_3)	1-7	GCR
Financial Services	Availability of financial services(F_1)	1-7	GCR
	Affordability of financial services(F_2)	1-7	GCR
	Financing through local equity market (F_3)	1-7	GCR
	Venture capital availability (F_4)	1-7	GCR
E-commerce	Availability of latest technologies (EC_1)	1-7	GCR
	Firm-level technology absorption(EC_2)	1-7	GCR
	Individuals using Internet, %(EC_3)	1-100	GCR

3.2. Measurement of Trade Facilitation Level

To accurately measure the level of trade facilitation and eliminate the influences of variable size or dimensions, this paper used the linear transformation method to standardize the raw data of each secondary indicator, thereby limiting the value range of the indicators to between 0 and 1. To avoid the subjectivity and randomness of assigning indicator weights that has been observed in previous studies, this paper used Stata 16.0 software to perform principal component analysis on the standardized values. Finally, the score and variance contribution rate of each principal component were obtained. As the first four principal components (Comp1, Comp2, Comp3, and Comp4) extract 88.659% of the information, it was thought reasonable to replace the original 19 secondary indicators with the first four principal components and use them to determine the corresponding weights. According to the coefficients of the secondary indicators corresponding to each principal component, the expressions of the four principal components were thus obtained as follows:

$$\text{Comp}_1=0.1753R_1+0.2484R_2+0.2545R_3+0.2429R_4+0.2313R_5+0.2277I_1+0.2048I_2+0.2473I_3+0.2484I_4+0.2103C_1+0.2495C_2+0.2606C_3+0.2261F_1+0.2310F_2+0.1869F_3+0.1985F_4+0.2437E_1+0.2371EC_2+0.212EC_3$$

$$\text{Comp}_2=0.3879R_1+0.1912R_2+0.1525R_3-0.0155R_4-0.0527R_5-0.2547I_1-0.3159I_2-0.144I_3-0.1045I_4+0.2842C_1-0.1084C_2+0.0294C_3+0.2532F_1+0.2091F_2+0.0844F_3+0.3724F_4-0.2276EC_1-0.2369EC_2-0.3686EC_3$$

$$\text{Comp}_3=0.5033R_1-0.0196R_2+0.105R_3-0.1884R_4-0.1923R_5+0.3521I_1+0.1373I_2+0.2296I_3+0.1511I_4-0.0343C_1+0.0226C_2+0.1501C_3-0.2806F_1-0.0795F_2-0.5151F_3+0.0343F_4-0.1481EC_1-0.2158EC_2-0.0069EC_3$$

$$\text{Comp}_4=0.1312R_1-0.1123R_2-0.1977R_3-0.3269R_4-0.3319R_5+0.1341I_1+0.3259I_2+0.156I_3+0.0785I_4-0.2752C_1-0.3219C_2-0.1719C_3+0.1013F_1+0.2315F_2+0.3805F_3+0.2673F_4+0.1153EC_1+0.1818EC_2-0.156EC_3$$

The coefficients of each secondary indicator were multiplied by the contribution rate of the corresponding principal component, and then divided by the cumulative contribution rate of the variance of the four principal components. They were then summed to obtain the comprehensive evaluation model of the trade facilitation level for this paper. The expression was as follows.

$$\text{Comp}_p=0.2139R_1+0.2045R_2+0.208R_3+0.1564R_4+0.1432R_5+0.182I_1+0.1564I_2+0.202I_3+0.1972I_4+0.1733C_1+0.1657C_2+0.2049C_3+0.19F_1+0.2097F_2+0.1451F_3+0.2097F_4+0.1652EC_1+0.1589EC_2+0.1189EC_3$$

To sum the coefficient weights of the secondary indicators to 1, the above equation was normalized. That is, the coefficient of each indicator was divided by the sum of the secondary

indicators' coefficients. The primary indicator's weight was the sum of the weights of the secondary indicators it contained. After these calculations, the weights of the primary indicators of trade facilitation in RCEP countries were regulatory environment (R) = 0.272, infrastructure development (I) = 0.2166, customs environment (C) = 0.1597, financial services (F) = 0.2216, and e-commerce (EC) = 0.1301. After collation, the composite evaluation index of trade facilitation for RCEP countries can be expressed as the following formula.

$$TWTFI=0.0628R_1+0.0601R_2+0.0611R_3+0.0459R_4+0.0421R_5+0.0535I_1+0.0459I_2+0.0593I_3+0.0579I_4+0.0509C_1+0.0487C_2+0.0602C_3+0.0558F_1+0.0616F_2+0.0426F_3+0.0616F_4+0.0485E_{C_1}+0.0467E_{C_2}+0.0349E_{C_3}$$

3.3. Measuring Results of Trade Facilitation Level

Bringing the value of each trade facilitation indicator for the RCEP countries from 2008 to 2019 into the expression TWTFI, the comprehensive level of trade facilitation in RCEP countries was obtained, as shown in Table 2.

