The Influence of Trade Facilitation on the Depth and Breadth of China's Agricultural Exports: Empirical Evidence Based on RCEP Countries

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Abstract

This article analyzes how trade facilitation influence China's agricultural exports to RCEP partners. Based on the data of the World Economic Forum Global Competitiveness Report and principal component analysis, we constructs a 14 index system to measure trade facilitation. Based on the export data from 2011 to 2019, the extended gravity model is used to estimate the relationship between trade facilitation and the depth and breadth of China's agricultural exports. The study shows that improving the trade facilitation of RCEP partners can significantly enhance the depth of China's agricultural exports. Specifically, the trade openness, e-commerce and financial environment of importing countries have a significant positive impact on the depth and breadth of exports. Another important finding is that China's trade facilitation has played a more active role in the depth and breadth of exports. Its infrastructure quality, e-commerce and financial environment can greatly promote China's agricultural exports.

Keywords: trade facilitation, agricultural products, RCEP, export depth and breadth

1. Introduction

RCEP, which stands for Regional Comprehensive Economic Partnership Agreement, was officially signed by fifteen trade ministers from China, Japan, South Korea, Australia, New Zealand and ten ASEAN countries on November 15, 2020, and entered into force on January 1, 2022. As of March 2022, there have been twelve countries, except Indonesia, Myanmar and the Philippines, beginning implementing the agreement. The implementation of this comprehensive, mutually-beneficial, high-quality regional FTA will strongly boost the confidence of countries in the region in economic growth, unleash their market potential, promote investment and trade, which will help China improve the gold content of its FTA network and form a new development pattern of dual circulation.

Since China's accession to the WTO, its agricultural trade has developed rapidly and occupied a pivotal position in foreign trade. The Sino-U.S. trade disputes have hampered the trade between the two countries, so China has accelerated the pace of regional economic integration. With the successful negotiation of RCEP, China's agricultural trade with RCEP member countries has developed well in the past decade. However, due to the lack of awareness of trade facilitation, imperfect port infrastructure, cumbersome customs procedures, lack of coordination between departments, and long inspection time of goods, RCEP countries still suffer from high trade costs and low efficiency, which play a particularly prominent role in hindering China's agricultural trade with RCEP countries. Therefore, it is necessary to explore the impact of RCEP trade facilitation on China's agricultural exports and how to improve the current situation.

As the RCEP agreement's Chapter 4 focuses on customs procedures and trade facilitation, and it is dedicated to improving trade environment, optimizing the business environment, improving the efficiency of customs clearance, and reducing the impact of non-tariff barriers within the region. Can strengthening trade facilitation among China and other RCEP members promote the growth of China's agricultural exports and increase its export diversification? Based on the background above, this paper will measure the trade facilitation level of RCEP member countries using the panel data of fifteen RCEP countries from 2011-2019, select four first-level indicators and fourteen secondary

indicators, and analyze the impact of trade facilitation level on the scale and variety of China's agricultural exports.

2. Literature Reviews

Up to now, there is no universally accepted definition of trade facilitation worldwide, which generally refers to the promotion of the free flow of goods and services through the harmonization of national trade regimes and the simplification of international trade procedures. And the methodologies used to measure it in previous studies are not unique. On the one hand, some scholars take other indicators as proxy variables for trade facilitation. For example, Freund and Weinhold (2000) use Internet penetration, Djankov et al. (2010) take export time and import time from the World Bank database, Clark et al. (2004) choose infrastructure indicators such as roads and railroads, Dennis and Shepherd (2011) select transaction costs in the process of cross-border trade, Dennis (2010) uses export time to represent national logistics level, and Felipe et al. (2010) take logistics performance index as a single proxy variable. Iwanow and Kirkpatrick (2007) use invisible barriers to export trade and unconventional payments for imports and exports as proxy variables to measure trade facilitation. Portugal-Perez and Wilson (2010, 2012) use border clearance efficiency and political regulatory environment as proxies for software, and infrastructure and ICT quality level as hardware, such as roads and railroads, combining software and hardware to measure trade facilitation. Hoekman and Shepherd (2015) use import and export time as a proxy for trade facilitation. Nguyen Viet (2015) combined the number of customs documents and import and export time in the research on trade facilitation, gap between rich and poor and inequality. Huang et al. (2020) measured trade facilitation from the perspective of cross-border cost and cross-border time. Ge and Yu (2020) use the number of customs documents and the quality of port infrastructure to represent trade facilitation. On the other hand, the method of constructing a indicator system is also commonly used. Wilson, Mann and Otsuki (2003, 2005) pointed out in their study that trade facilitation includes not only the border factors such as port efficiency and customs environment, but also the domestic factors like regulatory environment, infrastructure and e-commerce. And they constructed a framework for measuring trade facilitation that includes four dimensions of port efficiency, customs environment, regulatory environment and e-commerce, which were assigned weights of 58.3%, 7.2%, 18.4% and 16.1%, respectively. Later, some scholars changed the algorithm of first-level and second-level indicators as well as the calculating methods of indicator weights on this basis for related studies. Li and Guo (2013), Wu et al. (2020) measured the level of trade facilitation of their respective research subjects based on the principal component method. Tan and Pan (2016), Zhang (2018), Duan et al. (2020) measured the trade facilitation level of countries along the Belt and Road and BRICS countries by taking the simple arithmetic mean. Noting the growing importance of finance and logistics, some scholars have added relevant indicators to the measurement framework. Kong and Dong (2015) have included the primary indicators of finance and e-commerce, port and logistics efficiency, and added the secondary indicators of logistics competitiveness and financial service convenience. Dong and Zhou (2020) added the first-level indicators of financial services and used the arithmetic mean method to determine the indicator weights. Li (2021) added two new dimensions of logistics environment and financial environment, and used principal component analysis to calculate the trade facilitation level of countries along the China Railway Express.

