

# The Impact of Trade Facilitation on Cross-Border E-Commerce Exports of China Based on the Gravity Model

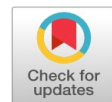
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**Abstract:** This paper aims to analyze the development of trade facilitation and the existing problems in China's cross-border e-commerce. Then, it analyses the influence mechanism of trade facilitation on cross-border e-commerce from the theoretical basis and evaluation system. Second, it establishes the trade facilitation system, including five primary indicators and thirty-one secondary indicators from the Global Competitiveness Report. Third, it establishes the gravity model to analyse the impact of TFI on China's cross-border e-commerce exports. China's cross-border e-commerce export is taken as the explained variable. The empirical result shows that trade facilitation has a significant positive impact on China's cross-border e-commerce exports. The customs environment of high-income and lower-middle-income countries has the most obvious impact on cross-border e-commerce exports. The infrastructure of upper-middle-income countries has the most significant impact on cross-border e-commerce exports. Finally, it makes policy recommendations on the aspects of TFI that countries should prioritize.

**Keywords:** Trade facilitation, Cross-border e-commerce, International trade, Gravity model, TFIs

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## INTRODUCTION

### Current situation and major problems of cross-border e-commerce in China

With the development of economic globalisation and popularity of the Internet, cross-border e-commerce, as a new form of trade, plays an increasingly important role in international trade. By conducting transactions through the Internet, cross-border e-commerce breaks the transaction restrictions of time, region, and object, bringing convenience to both parties (Huang, Wu, & Cheng, 2018).

As a developing country, China's e-commerce development started late. Still, it has been developing rapidly, even more than in many countries. According to Fig. 1, China's cross-border e-commerce transaction scale is on an upward trend from 2008 to 2017, climbing from 9.13 to 92.04 million us dollars, and with an annual growth rate of 26.50%.

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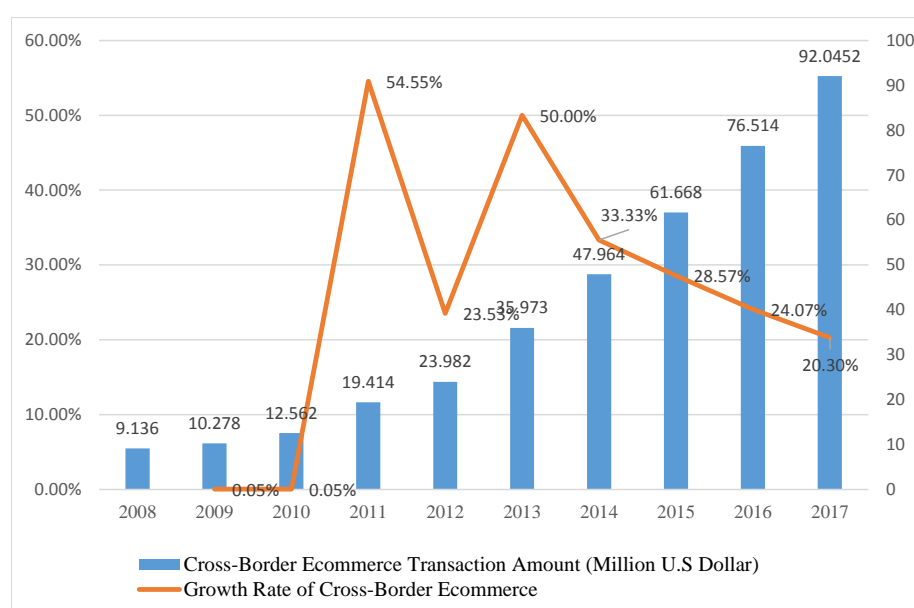


Figure 1. China's cross-border e-commerce transaction amount and growth rate from 2008-2017. Source: (Yong, Si, & Lun, 2020)

To minimise the risk of infection of the COVID-19 pandemic, the government has implemented social isolation and city closures to encourage online shopping instead of offline shopping. It has prompted many consumers to switch to online shopping, telephone shopping, and online media use. Enterprises and employees are faced with remote work, solving business through Internet telephony and video conferencing. As a result, there has been a surge in demand for e-commerce transactions and services (except travel services). E-commerce has become an essential tool or solution for consumers and enterprises in the face of the epidemic crisis (Qalati, Ahmed, Mei, Thu, & Sohu, 2020).

It may be a short-term phenomenon. As the epidemic passes, such a great demand for online shopping will not continue. However, consumers who do not fully trust e-commerce before are likely to have to contact e-commerce. Customers long-term consumption habits may change (they prefer online shopping to physical shopping), and companies and employees are more accustomed to using online services at work.

Facing the surge in demand for Internet and mobile data services, governments, operators, and companies all urgently need to adjust network capacity and improve technology to adapt to the shift to online activities. During this period, the challenges of cross-border e-commerce have arisen or further amplified. These problems include product security issues, deceptive behaviour, network security issues, etc., which mainly manifested in the following aspects.

In terms of the law, the customs, inspection and quarantine, tax and foreign exchange's receipt and payment methods that follow the traditional rules can no longer meet the new demands in the cross-border e-commerce. For example, the paperless nature of cross-border e-commerce makes transactions lack the contract text, and the relevant laws have not updated the provisions in time, which makes it impossible to resolve such economic disputes. Besides, new health regulations introduced by the government have severely disrupted many industries due to COVID-19. Moreover, new health regulations vary from country to country, which has a severe impact on international trade.