Table 2. Comparison of Trade Facilitation Levels Between China and other RCEP Countries

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Singapore	0.9357	0.9543	0.9520	0.9410	0.9540	0.9478	0.9440	0.9511	0.9611	0.9587	0.9565	0.9648
Japan	0.8035	0.7932	0.7900	0.7914	0.8003	0.8234	0.8421	0.8471	0.8546	0.8497	0.8699	0.8748
New Zealand	0.8200	0.8462	0.8486	0.8445	0.8778	0.8845	0.8906	0.8750	0.8647	0.8729	0.8653	0.8697
Malaysia	0.7840	0.7663	0.7712	0.7906	0.8031	0.8083	0.8424	0.8379	0.8144	0.8060	0.8197	0.8238
Australia	0.8081	0.8123	0.8262	0.8043	0.8119	0.8027	0.7894	0.7987	0.7870	0.7880	0.7957	0.8052
Korea	0.7628	0.7115	0.6989	0.6838	0.6999	0.6961	0.6834	0.6936	0.7075	0.7172	0.7334	0.7479
China	0.6302	0.6542	0.6630	0.6647	0.6672	0.6826	0.6896	0.6777	0.6972	0.7127	0.7035	0.7098
Indonesia	0.5738	0.6135	0.6240	0.6033	0.6177	0.6471	0.6621	0.6410	0.6533	0.6771	0.6772	0.6933
Thailand	0.6576	0.6674	0.6774	0.6453	0.6501	0.6641	0.6522	0.6514	0.6510	0.6649	0.6659	0.6876
Brunei	0.6434	0.6670	0.6694	0.6495	0.6744	0.7027	0.7047	0.6139	0.6189	0.6273	0.6372	0.6445
Philippines	0.5374	0.5320	0.5241	0.5335	0.5755	0.6076	0.6213	0.5981	0.5662	0.5555	0.5892	0.6024
Vietnam	0.5524	0.5749	0.5683	0.5333	0.5347	0.5519	0.5618	0.5744	0.5859	0.5798	0.5734	0.6010
Laos	0.5443	0.5612	0.5660	0.5591	0.5849	0.6048	0.5906	0.5705	0.5770	0.5857	0.5895	0.5994
Cambodia	0.4832	0.5106	0.5403	0.5494	0.5825	0.5556	0.5131	0.5069	0.5223	0.5143	0.5225	0.5387

Data source: Calculated using the principal component analysis method.

Regarding the rating of the trade facilitation level, Zeng and Zhou (2008) classified it into four levels, with scores above 0.8 being very convenient, between 0.7 and 0.8 being relatively convenient, between 0.6 and 0.7 being generally convenient, and below 0.6 being not convenient. According to this standard, the trade facilitation levels of the RCEP countries were ranked from highest to lowest based on 2019 data. A cross-sectional analysis shows significant differences in the trade facilitation levels of the RCEP countries. Singapore, Japan, New Zealand, Malaysia, and Australia all scored more than 0.8, indicating a great advantage in trade facilitation over the other countries. Cambodia had the lowest level with a score of

only 0.5387 in 2019, showing a need for improvement. Both South Korea and China scored 0.7479 and 0.7098, which are relatively convenient scores.

Vertically, except for Australia and Korea, most RCEP countries showed a consistent upward trend in trade facilitation levels in 2019 compared to 2012. Among them, Indonesia's trade facilitation level increased the fastest, rising 20.8%. From 0.5738 in 2008 to 0.6933 in 2019. China increased by 12.6% from 0.6302 in 2008 to 0.7098 in 2019, moving it into the ranks of relatively convenient.