As for the study on the relationship between trade facilitation and trade flows, Freund and Weinhold (2000) used gravity model to examine the impact of e-commerce as the main indicator of trade facilitation on national import and export trade. The empirical study showed that a 10% increase in Internet penetration would increase national import and export trade by 1% in 1998 and 1999. Shepherd and Wilson (2009) construct the regression formulae with gravity model using Southeast Asian countries as the study subjects and conclude that trade flows between Southeast Asian countries are more influenced by infrastructure and information communication. Wilson, Mann and Otsuki (2003) found that port efficiency has a significant positive effect on import and export volume, regulatory barriers hinder trade, and improving customs efficiency and e-commerce environment can significantly expand trade volume, but not as much as the effect of port efficiency and regulatory barriers. Hoekman and Nicita (2010) take countries at different economic development levels as research subjects. With an extended gravity model, they find that if middle-income countries improve their trade facilitation level, trade flows of low-income countries will also increase. Sun and Ni (2013) studied the impact of trade facilitation measures on agricultural exports in ASEAN countries and found that improved customs efficiency, improved port quality, lower trade barriers, and the popularity of the Internet in ASEAN can significantly promote international agricultural exports to ASEAN. Özge Aynagöz et al. (2015) use logistics performance as a key indicator of trade facilitation and then applied gravity model combined with panel data from 2007 to 2013 to study trade facilitation level, and the results of the study showed a significant positive relationship between trade flows and bilateral logistics performance indicators. Zhang and Li (2015), Tan and Pan (2016) found that trade facilitation measures in countries along the Belt and Road have significant positive effects on trade flows and China's exports of agricultural products to them, with port and logistics efficiency,

business environment and border management level playing the largest roles. Zhang and Gong (2015), Zhang (2018), and Li (2021) studied the effects of trade facilitation level of Shanghai Cooperation Organization countries, BRICS countries, and countries along the China Railway Express on China's agricultural exports based on the extended gravity model, and found that the trade facilitation level of importing countries, WTO accession and joining Shanghai Cooperation Organization have promoted China's agricultural exports. And the customs environment, e-commerce, and port and logistics efficiency significantly promote the growth of China's agricultural exports. Logistics efficiency significantly promotes the growth of China's agricultural exports. Cui et al. (2019) found that improving trade facilitation level in each province can significantly promote the growth of China's agricultural trade at the provincial level.

In summary, previous studies have mainly used the method of establishing a multi-indicator measurement framework and then reducing dimensions to calculate the trade facilitation level, mostly based on the gravity model, taking countries along the Belt and Road, ASEAN countries, BRICS and SCO countries as research objects. Referring to the measurement methods of previous studies, this paper adds the indicators of venture capital availability and bank stability to the measurement framework, and assigns weights to the indicators by using principal component analysis and simple arithmetic mean method, in order to measure the trade facilitation of new research objects, RCEP countries. Variables such as the degree of opening up to the world and ASEAN dummy variable are added to study the impact of trade facilitation on the depth and breadth of China's agricultural exports using an extended gravity model.

3. Measuring Trade Facilitation Level in RCEP Countries

3.1 The Construction of Trade Facilitation Indicators System

This paper refers to Wilson (2003, 2005) to construct a trade facilitation indicator system, combining relevant literature studies and data availability of RCEP countries, and finally taking the twelve RCEP countries as the research objects (excluding Myanmar, Brunei and Laos, which have serious data deficiencies). Four first-level indicators and 14 second-level indicators are selected as shown in Table 1, with weights calculated subsequently in parentheses, and the attributes of the indicators are all positive indicators, i.e., the higher the score, the more reflects trade facilitation.