In terms of inspection and quarantine, there is no specific supervision method for the direct mail mode of cross-border e-commerce. For products imported by direct mail, no re-sale involved. Companies are only required to declare a list of commodities to the quarantine agency three working days in advance in their jurisdiction. And the quarantine agency will conduct on-site inspections according to the declaration list.

Due to the shortage of hygiene products and the vast demand, many fake or substandard hygiene products, such as hand sanitisers, masks, and disinfectants, have emerged. If goods enter the country

by direct mail, the quality of goods will not be guaranteed. Furthermore, the number of small parcels ordered poses a challenge for importing countries to comply with health and safety regulations and protect workers' health involved in handling goods. On the other hand, it also tests whether the regulatory agency can quickly inspect large and small packages.

Payment is an essential link in trade. The virtual nature of e-commerce makes it difficult for foreign exchange regulators to verify whether cross-border e-commerce transactions are real or whether payment funds are legal. During the COVID-19 pandemic, some manufacturers and retailers resorted to fraud to make profits, such as not delivering goods after receiving payment or sending fake goods. It is difficult for consumers and companies to recover their money or pursue legal liability after the fraud discovered in such online transactions.

As an emerging branch of the logistics industry, cross-border e-commerce logistics has an ample development space. However, we have to admit that the lagging development of cross-border logistics, such as long delivery cycles, high transport costs, cumbersome procedures for returning and changing goods, and logistics of fresh products, has become an obstacle for e-commerce. Also, the COVID-19 pandemic is testing logistics services like never before. As a result of implementing the new health regulations and social distance measures, most international transport (including land, sea, and air) has been suspended, and logistics services have significantly disrupted. Many international flights cancelled, which prevents the normal flow and transportation of labour and small goods. It dramatically reduces the transportation capacity of cross-border small cargo transactions and increases the transportation price.

Demand for Internet and mobile data services is also increasing. It has put pressure on telecoms infrastructure. They need to increase network traffic and ease congestion urgently to keep up with increased demand for online activity. Like other developing countries, China has many economic problems to be solved in different aspects. It is difficult for China to have the same financial strength and capital to invest in e-commerce as developed countries. And it is difficult for the government to invest enough money to solve all problems simultaneously due to the limited allocation of resources. Moreover, in the context of the COVID-19 pandemic, the traditional shortcomings of cross-border e-commerce have become more serious. But the epidemic has also made clear the importance of e-commerce in times of similar crisis. It is an essential tool or solution for governments and consumers facing the epidemic. It may make it a priority for the government to invest more money in the development of e-commerce.

In the context of the continuous development of cross-border trade, the negative impact of non-efficiency of trade has also begun to be paid attention to. Different customs procedures between countries lead to increased costs of cross-border trade, forming a non-tariff barrier. Therefore, the study of trade facilitation is very necessary.

### **Trade facilitation measures to promote cross-border e-commerce**

To promote the pilot of cross-border e-commerce, China has taken a series of measures. For instance, in the aspect of customs clearance, the procedures of import customs clearance are simplified to realise one declaration, one inspection and one release. In terms of logistics, the government encourages enterprises to build up the supply chain of global logistics, set up warehousing and logistics centres, and improve overseas service system. In terms of payment, the government advocates third-party payment institutions to provide cross-border payment services. Moreover, it encourages the service upgrading of payment institutions and the product innovation of banks. It ensures the service quality of cross-border payment while speeding up the payment service. While ensuring transaction security, it makes the transaction more convenient. In terms of electronic information, the Chinese government has realised information sharing. It not only improves management efficiency, reduces management costs, but also prevents and the crackdown on illegal acts such as smuggling and defrauding of export tax rebates. These measures create various favourable conditions for cross-border export e-commerce and promote its rapid growth (Yong et al., 2020).

At present, the government involved in the formulation of cross-border e-commerce policies mainly include the State Council of China, the General Administration of Customs of China, and the Ministry of Commerce. The State Council is the maker of the guiding opinions on cross-border e-commerce

related policies. The relevant cross-border e-commerce policies of the State Council involve infrastructure construction, approval of pilot zones, improvement of efficiency, optimisation of processes, and reduction of import tax rates. As a critical link in the cross-border e-commerce regulatory chain, the Customs has a high right to formulate the cross-border e-commerce policies. In recent years, the General Administration of Customs of China has introduced many specific measures to improve the customs clearance efficiency of cross-border e-commerce. For example, there is no rest day for cross-border e-commerce supervision, and customs formalities are set within 24-hour after the goods arrive at the customs supervision site. It ensures that e-commerce companies can enjoy the convenience of customs clearance thoroughly. The measures taken by the General Administration of Customs to promote cross-border e-commerce are mainly to strengthen supervision, improve efficiency, and implement pilot cities and duty-paid prices.

### **Evaluation system of trade facilitation for China's cross-border e-commerce**

To systematically quantify trade facilitation and analyse its impact on economic sectors or factors, starting from the essence and connotation of trade facilitation, this paper establishes an evaluation system of trade facilitation from five perspectives: national policy, legislative environment, infrastructure construction, customs environment, and technological readiness.