The overall trade facilitation level in RCEP countries (Figure 1), appears to be related to the nation's economic development. The higher a country's level of economic development, the higher its trade facilitation level, and vice versa. RCEP countries are committed to the development of intra-regional trade facilitation in order to promote economic growth, and each nation's trade facilitation level has greatly improved, especially in emerging market countries such as China and Malaysia. Countries with lower rankings such as Philippines or Myanmar, show varying degrees of improvement in trade facilitation levels.

4. Research Model and Empirical Analysis

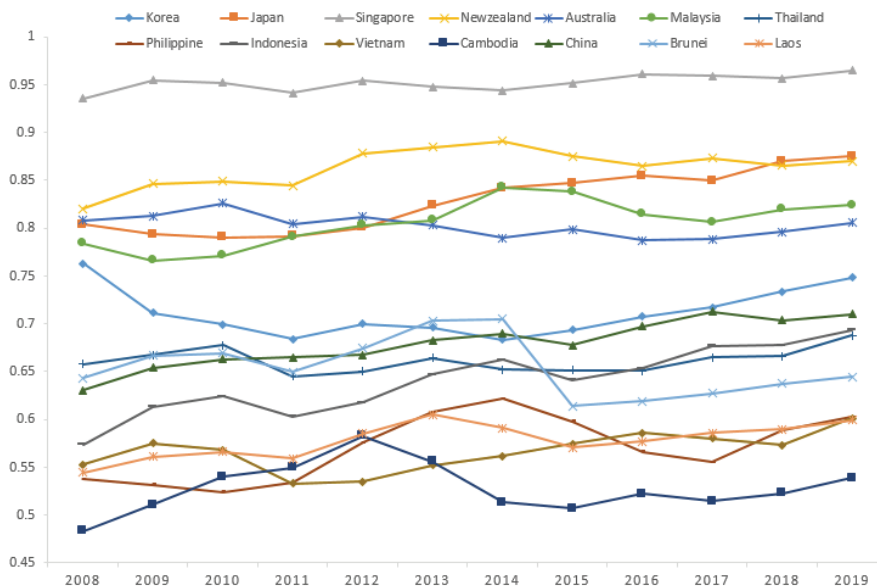
4.1. Model Setting

The gravity model originated in physics as Newton's Law of Universal Gravitation. Later Tinbergen (1962) and Poyhonen (1963) successively applied the gravity model into the field of international trade. Their research discovered that the trade volume between two countries is proportional to the size of their economies and inversely proportional to the actual distance between them. Linnemann (1966) and Berstrand (1985) added population and exchange rates to the trade gravity model, respectively, which enriched research into the gravity model. It is also possible to include some dummy variables that cannot be quantified in gravity models, such as whether a certain trade agreement has been signed or whether they belong to the same economic organization.

Because the purpose of this paper was to explore the impact of trade facilitation levels in RCEP countries on China's cross-border e-commerce exports after the signing of RCEP, we chose to incorporate the GDP per capita of China and other RCEP countries into the gravity model, as well as trade facilitation indicators, geographical distance, and whether China has signed a free trade agreement (FTA) with the other country as explanatory variables. In addition, cultural distance was used to represent cultural differences between countries and to reflect differences in consumer tastes more deeply (Blum, 2006; Feyrer, 2009). With the development of cross-border e-commerce, cultural distance dimensions, such as whether the two countries share a common language, history, legal system, trade agreement (Kim et al., 2017), social or psychological distance (Cui et al., 2020), and so on, are frequently used as influencing factors. As a result, we included cultural distance as an explanatory variable. For regression analysis, this study selected the panel data of the 13 RCEP countries and China from 2008 to 2019. In order to reduce heteroscedasticity, some variables were taken logarithmically, and the final gravity model was developed as follows:

$$\ln EXP_{ijt} = \beta_0 + \beta_1 \ln PGDP_{jt} + \beta_2 \ln PGDP_{it} + \beta_3 \ln DIS_{ij} + \beta_4 \ln CDI_{ij} + \beta_5 FTA_{ijt} + \beta_6 \ln TFI_{jt} + \mu_{ij} \quad (1)$$

Fig. 1. Distribution of Trade Facilitation Levels among RCEP Countries, 2008-2019



Where EXP_{ijt} represents the total export value of China’s cross-border e-commerce exports to RCEP Country j in period t , and the cross-border e-commerce data can be calculated using the method of iResearch (<https://www.iresearch.cn>). The specific formula is as follows:

$$\text{China's cross-border e-commerce exports to Country } j = \text{China's total cross-border e-commerce exports} * \frac{\text{China's exports to country } j}{\text{China's total exports}}$$

$PGDP_{jt}$ represents the GDP per capita of importing Country j in period t , which measures the economic strength and purchasing power of Country j . $PGDP_{it}$ is the GDP per capita of China in period t . The data was obtained from the “World Bank Development Indicators”.