Table 1. Indicators Measuring Trade Facilitation Level

First-Level Indicators		Second-Level Indicators	Score Ranges
Regulatory Environment (0.3831)	G1	Judicial Independence	1-7
	G2	Burden of government	1-7
	G3	Efficiency of legal framework in settling disputes	1-7
	G4	Transparency of government policy-making	1-7, 1-100
	G5	Intellectual property protection	1-7
Infrastructure Quality (0.2695)	I1	Quality of road infrastructure	1-7
	I2	Efficiency of train services	1-7
	I3	Efficiency of seaport services	1-7
	I4	Efficiency of air transport services	1-7
Custom and Border Efficiency (0.1585)	C1	Prevalence of trade non-tariff barriers	1-7
	C2	Burden of custom procedures	1-7, 1-5
E-Commerce and Financial Environment (0.1899)	E1	Internet users	1-100
	E2	Venture capital availability	1-7
	E3	Soundness of banks	1-7

Source: GCR.

The original data of each indicator come from the Global Competitiveness Report released by World Economic Forum, whose official website only released the report after 2008 and made large-scale changes to the statistical indicators and statistical caliber of the Global Competitiveness Report in 2010. And due to the impact of the Covid-19 pandemic, the latest release of the special edition of the report for 2020 does not contain the indicator. Therefore, this paper selects the data from 2011 to 2019.

3.2 Calculation of Trade Facilitation Level in RCEP Countries

Since the selected indicators have different score ranges, in order to facilitate comparative analysis, the linear transformation method of Zeng and Zhou (2008) was used to standardize the raw indicator data, i.e., the raw score of each of the above indicators was divided by the corresponding maximum value. Let $y_{i\max}$ be the maximum value in the data corresponding to vector index i, and z_{ij} be the normalized index, then $z_{ij} = \frac{y_{ij}}{y_{i\max}}$. After the normalized transformation, it is possible to visualize the position of each indicator in each country, where the highest level of each indicator is 1, but the lowest level is not necessarily 0.

In order to determine the weights of indicators at each level when reducing the dimensions, the normalized data are processed using principal component analysis in this paper. The KMO test was performed on 14 secondary indicators to examine the strength of correlation between the variables. The value of the KMO test ranges from 0 to 1, with higher values indicating stronger correlation. The KMO test results for most of the indicators in this study were greater than 0.8, and the overall result was 0.8672, which was in the meritorious category according to Kaiser's judgment criteria (1974) , indicating that using the principal component method for this group of data can have good results. The SMC test was then done for 14 secondary indicators, and high SMC values indicated strong linearity of the variables. The SMC test results for most of the indicators in this study were greater than 0.9, and the overall result was 0.8979, indicating that principal component analysis was available. Finally, the principal component analysis was carried out, and the results showed that the three principal components with eigenvalues greater than 1 extracted 86.79% of the information from the 14 secondary indicators, which can basically reflect the information of the original data while ensuring that the variables of each indicator are not correlated. So three principal components were extracted in this study. The results of KMO test and SMC test and the score coefficients of each indicator on the extracted three principal components are shown in Table 2.

Table 2. Test Results and Score Coefficient of Principal Component Analysis

Variables	KMO	SMC	Comp1	Comp2	Comp3
G1	0.8746	0.9346	0.2825	0.0011	-0.3183
G2	0.7094	0.9434	0.2231	0.3375	0.5434
G3	0.8993	0.9645	0.3115	0.1092	0.0145
G4	0.9098	0.6966	0.2385	0.1676	-0.2496
G5	0.8823	0.9526	0.3029	-0.0120	-0.1371
I1	0.8747	0.9518	0.2750	-0.3195	0.1657
I2	0.8199	0.9100	0.2330	-0.4607	0.2599
I3	0.8511	0.9774	0.3000	-0.1610	0.1468
I4	0.8946	0.9537	0.2942	-0.1512	0.0696
C1	0.8807	0.8739	0.2537	0.3718	-0.1230
C2	0.9516	0.9100	0.3041	-0.0293	-0.0279
E1	0.8748	0.8651	0.2471	-0.3598	-0.2336
E2	0.8041	0.8809	0.2256	0.3692	0.3853
E3	0.8506	0.7561	0.2226	0.2793	-0.4264
Overall	0.8672	0.8979			

Source: Computed from GCR.

The results in Table 2 are organized to derive the formulae for the three principal components.

Comp1=0.2825G1+0.2231G2+0.3115G3+0.2385G4+0.3029Z5+0.2750I1+0.2330I2+0.3000I3+0.2942I4+0.2537C1+0.3041C2+0.2471E1+ 0.2256E2+0.2256E3

Comp2=0.0011G1+0.3375G2+0.1092G3+0.1676G4-0.0120G5-0.3195I1-0.4607I2-0.1610I3-0.1512I4+0.3718C1-0.0293C2-0.3598E1+ 0.3692E2+0.2793E3

Comp3=-0.3183G1+0.5434G2+0.0145G3-0.2496G4-0.1371G5+0.1657I1+0.2599I2+0.1468I3+0.0696I4-0.1230C1-0.0279C2-0.2336E1+ 0.3853E2-0.4264E3

The coefficient composition of each indicator in the total equation can be obtained from the above three principal components, and the coefficients of the secondary indicators in each principal component are summed separately by multiplying the contribution of that principal component and dividing by the cumulative contribution of 86.79% (Li and Guo, 2013) to obtain the total equation for calculating trade facilitation.