#### ***Political environment***

Cross-border e-commerce is a new business model for China. Policies have always been the forerunner of industry. The government helps e-commerce enterprises develop better-utilising macro-planning, coordinating various departments, and issuing different preferential support policies. Under the guidance of policies, enterprises can also understand the market more directly and more accurately, to produce products more in line with market demands. The policy is not only a weathervane of the industry but also the sword of restricting the industry's development direction. The government's guidelines to promote the e-commerce industry support the development of enterprises and regulate the behaviour of enterprises. With the rise of e-commerce enterprises, consumers online shopping complaints, false advertising, unfair competition and other chaotic situations have also occurred. Policies can effectively regulate the behaviour of enterprises. Moreover, it protects the rights and interests of not only consumers but also operators. Therefore, the development of cross-border e-commerce requires the government to establish an efficient, trustworthy, and transparent political environment. It can not only build e-commerce enterprises confidence, attract foreign investment, but also help enterprises reduce additional costs.

#### ***Legal environment***

E-commerce is a business activity on the Internet. The government needs to establish a fair, open, and consistent legal system to provide legal protection. The development of the e-commerce industry must be standardised and consistent.

#### ***Infrastructure***

Infrastructure is the foundation of e-commerce and a vital link in trade activities. Infrastructure refers to various media that can realise cross-border e-commerce goods transportation, such as road, railway, port, and air transportation. E-commerce transactions usually include information flow, business flow, capital flow, and logistics. In addition to logistics, the other three flows can be achieved through computers and network communication equipment. Except for a few commodities and services such as electronic publications and information queries, logistics is still the circulation hub for most physical commodities. Therefore, to strengthen infrastructure construction, promote e-commerce logistics efficiency, and improve logistics quality is very important to encourage cross-border e-commerce.

#### ***Customs environment***

Simplifying customs procedures, reducing clearance time, improving clearance efficiency, optimising the customs environment, and reducing transaction costs have always focused on trade facilitation. For cross-border e-commerce, the quality of the customs environment directly affects the transaction process.

Establishing a port with an efficient, fast, and transparent clearance process can attract more cross-border e-commerce enterprises for trade and foreign investment. Also, customs inspection and quarantine affects the quality and safety of goods.

### Technological readiness

Technological upgrading can bring more imagination to the cross-border e-commerce industry. Technological readiness is mainly reflected in the readiness and application degree of various technologies, such as the Internet, broadband, the number of mobile users, the technology absorption degree of enterprises, and the use degree of information communications technology. Technological readiness is an essential difference between cross-border e-commerce and traditional international trade. In the e-commerce industry, both parties of the transaction use technology to exchange information. The payment and after-sales service need to be completed with the network technology. With the continuous development of science and technology, cross-border e-commerce trade relying on science and technology will be more convenient and expand.

### Objectives of the study

- To analyse the impact of trade facilitation on e-commerce trade between China and its partner countries, and give specific policy recommendations accordingly.
- To analyse trade facilitation level over time. Thirty-one second-level indicators of the Global Competitiveness Report are selected from five aspects: policy environment, legislative environment, infrastructure, customs environment, and technology readiness.
- To divide the trading partners into high-income economies, upper-middle-income economies, and lower-middle-income economies, compare their first-level indicators of trade facilitation and give suggestions on which sectors should develop first.

### Scope of the study

This paper focuses on the exports of China’s cross-border e-commerce. Among the dozens of secondary indicators of the Global Competitiveness Report, this paper only selects indicators related to the economy to interpret the level of trade facilitation. Table 1 shows the variables that makeup trade facilitation indicators.

Table 1: Evaluation Index of Variable Trade Facilitation Level Primary Indicator

Primary Indicator (Abbreviations)	Secondary Indicator	Code	Original Index Number	Score Ranges
Political Environment (PLEN)	Public Trust in Politicians	X1	1.04 Public Trust in Politicians	0-1(Best)
	Irregular Payments and Bribes	X2	1.05 Irregular Payments and Bribes	0-1(Best)
	Ethics and Corruption	X3	A.01.01.02 Ethics & Corruption	0-1(Best)
	Favouritism in Government Officials’ Decisions	X4	1.07 Favoritism in of Government Officials’ Decisions	0-1(Best)
	The burden of Government Regulation	X5	1.09 Burden of Government Regulation	0-1(Best)
	Transparency of Government Policymaking	X6	1.12 Transparency of Government Policymaking	0-1(Best)
Legal Environment (LGEN)	Judicial Independence	X7	1.06 Judicial Independence	0-1(Best)
	Efficiency of Legal Framework in Settling Disputes	X8	1.10 Efficiency of Legal Framework in Settling Disputes	0-1(Best)
	Efficiency of Legal Framework in Challenging Regulations	X9	1.11 Efficiency of Legal Framework in Challenging Regulations	0-1(Best)

Table 1: Continued...