CDI_{ij} expresses the cultural distance between China and Country j . The greater the cultural difference between the two countries, the less favorable it is to cross-border e-commerce exports. The smaller the cultural difference, the better it is for international trade. The relevant data were downloaded and collated from the website <https://www.geerthofstede.com>.

DIS_{ij} is the actual distance between China and Country j . The greater the actual distance between the two countries, the higher the trade costs and therefore, the more unfavorable the trade flows. The data was obtained from the CEPII online database of the French Centre for World Economic Studies.

FTA_{jt} denotes whether China and importing Country j have signed a free trade agreement and was included as a dummy variable. It takes the value of 1 if the two countries have signed in period t , and 0 if they have not yet signed an FTA. Signing an FTA reduces trade barriers for both countries and enhances trade flows between them.

The TFI_{jt} is the core explanatory variable in this study, denoting the level of trade facilitation in importing country j in period t . An improvement in the level of trade facilitation in

Country j will increase the volume of cross-border e-commerce trade between the two countries. The data was drawn from “The Global Competitiveness Report” of the World Economic Forum and the Corruption Perceptions Index published by Transparency International.

β_0 is the constant term, β_k ($k = 1, 2, \dots, 5$) are the regression coefficients of the explanatory variables; and μ_{ij} is the random error term.

The five primary indicators of trade facilitation have different impacts on China's cross-border e-commerce exports. To study the impact of each primary indicator more intuitively and to propose targeted countermeasures, this study took the five primary indicators of trade facilitation, namely: regulatory environment, infrastructure development, customs environment, financial services, and e-commerce as trade facilitation level, resulting in the following five regression equations.

$$\ln \text{EXP}_{ijt} = \beta_0 + \beta_1 \ln \text{PGDP}_{jt} + \beta_2 \ln \text{PGDP}_{it} + \beta_3 \ln \text{DIS}_{ij} + \beta_4 \ln \text{CDI}_{ij} + \beta_5 \text{FTA}_{ijt} + \beta_6 \ln R_{jt} + \mu_{ij} \quad (2)$$

$$\ln \text{EXP}_{ijt} = \beta_0 + \beta_1 \ln \text{PGDP}_{jt} + \beta_2 \ln \text{PGDP}_{it} + \beta_3 \ln \text{DIS}_{ij} + \beta_4 \ln \text{CDI}_{ij} + \beta_5 \text{FTA}_{ijt} + \beta_6 \ln I_{jt} + \mu_{ij} \quad (3)$$

$$\ln \text{EXP}_{ijt} = \beta_0 + \beta_1 \ln \text{PGDP}_{jt} + \beta_2 \ln \text{PGDP}_{it} + \beta_3 \ln \text{DIS}_{ij} + \beta_4 \ln \text{CDI}_{ij} + \beta_5 \text{FTA}_{ijt} + \beta_6 \ln C_{jt} + \mu_{ij} \quad (4)$$

$$\ln \text{EXP}_{ijt} = \beta_0 + \beta_1 \ln \text{PGDP}_{jt} + \beta_2 \ln \text{PGDP}_{it} + \beta_3 \ln \text{DIS}_{ij} + \beta_4 \ln \text{CDI}_{ij} + \beta_5 \text{FTA}_{ijt} + \beta_6 \ln F_{jt} + \mu_{ij} \quad (5)$$

$$\ln \text{EXP}_{ijt} = \beta_0 + \beta_1 \ln \text{PGDP}_{jt} + \beta_2 \ln \text{PGDP}_{it} + \beta_3 \ln \text{DIS}_{ij} + \beta_4 \ln \text{CDI}_{ij} + \beta_5 \text{FTA}_{ijt} + \beta_6 \ln \text{EC}_{jt} + \mu_{ij} \quad (6)$$

4.2. Empirical Results

For panel data the mixed-effects model, fixed-effects model, and random-effects model are the three most frequently used models. The best regression estimation must be determined by choosing a test model from the three models. In this study, the F -test was firstly used to decide between using the fixed-effects model and the mixed-effects model. Then the Hausman test was used to choose between the random-effects model and the fixed-effects model. The results of the F -test and the Hausman test are shown in Table 3.