Comp=0.1937G1+0.2661G2+0.2599G3+0.1857G4+0.2246G5+0.1924I1+0.1505I2+0.2297I3+0.2194I4+0.2341C1+0.2333C2+0.1294E1+0.2576E2+0.1732E3

The equation above is also normalized in order to get the total level of trade facilitation. The resulting coefficients are divided by the sum of all coefficients to obtain the following formula for calculating trade facilitation based on secondary indicators.

TF=0.0657G1+0.0902G2+0.0881G3+0.0630G4+0.0761G5+0.0652I1+0.0510I2+0.0779I3+0.0744I4+0.0794C1+0.0791C2+0.0439E1+0.0873E2+0.0587E3

The weights of the four first-level indicators are obtained through weighted calculation, which leads to the following trade facilitation calculation formula.

TF\=0.3831G+0.2695I+0.1585C+0.1899E

Finally, the trade facilitation level in RCEP countries can be calculated based on the weights and the normalized indicator values.

3.3 The Results of Trade Facilitation Level in RCEP Countries

Table 3 shows the results of the trade facilitation level in the 12 selected RCEP countries from 2011 to 2019.

Table 3. 2011-2019 Trade Facilitation Index and Rank of RCEP Countries

Country/Year	2011		2012		2013		2014		2015		2016		2017		2018		2019	
Singapore	0.952	1	0.949	1	0.932	1	0.929	1	0.944	1	0.958	1	0.961	1	0.945	1	0.947	1
Japan	0.754	5	0.758	5	0.781	4	0.809	4	0.823	4	0.824	3	0.823	3	0.850	2	0.857	2
New Zealand	0.849	2	0.870	2	0.846	2	0.860	2	0.850	2	0.847	2	0.861	2	0.838	3	0.831	3
Malaysia	0.794	3	0.793	3	0.790	3	0.829	3	0.837	3	0.814	4	0.810	4	0.804	4	0.795	4
Australia	0.790	4	0.785	4	0.754	5	0.752	5	0.772	5	0.771	5	0.775	5	0.792	5	0.789	5
Korea	0.660	7	0.668	6	0.662	7	0.646	7	0.671	7	0.683	7	0.693	7	0.769	6	0.747	6
China	0.672	6	0.664	7	0.676	6	0.686	6	0.677	6	0.699	6	0.716	6	0.703	7	0.681	7
Indonesia	0.589	9	0.596	9	0.623	9	0.636	8	0.619	8	0.637	8	0.668	8	0.662	8	0.673	8
Thailand	0.633	8	0.622	8	0.624	8	0.612	9	0.618	9	0.624	9	0.644	9	0.653	9	0.665	9
Philippines	0.495	12	0.531	11	0.561	10	0.581	10	0.566	11	0.539	11	0.534	11	0.594	10	0.607	10
Vietnam	0.511	11	0.512	12	0.532	12	0.541	11	0.571	10	0.571	10	0.569	10	0.574	11	0.576	11
Cambodia	0.557	10	0.578	10	0.545	11	0.496	12	0.494	12	0.517	12	0.506	12	0.522	12	0.528	12

Source: Computed from GCR.

Taking Zeng and Zhou (2008) for reference, the trade facilitation level is classified as follows: below 0.6 means inconvenient, 0.6-0.7 is generally convenient, 0.7-0.8 is relatively convenient, and over 0.8 is very convenient.

According to this criteria, it can be judged that Singapore has the highest level of trade facilitation and has been steadily in the first place in this decade, while New Zealand also ranks the top and has been in the very convenient level. Malaysia fluctuates slightly between relatively convenient and very convenient level, with a slight drop in ranking. Japan's trade facilitation progressed significantly, while Australia, China and Thailand's trade facilitation levels increased modestly and were in the relatively convenient and generally convenient ranks, respectively. Indonesia and the Philippines have progressed from inconvenient to generally convenient, and the growth of trade facilitation in the Philippines is more than 0.1. Vietnam and Cambodia are at the bottom of the list of RCEP countries in terms of trade facilitation level every year, and Vietnam has progressed in absolute value, but Cambodia has not changed significantly. Therefore, increasing investment in trade facilitation construction is imminent.

During 2011-2019, the ten ASEAN countries have a wide gap in the trade facilitation level, and lower than other RCEP members on the whole. The situation is that Singapore with the highest score, Vietnam and Cambodia with the lowest score, are all ASEAN members. The trade facilitation level in developed countries is significantly higher than that in developing countries. And there is room for further improvement in all countries.