Infrastructure (FURS)	Transparency of Government Policymaking	X10	1.12	Transparency of Government Policymaking	0-1(Best)
	Legal Rights Index	X11	8.08	Legal Rights Index	0-1(Best)
	PCT Patents	X12	12.07	PCT Patents	0-1(Best)
	Quality of Overall Infrastructure	X13	2.01	Quality of Overall Infrastructure	0-1(Best)
	Quality of Roads	X14	2.02	Quality of Roads	0-1(Best)
	Quality of Railroad Infrastructure	X15	2.03	Quality of Railroad Infrastructure	0-1(Best)
	Port Infrastructure Quality	X16	2.04	Port Infrastructure Quality	0-1(Best)
	Quality of Air Transport Infrastructure	X17	2.05	Quality of Air Transport Infrastructure	0-1(Best)
	Available Airline Seat Km	X18	2.06	Available Airline Seat	0-1(Best)
	Quality of Electricity Supply	X19	2.07	Electricity Supply Quality	0-1(Best)
	Fixed-telephone Lines	X20	2.09	Fixed Telephone Lines	0-1(Best)
Mobile-cellular Telephone Subscriptions	X21	2.08	Mobile Telephone Subscriptions	0-1(Best)	
Customs Environment (CUSE)	Trade Barriers Prevalence	X22	6.09	Trade Barriers Prevalence	0-1(Best)
	The burden of Customs Procedures	X23	6.13	Burden of Customs Procedures	0-1(Best)
Technological Readiness (THCH)	Availability of Latest Technologies	X24	9.01	Availability of Latest Technologies	0-1(Best)
	Firm-level Technology Absorption	X25	9.02	Firm-level Technology Absorption	0-1(Best)
	FDI & Technology Transfer	X26	9.03	FDI & Technology Transfer	0-1(Best)
	Individuals Using the Internet	X27	9.04	Individuals Using the Internet	0-1(Best)
	Fixed-broadband Internet Subscriptions	X28	9.05	Fixed Broadband Internet Subscriptions	0-1(Best)
	Internet Bandwidth	X29	9.06	Intl Internet Bandwidth	0-1(Best)
	Mobile-broadband Subscriptions	X30	9.07	Mobile Broadband Subscriptions	0-1(Best)
ICT Use	X31	B.	ICT Use	0-1(Best)	

Based on the summary of the World's Top Exports website, data from the top 50 countries that traded the most with China in 2018 was selected. Table 2 shows the top 50 countries that trade with China.

Table 2: China's top 50 trading partners in 2018

1.United States	11.Taiwan	21.Italy	31.South Africa	41.Argentina
2.Hong Kong	12.Russia	22.France	32.Chile	42.Sweden
3.Japan	13.Australia	23.United Arab Emirate	33. Iran	43.Peru
4.South Korea	14. Malaysia	24.Spain	34.Nigeria	44.Algeria
5.Vietnam	15.Mexico	25.Poland	35.Egypt	45.Iraq
6.Germany	16.Indonesia	26.Turkey	36.Czech Republic	46.Denmark
7.India	17.Thailand	27.Bangladesh	37.Kazakhstan	47.Ukraine
8.Netherlands	18.Canada	28.Saudi Arabia	38.Myanmar	48.Panama
9.United Kingdom	19.Philippines	29.Belgium	39.Israel	49.Greece
10.Singapore	20.Brazil	30.Pakistan	40.Colombia	50.Hungary

## **REVIEW OF LITERATURE**

### **Research on the Impact of Trade Facilitation on Economy**

Yang (2007) used the Global Trade General Equilibrium model to analyse the impact to save customs clearance time on China's economy. He found that trade facilitation significantly promoted economic growth and improved social and economic welfare. Dollar, Hallward-Driemeier, and Mengistae (2004) found that the longest customs clearance time of a country affected the predictability of the time that has passed the customs. Unpredictability and instability in delivery times often force companies to keep higher levels of inventory. Guasch and Kogan (2001a) found that manufacturing inventories in developing countries are usually 200-500% higher than in the United States. They estimate that reducing the stock of manufacturing companies in developing countries by half can reduce production cost by 20%. Besides, a more efficient transportation and logistics system can reduce the delivery cost and make the delivery time more reliable. It reduces capital occupation and delivery delay costs. Yang (2007) believed that the promotion of trade facilitation could promote exports as China faces pressure from the trade deficit. He believed that it could also promote the absorption of foreign investment by improving customs revenue, enhance export tax rebates, release export vitality, and improve the investment environment.

### **Free trade theory**

The free trade theory encourages trade among countries through the international division of labor and the exploitation of comparative advantages. In the context of the international division of labor, each state gives full play to its comparative advantages to make the best allocation of its resources. It is the theoretical core of international trade and also the connotation of trade facilitation. In the context of free trade, countries can develop sectors with comparative advantages according to their conditions of the endowment. They can conduct professional production and division of labor. And factors can reasonably be distributed and applied. A country can then exchange more things with less cost through the regulation of the commodity and increase national wealth and capital accumulation (Guasch & Kogan, 2001b).

### **Government intervention theory**

According to Joseph Stiglitz's theory of government intervention, when market participants cannot get sufficient information, and the market mechanism cannot solve the externality and monopoly, the government should carry out the ingenious intervention to make it operate normally.