Table 3. Overall Regression Results of the Trade Gravity Model

Type of Test	Test Statistic	P-value
F-test	345.42	0.0000
Hausman Test	0.96	0.9156

As can be seen from the above table 3, in the F -test the p -value is 0.0000, so the fixed effects model is better than the mixed OLS (Ordinary Least Squares) model. The Hausman test results show that the p -value is greater than 0.05, indicating that the random effects model is better than the fixed effects model. Therefore, the random effects model was employed in this study. The overall effect of trade facilitation and the effects of the five primary indicators were obtained using Stata16.0 to estimate models 1-6, and are shown in Table 4 along with their respective effects.

Table 4. Effects of Trade Facilitation in RCEP Countries on China's Cross-border E-commerce Exports

Variables	Overall Effect		Primary Indicator Effects			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$\ln\text{PGDP}_{it}$	2.2418*** (25.73)	2.261*** (26.94)	2.3023*** (26.67)	2.2256*** (24.96)	2.2813*** (26.92)	2.1704*** (23.61)
$\ln\text{PGDP}_{jt}$	0.6563*** (4.91)	0.6508*** (5.14)	0.7374*** (5.29)	0.5819*** (4.76)	0.7201*** (5.31)	0.5625*** (3.97)
$\ln\text{DIS}_{ij}$	-0.9171 (-1.83)	-0.943* (-2.14)	-0.7755 (-1.42)	-0.9149** (-2.64)	-0.9333 (-1.70)	-0.7921 (-1.48)
$\ln\text{CDI}_{ij}$	-1.7655* (-2.26)	-1.8119** (-2.66)	-1.8886* (-2.20)	-1.7947** (-3.40)	-1.7278* (-2.02)	-1.8306* (-2.18)
FTA_{ijt}	0.1863* (2.53)	0.1876* (2.54)	0.1699* (2.28)	.2268** (2.89)	0.1705* (2.32)	0.1714* (2.37)
$\ln\text{TFI}_{jt}$	3.1847* (2.25)					
$\ln\text{R}_{jt}$		2.5569* (2.42)				
$\ln\text{I}_{jt}$			-0.912 -0.95			
$\ln\text{C}_{jt}$				3.009* (2.07)		
$\ln\text{F}_{jt}$					2.299* (2.30)	
$\ln\text{EC}_{jt}$						3.6184*** (3.15)
Constant	-12.2539*** (-3.17)	11.7315*** (-3.45)	12.3652*** (-2.91)	11.3763*** (-4.20)	12.6649*** (-2.99)	11.9452*** (-2.88)

From the overall results of the random effects regression, we note that the actual distance between China and RCEP countries had no significant effect. However, the other explanatory variables are consistent with predictions, and results all pass the significance level tests of 1%, 5%, and 10%. With the exception of an insignificant effect of port efficiency, the coefficients of the other four primary indicators all passed the significance test. The specific analysis is as follows:

Model 1 measures the overall impact of trade facilitation on China's cross-border e-commerce exports. According to the regression coefficients of the variables, the trade facilitation levels in the RCEP countries had the largest impact, with a regression coefficient of 3.1847. It indicates China's cross-border e-commerce exports will increase by 3.1847% for every 1% increase in the trade facilitation level assuming all other factors stay the same. The improvement of the trade facilitation level has a far greater positive impact than the signing of a FTA.

China and the RCEP countries' per capita GDP also has a greater impact on China's cross-border e-commerce exports. This indicator is a significant factor in the growth of import and export trade because it reflects a country's economic capacity, potential supply capacity, and potential trade demand. With continuous economic development of RCEP countries and the substantial improvement of living standards, more and more people are making purchases

outside of their home countries, opening up a broad market for cross-border e-commerce in these countries. In this study, the coefficients of GDP per capita in RCEP countries and China are 0.6563 and 2.2418, respectively, indicating that China's cross-border e-commerce exports increased by 0.6563% and 2.2418% for every 1% increase in GDP per capita.