4. Empirical Analysis

4.1 Model Specifications and Data

The trade gravity model is derived from the law of gravity in physics and takes the general form of $M_{ij} = b_0 Y_i^{b_1} Y_j^{b_2} D_{ij}^{b_3} A_{ij}^{b_4}$, where M_{ij} is the trade volume between country i and country j. Y_i and Y_j are the GDP of the exporting and importing countries, respectively. D_{ij} represents the distance between the two countries. A_{ij} means other influence on trade between the two countries. b_0 is a constant term, and b_1, b_2, b_3 and b_4 are the elasticity coefficients. Linnemannn (1966) extended the gravity model by introducing demographic and policy variables as follows: $\ln M_{ij} = b_0 + b_1 \ln GDP_i + b_2 \ln GDP_j + b_3 \ln D_{ij} + b_4 \ln Peo_i + b_5 \ln Peo_j + b_6 \ln Policy + \varepsilon_{ij}$. Peo_i and Peo_j refer to the population of country i and country j. And Policy is a 0-1 variable for whether a preferential trade agreement is signed or not.

Based on the extended trade gravity model above, this paper makes the following changes according to the research purpose: the exporting country is fixed as China, the regression results of China's GDP and population have little effect on the breadth and depth of exports, so only the GDP and population of the importing country are considered, and the GDP and population of the exporting country are not considered (Zeng, 2008).

In this paper, the explanatory variables Exp stands for export value of agricultural products, and Kind represents export categories of agricultural products. The core explanatory variables are Tfm, trade facilitation level in RCEP importing countries, and Tfc, trade facilitation level in China. Other extended control variables include: Gdpm, the GDP of importing countries; Popm, the population of importing countries; Dis, short for distance; Open, openness to the outside world ; and Asean dummy variable. The two regression models are constructed as follows.

$$\ln Exp_{jt} = \beta_0 + \beta_1 \ln Tfm_{jt} + \beta_2 \ln Tfc_t + \beta_3 \ln Gdpm_{jt} + \beta_4 \ln Popm_{jt} + \beta_5 \ln Dis_{ij} + \beta_6 \ln Open_{jt} + \beta_7 Asean_j + \varepsilon \quad (1)$$

$$Kind_{jt} = \beta_0 + \beta_1 \ln Tfm_{jt} + \beta_2 \ln Tfc_t + \beta_3 \ln Gdpm_{jt} + \beta_4 \ln Popm_{jt} + \beta_5 \ln Dis_{ij} + \beta_6 \ln Open_{jt} + \beta_7 Asean_j + \varepsilon \quad (2)$$

Table 4. Variable Descriptions and Data Sources

Variable Name	Variable Meaning	Unit	Data source
Exp_{jt}	China's exports value of agricultural products to importing country j in year t	Million Dollars	UN Comtrade HS Codes Chapter 01-24
$Kind_{jt}$	Kinds of agricultural products exported from China to importing country j in year t, obtained by counting six-digit HS codes	Kind	
Tfm_{jt}	Trade facilitation level of RCEP importing country j in year t		Global Competitiveness Report

Tfc_t	Trade facilitation level of China in year t		
$Gdpm_{jt}$	Current price GDP of RCEP importing country j in year t	Hundred Million Dollars	World Bank Database
$Popm_{jt}$	Population size of RCEP importing country j in year t	Million People	World Bank Database
Dis_{ij}	Spherical geographic distance between the capital of RCEP importing country j and the capital of China, Beijing	Kilometers	CEPII Database
$Open_{jt}$	Total trade value of all commodities from RCEP country j divided by its GDP in year t		UN Comtrade
$Asean_j$	ASEAN dummy variable, takes the value of 1 if the importing country belongs to ASEAN, otherwise it is 0		

In addition, only China's agricultural exports to the eleven RCEP countries from 2011-2019 were considered due to the serious lack of raw data on trade facilitation indicators for Laos, Brunei, and Myanmar. And these three countries have low economic aggregates, which has little influence on the results of this study.

4.2 Analysis on Regression Results

In this paper, we use the export value of agricultural products as the depth of export, and conduct pooled regression, fixed effect and random effect for equation (1) respectively. The coefficient estimates of independent variables are in line with the expectation and quite significant, and the goodness of fit shows this model is feasible. First, the p-value of the F-test is infinitely close to zero, indicating that the fixed-effects model is better than the pooled regression. However, this test does not use clustering robust standard errors, so the LSDV method is used to generate individual dummy variables for further examination. And it is found that all RCEP country dummy variables except South Korea are significant at the 1% level, and individual effects are considered to exist. All annual dummy variables generated are then insignificant and the joint significance test is also insignificant, which does not indicate a time effect existence. P-values for the LM test are infinitely close to zero, indicating that the random effects model is superior to the pooled regression. Finally, the p-value of the Hausman test is significant only at the 10% level, not indicating that the individual effects are necessarily fixed effects. And the goodness of fit of the random effects model is as high as 0.8975 and the results are the most significant. The R-square of fixed effects model, however, is only 0.6765. And the results of fixed effects model are not able to include the distance variable Dis and the dummy variable Asean which do not vary over time. So the final analysis and interpretation will be based on the regression results of the random effects model. The results are shown in the first three columns of Table 5.