For trade facilitation, the government and other departments intervene in the economy by formulating guidelines, optimising the legal environment for fair trading, building infrastructure, and simplifying customs procedures to regulate the market and prevent its failure. Meanwhile, the improvement of infrastructure and the simplification of customs procedures will also have a positive affect on cross-border e-commerce. Therefore, it will also promote cross-border e-commerce while promoting trade facilitation.

### **Transaction cost theory**

Transaction cost (also known as transaction fee) refers to all kinds of costs before and after the transaction. The idea of transaction cost was proposed by Coase (1937) in his paper "The nature of enterprises," and Williamson (1985) later proposed the concept of the transaction cost. Coase argued that transaction costs are the costs of obtaining accurate market information, negotiating, and recurring contracts. That is to say; the transaction cost is composed of information cost, bargaining cost, decision cost, supervision cost, and possible default cost. Williamson (1985) further classified transaction costs into ex-ante and ex-post costs. Ex-ante costs are the costs of signing, negotiating and securing contracts; Ex-post costs refer to the costs of the incompatibility of deals, such as bargaining, construction, and operation.

Transaction cost theory is the basic concept of new institutional economics. The system enables people to behave in an orderly, predictive, and motivating manner, reducing the costs of chaos and disorder, and saving transaction costs. Institutional reduction of transaction costs can be divided into absolute reduction and relative reduction. For example, the purpose of WTO is to promote the liberalisation of international trade (Krugman, 1980). It formulates unified trade rules and terms and reduces (or

eliminate) tariff and non-tariff barriers. The greater the implementation space of a unified system, that is, the more the system is implemented in a larger area, the more people follow the same system, the smaller the transaction cost, and the more favourable to economic and social development. From the market perspective, the larger the market system, the more conducive to the division of labour and the improvement of efficiency.

## RESEARCH METHODOLOGY

### Model specification

Since Tinbergen (1962), the gravity model has applied to explain bilateral trade between the two countries. The traditional gravity model suggests that trade between countries ( $X_{ij}$ ) is proportional to their GDPs and distances ( $D_{ij}$ ) (Shepherd, Doytchinova, & Kravchenko, 2019). The conventional gravity model is shown as follows:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} \eta_i \quad (1)$$

where  $Y_i$  and  $Y_j$  represent the GDPs of origin country  $i$  and destination country  $j$ , respectively. Defines stochastic error term, which has unitary mean. The geographical distance between the two countries is considered an approximation of the cost of a trade. However, it is not comprehensive that the cost of business is only explained by geographical distance. Anderson and Van Wincoop (2003) pointed out that controlling relative transaction costs was crucial to the gravity model. They used the Arminton hypothesis, which means that all goods distinguished according to their origin. Under this assumption, goods produced and sold domestically are completely not substituted with imported goods. The gravity model of Anderson and Van Wincoop (2003):

$$X_{ij} = \frac{Y_i Y_j}{Y} \left( \frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad (2)$$

where  $\Pi_i$  defined as

$$\Pi_i \equiv \left[ \sum_j (t_{ij}/P_j)^{1-\sigma} \theta_j \right]^{1/(1-\sigma)} \quad (3)$$

and  $P_j$  can be defined as

$$P_j = \left( \sum_i (t_{ij}/\Pi_i)^{1-\sigma} \theta_i \right)^{1/(1-\sigma)} \quad (4)$$

So after combining the equation 3 and the equation 4, we can obtain all the  $\Pi_i$  and  $P_i$  in terms of income shares,  $i$  (i.e.,  $Y_i/Y$ ) and  $j$  (i.e.,  $Y_j/Y$ ), bilateral trade costs,  $t_{ij}$ , and the elasticity of substitution. If trade costs are symmetric,  $t_{ij}=t_{ji}$ , we can obtain the solution of equation 3 and 4 like  $\Pi_i = P_i$ , with:

$$P_j^{1-\sigma} = \sum_i P_i^{\sigma-1} \theta_i t_{ij}^{1-\sigma}, \forall j \quad (5)$$

Thus, the price indices can be obtained by the function of all bilateral trade barriers,  $t_{ij}$ , and income shares. Therefore, the gravity model becomes:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left( \frac{t_{ij}}{P_i P_j} \right)^{1-\sigma} \quad (6)$$

Given that it can not be observed, bilateral resistance,  $t_{ij}$  defined as a log-linear function: bilateral distance,  $D_{ij}$ , and a dummy variable,  $b_{ij}$  that equals to one if  $i$  and  $j$  located in different countries, and zero otherwise. Then,

$$t_{ij} = D_{ij} b_{ij} \quad (7)$$

Substitute equation 7 into 6, then the gravity model turns into:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left( \frac{D_{ij} b_{ij}}{P_i P_j} \right)^{1-\sigma} \quad (8)$$



The multilateral trade resistance in equation 8,  $P_i$  and  $P_j$  are unobserved because they do not match any data collected by the national statistical agency. What they mean is that if countries are far away from world markets, their values are low, usually due to some physical factor, such as the physical distance from a large market. A case is that two countries surrounded by other large trading economies, such as Belgium and the Netherlands, are neighbors of each other and border France and Germany respectively. But assuming they are surrounded by oceans (such as Australia and New Zealand), mountains or deserts (such as the Kyrgyzstan and Kazakhstan), trade between them will become less. This result solves the estimation error that may occur in previous gravity models without controlling multilateral resistance conditions.