The effect of the physical distances between China and the RCEP countries was not shown to be significant. However, the effect of cultural distance did have a significant negative correlation. China's cross-border e-commerce exports will increase by 1.7655% for every 1% decrease in cultural distance. This is because cross-border e-commerce relies on Internet platforms to carry out transactions and settlements, thereby reducing transaction costs. Previous research (Cowgill and Dorobantu, 2012; Ma et al., 2019) has found that cross-border e-commerce can somewhat weaken the negative effects of geographical distance. In contrast to the "death of geographical distance", the weakening effect of cultural distance on cross-border e-commerce is very limited (Gomez-Herrera et al., 2014; Lendle et al., 2016).

The dummy variable of whether a FTA has been signed or not was also shown to have a significant effect, with a regression coefficient of 0.1863. This means that when China signs a FTA with other RCEP countries, its cross-border e-commerce exports will increase by 0.1863%.

The study also conducted regression analysis on the effects of the five primary indicators of trade facilitation on China's cross-border e-commerce exports, using the optimal random effects model. The results show that, with the exception of the insignificant effect of infrastructure, the remaining four primary indicators of e-commerce, customs environment, regulatory environment, and financial services all have a positive effect on e-commerce exports. E-commerce has the greatest impact of the four primary indicators, followed by customs environment, institutional environment, and financial services, with impact coefficients of 3.618, 3.009, 2.557, and 2.299, respectively. This means that all else being equal, for every 1% increase in RCEP countries' e-commerce, customs environment, regulatory environment, and financial services, China's cross-border e-commerce exports will increase by 3.618%, 3.009%, 2.557%, and 2.299%, respectively.

It is important to improve trade facilitation level in developing countries in "hardware" environments, such as infrastructure development (Wilson, Mann & Otsuki, 2005). However, the study shows that the infrastructure indicator has no significant effect on China's cross-border e-commerce exports. This is most likely due to the fact that most RCEP countries, including Philippines, Vietnam, and Laos have very underdeveloped railway, road, and air transport systems. Furthermore, these nations' connections with foreign countries are not particularly smooth at present, which has an impact on cross-border e-commerce exports. As a result, there is an urgent need to invest heavily in RCEP countries with lagging infrastructure in order to bring them up to, if not above, the global average.

5. Conclusion and Enlightenment

5.1. Conclusions

This study first constructed a trade facilitation index system, and then quantitatively calculated the RCEP countries' levels of trade facilitation. The extended gravity model was then used to study the influence mechanism by which RCEP countries' trade facilitation levels affect China's cross-border e-commerce exports. The following findings were obtained:

First, the overall level of trade facilitation in RCEP countries is constantly improving, even though there are obvious country-specific differences among these countries. The study's results showed that developed countries have a high level of trade facilitation, while developing countries lag behind. China's TFI score increased steadily from the 2008 to 2019 period, ranging from the middle to upper level, but there still remains a big gap between China's TFI score and that of developed countries.

Second, while the overall level of trade facilitation in RCEP countries has a significant positive effect on China's cross-border e-commerce exports, the effects of the five primary trade facilitation indicators vary. The effects of e-commerce, financial services, customs environment, and regulatory environment decreases sequentially, while the influence of infrastructure is not significant.

Third, in addition to the core explanatory variable of trade facilitation, which has a significant impact on China's cross-border e-commerce exports, the findings of this study confirm the significant impact of cultural distance. Although Internet-based cross-border e-commerce significantly reduces trade costs related to geographical distance, trade costs related to cultural distance may increase. As a result, cross-border e-commerce enterprises should provide relevant service support to eliminate consumer confusion caused by language, culture, and custom differences, ultimately lowering transaction costs and improving trade efficiency.

5.2. Practical Implications

According to the findings of this study, the trade facilitation levels of RCEP countries can significantly promote China's cross-border e-commerce exports. In order to promote the better development of cross-border e-commerce through trade facilitation measures, we recommend that the following specific measures be carried out:

First, the results of the gravity model show that the customs environment has a significant impact on China's cross-border e-commerce exports. As a result, RCEP countries should encourage extensive customs cooperation and optimize the customs environment to facilitate trade. China and other countries can provide more convenience for enterprises with good credit through the "Authorized Economic Operator Mutual Recognition Arrangement". Countries should strengthen cooperation in "customs information sharing and mutual recognition of regulatory results", in order to reduce repeated inspections of the same batch of goods by different countries and to reduce customs detention time. At the same time, advanced electronic information technology, such as paperless customs clearance, should be used to improve customs clearance efficiency.