In this paper, the type of exported agricultural products is used to represent the breadth of exports. When the explanatory variable is counting variable, Poisson regression is usually used. The method requires the variable to be equally dispersed, i.e., the expectation and variance are equal. But in this paper the variance of the discrete data of the type of exports variable, Kind, is 31 times higher than the expectation. Drawing on Zhu and Bi (2018), pooled negative binomial regression and random negative binomial regression are conducted for equation (2), and the results are shown in the fifth and sixth columns of Table 5.

In order to make more specific suggestions, this paper further investigates how detailed aspects of trade facilitation impact on the depth and breadth of agricultural exports, by replacing the trade facilitation level in importing countries Tfm and China's trade facilitation level Tfc with the first-level indicators, Gov_{jt} government regulatory environment, Inf_{jt} infrastructure quality, Cus_{jt} customs environment, Ecf_{jt} e-commerce and financial environment, respectively. The Hausman test for the sub-indicators regression of export depth cannot reject the original hypothesis, so the random effect model is used. The LR test is done for the sub-indicators regression of export breadth, and the random effect model is selected, and the results in the fourth and seventh columns of Table 5 are obtained.

Table 5. Export Depth and Breadth Regression Results

Variables	Export depth lnExp				Export Breadth Kind		
	(1) Pooled regression	(2) Fixed effects regression	(3) Random effects regression	(4) Sub-indicator regression	(5) Pooled negative binomial regression	(6) Random negative binomial regression	(7) Sub-indicator Negative binomial regression
lnTfm	0.692**	0.463	0.705**		0.313	0.024	
	(1.81)	(1.25)	(1.89)		(1.47)	(0.11)	
lnGov				0.185			-0.210
				(0.49)			(-1.23)
lnInf				-0.498*			-0.471***
				(-1.37)			(-2.71)
lnCus				-0.166			-0.188
				(-0.46)			(-1.11)
lnEcf				1.135***			0.873***
				(3.77)			(5.89)
lnTfc	1.401	0.164	1.438**		1.447***	1.434***	
	(1.33)	(0.21)	(2.16)		(4.22)	(3.97)	
lnGovc				-1.160***			-0.381**
				(-2.86)			(-2.14)
lnInfc				1.696**			-0.326
				(1.84)			(-0.76)
lnCusc				-0.755*			-0.796***
				(-1.35)			(-3.04)
lnEcfc				1.452**			1.753***
				(2.22)			(5.90)
lnGdpm	1.007***	0.819***	1.002***	0.874***	0.496***	0.468***	0.388***
	(10.27)	(5.53)	(9.63)	(7.60)	(7.38)	(8.06)	(8.52)
lnPopm	0.281	2.169***	0.255*	0.325**	-0.068	-0.117	-0.091
	(1.12)	(3.49)	(1.43)	(2.08)	(-0.58)	(-1.52)	(-1.58)
lnDis	-0.535**		-0.544**	-0.622***	-0.030	-0.020	-0.060
	(-2.05)		(-2.13)	(-2.83)	(-0.21)	(-0.20)	(-0.85)
lnOpen	0.106	0.090	0.132	0.346***	0.123*	0.174***	0.256***
	(0.44)	(0.65)	(0.92)	(2.53)	(1.63)	(2.43)	(3.60)
Asean	1.102***		1.067***	0.577	0.544***	0.417**	0.160
	(3.71)		(2.63)	(1.33)	(2.44)	(2.32)	(1.18)
Constant	2.393	-7.542***	2.591	4.435**	1.946	3.061***	4.049***
	(0.94)	(-3.35)	(1.08)	(2.11)	(1.27)	(2.78)	(4.55)

Note: *** indicates 1% significance level, ** indicates 5% significance level, and * indicates 10% significance level.