After referencing the literature, I decided to use the fixed effects method, which is straightforward. Dummy variables for importers and exporters are used to refer to multilateral resistance indices. Let  $\delta_i$  and  $\delta_j$  represent the dummy variables respectively, when country  $i$  is the exporter, then  $\delta_i = 1$ , otherwise, 0; when country  $j$  is the importer,  $\delta_j = 1$ , otherwise zero. Then the equation 8 can be rewritten as:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left( \frac{D_{ij} b_{ij}}{\delta_i \delta_j} \right)^{1-\sigma} \quad (9)$$

Besides, the world GDP,  $Y$ , is a regression constant. Since it is consistent for all importers and exporters, it can be expressed simply by multiplying the coefficient by a constant term.

Also, in the gravity literature, it is generally assumed that the form of trade costs is:

$$t_{ij} = D_{ij}^{\beta_1} \cdot \exp(\beta_2 Pop_i + \beta_3 Pop_j + \beta_4 Contig_{ij} + \beta_5 Comlang_{ij} + \beta_6 Evercol_{ij} + \beta_7 FTA_{ij} + \beta_8 XCHR_{ij}) \quad (10)$$

$Pop_i$  and  $Pop_j$  are the populations of China and country  $j$ , respectively.  $contig_{ij}$  is a contiguity dummy variable.  $Comlang_{ij}$  is a dummy variable that represents a common language.  $Evercol_{ij}$  is the colonial relationship dummy variable, and  $FTA_{ij}$  represents the free trade agreement dummy variable.  $XCHR_{ij}$  is the bilateral exchange rate between China and its trading partners to the United States. All these variables have been found to be important determinants of bilateral trade. Their specific definitions are as follows:

- National population: The national population demonstrates the market size of a nation;
- Contiguity: A dummy variable that identifies the country-pair shares a common border. If it is, the variable is unity, and zero otherwise. If the two countries share a common border, they will have direct economic and cultural exchanges and a large number of border treaty ports. When two countries share a border, it is considered a boost to trade;
- Common language: A dummy variable, indicating whether the two countries use a common language. If so, it equals one; otherwise, it equals zero. The interoperability of languages between the two countries believed to facilitate trade;
- Colonial relationship: A dummy variable, indicating whether there ever a colonial relationship between the two countries. If the two had a colonial relationship, the variable is equal to one, otherwise zero. If the two countries had a colonial relationship, it means that there must have been some kind of economic relations between the two countries, which will not disappear with the interruption of the colonial connection;
- Free trade agreement: A dummy variable that represents whether the two countries have signed the trade agreement. If so, it equals one. Otherwise, it equals zero. If the two countries sign a free trade agreement, then preferential trade policies will have a significant impact on their trade;
- Exchange rate: According to [Anderson, Vesselovsky, and Yotov \(2013\)](#), the exchange rate also affects the trade. In the gravity model, this effectively means altering the cost of international relative to intra-national trade. Thus exchange rates with real effects are part of the border effect component of bilateral trade costs ([Anderson et al., 2013](#)).

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} / D_{ij}^{\beta_1(1-\sigma)} \exp \left( \begin{array}{l} \beta_4 Pop_i + \beta_5 Pop_j + \beta_6 Contig_{ij} + \beta_7 Comlang_{ij} + \\ f_8 Evercol_{ij} + \beta_9 FTA_{ij} + \beta_{10} XCHR_{ij} + \beta_{11}(1-\sigma)b_{ij} \\ -\beta_{12}(1-\sigma)\delta_i - \beta_{13}(1-\sigma)\delta_j \end{array} \right) \eta_i \quad (11)$$

Since this paper is a study on bilateral trade data between China and trading partner countries, China is an exporter, and trading partner countries are importers, so instrumental variables  $\delta_i$ ,  $\delta_j$ , and  $b_{ij}$  are all equal. These three variables can be included in the constant term. So the equation becomes:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} / D_{ij}^{\beta_1(1-\sigma)} \exp \left( \begin{array}{l} \beta_4 Pop_i + \beta_5 Pop_j + \beta_6 Contig_{ij} + \beta_7 Comlang_{ij} \\ +\beta_8 Evercol_{ij} + \beta_9 FTA_{ij} + \beta_{10} XCHR_{ij} \end{array} \right) \eta_i \quad (12)$$

### Model extension

Based on the above analysis, this paper adds a trade facilitation level index as an explanatory variable. There are bilateral data in the gravity model to construct bilateral TFI using arithmetic average, which denoted as:

$$TFI_{ij} = 2\sqrt{TFI_i TFI_j}$$

Assuming that this variable is positive, and using the plus sign, the expanded gravity model is as follows:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} / D_{ij}^{\beta_1(1-\sigma)} \exp \left( \begin{array}{l} \beta_4 Pop_i + \beta_5 Pop_j + \beta_6 Contig_{ij} + \beta_7 Comlang_{ij} \\ +\beta_8 Evercol_{ij} + \beta_9 FTA_{ij} + \beta_{10} XCHR_{ij} + \beta_{11} TFI_{ij} \end{array} \right) \eta_i \quad (13)$$