Second, convenient cross-border payments and multi-channel financing are the basis for the growth of cross-border e-commerce. Financial institutions in RCEP countries should be more open and provide professional, diversified financial services for enterprises. Countries should increase loan amounts for e-commerce enterprises with good credit and open green channels for efficient approval processes to ensure that enterprises' capital needs are met. At the same time, cross-border payment links should be optimized, as should payment efficiency. Because cross-border payments involve capital flow, it is also necessary to implement a timely financial early warning mechanism and financial supervision mechanisms to avoid potential financial security risks.

Third, the institutional environment has a significant impact on China's cross-border e-commerce exports. RCEP Countries should implement appropriate policies and regulations

to support the growth of cross-border e-commerce and improve information communication channels, publicly disclose information about cross-border enterprises, cargo clearance, inspections and logistics in a timely manner to reduce enterprise losses caused by information asymmetry. They should also pay close attention to changes in other countries' trade policies, in order to make professional interpretations and assessments of the changes, and provide timely, relevant feedback to enterprises.

Fourth, with a regression coefficient of 3.618, the promotion effect of e-commerce is the most significant of the five primary indicators of trade facilitation. As an emerging type of modern international trade, cross-border e-commerce is inseparable from the Internet, beginning with product searches, and progressing to online purchases and payments. A country's informatization level and e-commerce operation capability directly affect the core competitiveness of cross-border e-commerce. Therefore, RCEP countries should strengthen their e-commerce infrastructure construction and promotion efforts, as well as develop relevant laws and regulations to standardize and guide the development of internet technology. Furthermore, countries should fully utilize technologies such as cloud computing, big data, and the Internet of Things to encourage the integration of cross-border e-commerce with new technologies.

Finally, South Korea and China are close neighbors with set geographical distance. Trade facilitation level between the two countries should be improved so as to increase their trade volumes. South Korea sees a growing amount in cross-border e-commerce trades as its trade facilitation level improves (Xuan & Chang, 2022). In particular, its well-developed aviation and port facilities, good transportation connectivity, and the popularity of its network within the government as well as among civilians, all having contributed to the accelerated growth of cross-border e-commerce in the country. According to the data from Korea Statistics Office in 2019, China is the largest importer for South Korea, accounting for 86% of its e-commerce exports, while Japan and ASEAN rank the second and third, respectively, accounting for both 4% of South Korea's exports. Compared with exports, South Korea has a higher import volume via cross-border e-commerce, with the United States, Japan and China as its top three exporters. Nowadays, Korean consumers can purchase goods from China on shopping websites quicker and easier than in the past, thanks to the continuous development of China's logistics, simpler procedures for passing the Customs, plus the development of internet facilities and the growing number of netizens.

According to the results from assessing the trade facilitation level in RCEP countries by this paper, South Korea has not seen a substantial improvement in most areas for trade facilitation since 2010, especially its infrastructure and institutional regulations. Therefore, the South Korean government should implement more beneficial policies, such as policies to support e-commerce and business law as well as tariff law, to realize trade facilitation and boost the development of cross-border e-commerce. China and South Korea are both ratified countries of the "Trade Facilitation Agreement" who should actively advance the process of trade facilitation. The two countries should, for example, improve their public services and infrastructures, speed up the construction of a simple custom procedure system, and realize AEO mutual recognition to provide conveniences and high-quality services for capable enterprises.

5.3. Research Limitations and Prospects

With the popularization of the internet and the rapid development of global informa-

tization, cross-border e-commerce has grown into a new trading form, a novel engine that boosts international trades. Especially since 2020 when COVID has swept the world, traditional offline international trades face great challenges. Therefore, online international trades rise, which have facilitated the development of cross-border e-commerce. It is clear that COVID has a positive impact on cross-border e-commerce, particularly in China, a country of large exports.

However, due to the fact that China's cross-border e-commerce is still in the development stage, and studies on cross-border e-commerce started late, only statistics before the year of 2019 on China's cross-border e-commerce exports to partners bound by RCEP were available for analysis. Changes in cross-border e-commerce following the outbreak of COVID in 2020 is not mentioned in this paper. This is the limitation of the study. Thankfully, academicians paid increasing interests in China's cross-border e-commerce due to its rapid development. We believe the data will become more complete in the near future, and the comparison can be made between China's cross-border e-commerce before and after the COVID pandemic in the subsequent study, as a supplementary to the current study.

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