The empirical results of export depth and export breadth are consistent in general. As can be seen from the third and sixth columns of Table 5, for every 1% increase in the trade facilitation level of RCEP members, the depth of China's agricultural exports will rise significantly by 0.705%, but there is no significant driving effect on the export breadth. While increasing China's trade facilitation by 1% will significantly increase the value of agricultural exports by 1.438% and also broaden the breadth of agricultural exports very significantly, with other conditions remain unchanged, increasing its level by 1% will increase the variety of agricultural exports by 1.434%. In addition, GDP and population of RCEP member countries can significantly drive China to export more agricultural products to them. For example, the economic size of RCEP member countries has a significant positive effect on the depth and breadth of China's agricultural exports, the larger the economic aggregate, the greater the demand for China's agricultural products, but the effect on the export type is smaller compared to the export value. All other things being equal, for every 1% reduction in distance between RCEP importing countries and China, China's agricultural exports to that country will rise by 0.544%, and the results pass the 5% significance test. The openness degree of RCEP members has a significant positive effect on the breadth of China's agricultural exports, but the results for the depth of exports are not significant. The coefficient of the ASEAN dummy variable is significantly positive, and ASEAN countries are more likely to obtain Chinese agricultural exports than other RCEP countries, indicating that a series of measures to reduce taxes and open trade and investment markets after the official establishment of China-ASEAN Free Trade Area in 2010 have significantly promoted trade and investment exchanges. China’s agricultural products export depth and breath to ASEAN are not affected by ASEAN's overall low trade facilitation level. Other non-ASEAN RCEP members signed FTAs with China later than ASEAN, so the promotion mechanism is not yet mature. All of the above conclusions are in line with realistic logic and expectations.

From the sub-indicator random effect regression results in the fourth and seventh columns of Table 5, it can be seen that the coefficients of e-commerce and financial environment of RCEP importing countries are significantly 1.135 and 0.873, reflecting that the information technology, digitalization and financial technology in the Internet era have the greatest promoting effect on the depth and breadth of China's agricultural exports. The infrastructure quality of RCEP importing countries has a dampening effect on both the volume and type of Chinese agricultural exports, as its improvement is supposed to reduce the transportation cost and improve trade efficiency. But here it is likely that the roads and railway construction will make domestic trade or higher-quality products import from other countries become convenient, and the substitution effect will reduce imports from China. The role of regulatory and customs environments on China's agricultural exports is not significant. In addition, among the four first-level indicators of China’s trade facilitation, the one that contributes most to the depth of agricultural exports is infrastructure quality, with an increase of 1.696% in export value for 1% increase in score. And the improvement of domestic infrastructure helps to reduce the loss of goods and send more agricultural products out of the country conveniently and quickly, with quality and quantity guaranteed. But its effect on the export breadth is not significant. The positive effect of China's e-commerce and financial environment on the depth and breadth of exports is very significant. The positive effect of the e-commerce and financial environment on the depth and breadth of exports is very significant, with coefficients as high as 1.452 and 1.753. The fast transaction of e-commerce and financial support add double insurance to the international trade in the new era, providing the possibility of exporting more kinds of agricultural products. While the coefficients of the government regulatory environment are significant at -1.16 and -0.381, reducing the amount and types of agricultural export. On the one hand, the more perfect the national trade regime, the stronger the support for trade enterprises, the freer the business environment, the more willing the enterprises of other countries are to cooperate. But the improvement of the regulatory environment may also bring more stringent quality inspection and examination, which affects the export efficiency and thus has a suppressive effect. The improvement in the customs environment has not played a significant role, probably because the reduction of non-tariff barriers and the simplification of customs procedures in China have not yet reached the threshold that can positively affect agricultural exports.

4.3 Robustness Test

In this section, the empirical results above are tested for robustness by replacing the measure of trade facilitation level, using a simple arithmetic mean to give equal weight to the four first-level indicators. The empirical steps are the same as described in the previous section, and the regression results are shown in Table 6.

Table 6. Robustness Tests

Variables	Export depth lnExp				Export Breadth Kind		
	(1) Pooled regression	(2) Fixed effects regression	(3) Random effects regression	(4) Sub-indicator regression	(5) Pooled negative binomial regression	(6) Random negative binomial regression	(7) Sub-indicator Negative binomial regression
lnTfm	0.858**	0.549*	0.880**		0.010	0.446**	
	(2.49)	(1.48)	(2.36)		(0.05)	(2.19)	
lnGov				0.245			-0.156
				(0.71)			(-1.04)
lnInf				-0.433			-0.432***
				(-1.22)			(-2.66)
lnCus				-0.067			-0.177
				(-0.19)			(-1.13)
lnEcf				1.016***			0.892***
				(3.72)			(6.78)
lnTfc	1.682*	0.365	1.710***		1.592***	1.599***	
	(1.75)	(0.45)	(2.77)		(4.68)	(5.19)	
lnGovc				-0.876***			-0.257*
				(-2.58)			(-1.74)
lnInfc				1.705**			-0.317
				(1.86)			(-0.74)
lnCusc				-0.605			-0.680***
				(-1.13)			(-2.73)
lnEcfc				1.332**			1.702***
				(2.05)			(5.78)
lnGdpm	0.944***	0.768***	0.931***	0.771***	0.439***	0.440***	0.376***
	(11.89)	(5.11)	(8.00)	(6.30)	(7.94)	(9.04)	(8.65)
lnPopm	0.303	2.123***	0.287	0.344**	-0.106	-0.107*	-0.056
	(1.29)	(3.42)	(1.63)	(2.14)	(-1.48)	(-1.67)	(-0.99)
lnDis	-0.539**		-0.557**	-0.615***	-0.014	-0.013	0.024
	(-1.98)		(-2.17)	(-2.71)	(-0.14)	(-0.14)	(0.29)
lnOpen	0.105	0.083	0.128	0.350**	0.193***	0.193***	0.280***
	(0.45)	(0.60)	(0.90)	(2.56)	(2.81)	(2.81)	(4.59)
Asean	1.059***		1.027**	0.632*	0.342**	0.343**	0.144
	(3.88)		(2.57)	(1.71)	(2.08)	(2.10)	(1.05)
Constant	2.261	-6.784***	2.628	4.452**	3.520***	3.510***	4.339***
	(0.87)	(-3.74)	(1.08)	(2.06)	(3.38)	(3.42)	(4.73)