### Estimation methods

Since the OLS regression estimation has been used for a long time to estimate the variables of interest in the trade gravity model, this paper also uses OLS to estimate the gravity model, and a logarithmic equation obtained.

$$\begin{aligned} \ln X_{ij} = & \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j - \beta_3(1-\sigma) \ln D_{ij} + \beta_4 \ln Pop_i + \beta_5 \ln Pop_j \\ & +\beta_6 \ln Contig_{ij} + \beta_7 \ln Comlang_{ij} + \beta_8 \ln Evercol_{ij} + \beta_9 \ln FTA_{ij} \\ & +\beta_{10} \ln XCHR_{ij} + \beta_{11} \ln TFI_{ij} + \ln \eta_i \end{aligned} \quad (14)$$

According to the data processing method of the previous gravitational model literature, the variables  $X_{ij}$ ,  $Y_i$ ,  $Y_j$ ,  $D_{ij}$ ,  $Pop_i$ ,  $Pop_j$ ,  $XCHR_{ij}$  are logarithmic, and then the regression is performed. Since  $contig_{ij}$ ,  $Comlang_{ij}$ ,  $Evercol_{ij}$ , and  $FTA_{ij}$  variables are dummy variables, TFI is a fractal policy data (according to the scale of zero to one, a higher score is equivalent to a better trade facilitation environment), it is not necessary to take logarithms of them when conducting regression.

However, the disadvantage of OLS estimation is that it ignores the unobserved heterogeneity of individuals. Heterogeneity may be related to explanatory variables and lead to inconsistent estimates. Technically, heteroscedasticity means that for different sample points, the conditional variances are no longer constant. And they are different from each other. The OLS equation is established by assuming that the error term's logarithm is statistically independent of the regression.

Therefore, if the variance of the error term depends on other independent variables ( $Y_i$ ,  $Y_j$ ,  $Y$ ,  $t_{ij}$ , etc.), the expected value of the logarithm of the error also depends on regressor, "...violating the condition for consistency of OLS" (Silva & Tenreyro, 2006). If the panel data treated as cross-sectional, and mixed regression performed, each individual in the sample is regarded as having the same regression equation. It is not possible in reality.

Therefore, considering the heterogeneity of export companies (e.g., companies with different sizes, human capital, technology, etc.), this paper uses the Poisson Pseudo Maximum Likelihood (PPML) method to estimate the model by referring to the approach of Silva and Tenreyro (2006), which can directly estimate the gravity model in nonlinear form and eliminate the heterogeneity. Silva and Tenreyro (2006) show that the PPML estimator can provide consistent estimates for the original nonlinear model

without requiring the data to be Poisson distribution. According to The gravity model of international trade: a user guide, it is appropriate to apply it far more generally to nonlinear models such as gravity. Therefore, the gravity equation, just like the form of the formula in equation 15.

$$X_{ij} = \beta_0 \ln Y_i^{\beta_1} \ln Y_j^{\beta_2} / \ln D_{ij}^{\beta_3(1-\sigma)} \exp \left( \begin{array}{l} \beta_4 \ln Pop_i + \beta_5 \ln Pop_j + \beta_6 \text{Contig}_{ij} + \beta_7 \text{Comlang}_{ij} \\ + \beta_8 \text{Evercol}_{ij} + \beta_9 \text{FTA}_{ij} + \beta_{10} \ln XCHR_{ij} + \beta_{11} \text{TFI}_{ij} \end{array} \right) \eta_i \quad (15)$$

## RESULTS

It need to process the panel data before running: First, the panel data are tested for stationery to avoid false regression. Second, the panel data is cointegrated to prove a long-term co-integration relationship among variables. If there is a common trend among variables, the original data can be used for regression. The data is then tested for heteroscedasticity, autocorrelation within-group, and cross-section correlation; Finally, the multicollinearity tests performed on the five first-level variables of TFI. Because in the regressions of the sub-indicators, the *t* value of each variable is not significant. Moreover, the sign is contrary to expectation.

All variables are integrated of order one except for the log of Chinese population. It is integrated of order 2. This paper drops it for regression. And, the technology readiness variable of TFI has multicollinearity, and VIF value is higher than ten. Therefore, this paper drops the variable of technical readiness while performing the sub-index of TFI regressions.

For the convenience of reading, the meanings of all variable abbreviations are shown in Table 3.