The results of each regression model in Table 6 show that increasing the trade facilitation level has a significant positive effect on the depth and breadth of China's agricultural exports. 1% increase in the trade facilitation in RCEP importing countries can increase the depth and breadth of exports by 0.880% and 0.446%, while 1% increase in the

trade facilitation of China will increase the value of agricultural exports by 1.710% and the variety of exports by 1.599%, both of which have a greater driving effect than the original results. The results of sub-indicators regression shows that the importing country's e-commerce and financial environment has the greatest positive effect on the depth and breadth of China's agricultural exports, and each 1% increase will significantly increase the export depth by 1.016% and the export breath by 0.892%; while the infrastructure quality in RCEP member countries has a significant inhibitory effect on China's export breadth broadening, and the results of other dimensions in importing countries are not significant. China's e-commerce and financial environment has a significant positive effect on the depth and breadth of agricultural exports, and each 1% increase in the score will increase 1.332% of export value and 1.702% of export types, which is slightly less than the driving effect of the original results. The home government regulatory environment and customs environment play a significant inhibitory role; the quality of China's infrastructure has a significant positive effect on the depth of agricultural exports. There is a significant positive effect of Chinese infrastructure quality on the depth of agricultural exports, but not on the breadth of exports. The coefficients of the variables are generally consistent with the previous section, indicating that the empirical results of both export depth and export breadth are robust.

5. Conclusions

Based on the panel data from 2011 to 2019, this paper establishes an indicator system to measure the trade facilitation level of the twelve RCEP countries using principal component analysis, and finds that the trade facilitation level of the ten ASEAN countries is widely disparate and slightly lower than that of other RCEP member countries. The empirical analysis shows that the improvement of trade facilitation level of RCEP members can effectively promote the export of Chinese agricultural products. Specifically, the facilitation of RCEP members' e-commerce financial environment can strengthen the depth and breadth of China's agricultural exports and is much greater than the impact of other first-level indicators. As an exporter, China's trade facilitation level has a greater positive impact on the depth and breadth of its own agricultural exports, the positive effect of infrastructure quality and e-commerce financial environment is the largest and most significant, but the government regulatory environment has a significant negative impact on agricultural exports. Other empirical results are consistent with the general findings of the gravity model. As for the extended control variables, increasing the degree of opening up of RCEP importing countries also has a positive effect on the depth and breadth of China's agricultural exports, and ASEAN countries are more likely to benefit from trade facilitation than other RCEP members.

According to the findings above, RCEP countries should increase investment in trade facilitation construction, attach importance to the role of e-commerce and financial environment in trade, promote cross-border e-commerce cooperation, standardize e-commerce payment processes, construct mutually-recognized payment systems and simplify payment procedures. Accelerate the construction of infrastructure such as transportation and information networks among RCEP members to improve the efficiency of cargo transportation and communication among import and export enterprises. The regulatory environment and customs environment should not be neglected. On the one hand, we should continue to create a friendly investment environment, improve Internet penetration, strengthen intellectual property protection, and put more financial budget into agricultural products preservation technology, etc. On the other hand, we should also actively engage in trade negotiations, clarify the directions of agricultural cooperation, deepen foreign cooperation, reduce agricultural trade costs, simplify customs clearance procedures, and improve the efficiency of agricultural products transit. RCEP has made a major breakthrough by adopting a negative list to enhance policy transparency and investment openness in agriculture-related industries, creating conditions for the free flow of production factors. With the enforcement of RCEP, the trade facilitation level in each country will be further improved, which will definitely expand the volume and types of China's agricultural exports and promote the high-quality of China's agricultural products.

The limitation of this study is that the sample does not include all RCEP countries, and the data are only limited to 2011-2019 due to the data availability problem. Therefore, the sample size was relatively small, and the empirical results may be biased to some extent. Trade facilitation will face even severer challenges in the future due to redundant procedures for the COVID-19 pandemic prevention and control. How to reverse the negative impact of the government regulatory environment and how to negotiate and achieve more favourable terms of economic and trade agreements, in order to ensure the smooth export of perishable agricultural products, will become the focus of subsequent research in this field.

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