Table 3: China's top 50 trading partners in 2018

Variable	Abbrevia- tion	Variable	Description
Lxij		Log of $X_{ij}$	Log of Chinese Cross-border E-commerce Exports to Country j
Ly <sub>i</sub>		Log of $Y_i$	China's GDP Growth Rate
Ly <sub>j</sub>		Log of $Y_j$	GDP Growth Rate of Country j
lpop <sub>i</sub>		Log of $Pop_i$	China's Population Growth Rate
lpop <sub>j</sub>		Log of $Pop_j$	Population Growth Rate of Country j
ldij		Log of $D_{ij}$	Log of Population-weighted-great-circle Distance, in km. between China and Country j
$contig_{ij}$		$contig_{ij}$	Dummy Set to 1 if the Countries are Contiguous
$Comlang_{ij}$		$Comlang_{ij}$	Dummy Set to 1 if at Least One Language is Spoken by More Than 9% of the Population in Both Countries
$Evercol_{ij}$		$Evercol_{ij}$	Dummy Set to 1 if China and Country j ever were in a Colonial Relationship
$FTA_{ij}$		$FTA_{ij}$	Dummy Set to 1 if There is a Free Trade Agreement between the Two Countries
lxchrij		Log of $XCHR_{ij}$	Bilateral Exchange Growth Rate between China and Trading Partners to the United States
$TFI_{ij}$		$TFI_{ij}$	Bilateral Trade Facilitation Level Index
$plen_{ij}$		Political Environment	Political Environment Index of TFI
$lgen_{ij}$		Legal Environment	Legal Environment Index of TFI
$furs_{ij}$		Infrastructure	Infrastructure Index of TFI
$cuse_{ij}$		Customs Environment	Customs Environment Index of TFI
$thch_{ij}$		Technological Readiness	Technological Readiness Index of TFI

Empirical Results and Analysis of the Overall Regression After processing the data, the overall regression presented in Table 4.

Table 4: Empirical results of overall regression from 2000 to 2017

Variables	(1) modelPOLS	(2) modelFE1	(3) modelFE2	(4) modelFE3	(5) modelPPML
lyi	1.833*** (16.73)		1.83*** (16.85)		1.694*** (7.70)
lyj	0.651*** (12.76)	0.526*** (10.11)	0.66*** (13.78)	0.54*** (11.26)	0.84*** (4.81)
lpopj	-0.029 (-0.74)	0.098** (2.49)	-0.048 (-1.25)	0.07** (2.19)	-0.114 (-0.75)
ldij	-0.58*** (-12.78)	-0.515*** (-10.79)	-0.548*** (-10.62)	-0.48*** (-9.00)	-0.442*** (-2.44)
<i>contig<sub>ij</sub></i>	0.39*** (4.37)	0.390*** (4.69)	0.374*** (4.15)	0.37*** (4.48)	0.789*** (2.79)
<i>Comlang<sub>ij</sub></i>	0.759*** (7.93)	0.669*** (7.14)	0.761*** (7.75)	0.67*** (6.95)	0.905*** (3.58)
<i>FTA<sub>ij</sub></i>	0.27*** (3.08)	0.217** (2.57)	0.276*** (2.99)	0.21** (2.53)	0.302 (1.39)
lxchrij	-0.017 (-1.40)	-0.015 (-1.35)	-0.01 (-0.95)	-0.010 (-0.88)	-0.009 (-0.19)
<i>TFI<sub>ij</sub></i>	1.28 (1.60)	4.352*** (4.81)	1.20 (1.52)	4.237*** (4.75)	3.021 (1.31)
Constant	-8.207*** (-10.56)	-261.303*** (-6.85)	-8.02*** (-10.67)	-263.89*** (-7.01)	-8.450*** (-3.22)
Observations	428	428	428	428	428
R-squared	0.80	0.831	0.811	0.84	0.865
Year FE		Yes	No	Yes	
PairCountries FE		No	Yes	Yes	

Robust *t*-statistics in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Table 4 shows the results of different models. The modelPOLS uses the robust standard error, which can solve heteroscedasticity and intra-group autocorrelation problems in the data. In general, gravity modellers use the cluster robust standard error to control the error correlation between different country pairs. This paper only studies China's relations with its trading partners, so the data is equivalent to only one cluster. Therefore, only the robust standard error is used in this paper. Model FE1 takes into account the time fixed effect, while model FE2 takes into account the country-pair fixed effect. Model FE3 considers both time fixed effect and country-pair fixed effect. Model PPML is the PPML estimation model. After controlling the time effect, the result excludes the influence factors that change with time. The country-pair fixed effect indicates the propensity to trade a pair of countries. In panel data, the country pair's heterogeneity can also be controlled by the country-pair fixed effect, not just by looking at the country pair's characteristic (such as common language, common currency).

First, the model has a good fitting to the data, with  $R^2$  all above 0.80, indicating that explanatory variables account for more than 80% of the trade changes observed in the data. It is worth noting that the PPML model has a better fitting degree than the OLS. This difference may indicate the problem of heteroscedasticity, so it is necessary to consider the PPML model.

Other than that, the observations are 428, which is the same among models. Generally speaking, since the international trade contains zero trade flows, there might be more observations when using the PPML estimation. Because the PPML can estimate the nonlinear gravity model directly, including the zero trade flows that are dropped by OLS estimation. However, as China's major trading partners, there is no zero trade flows during the study period. Therefore, both OLS and PPML observations in this paper are the same.

To better understand each variable, we look at the coefficients and *t*-tests of each

variable. First of all, the GDP growth rate is positively correlated with China's cross-border e-commerce exports. Both of them are significant at 1%. According to the PPML model, for every 1% increase in China's GDP, China's cross-border e-commerce exports will increase by about 1.7%. For every 1% increase in the GDP of importing countries, China's cross-border e-commerce exports increase by about 0.8%. It shows that the increased purchasing power between the two countries, and the improvement of national consumption capacity. And the consumer demand increased. It will help increase trade flows.

Regarding population growth rate, the OLS models FE1 and FE3 that consider the time fixed effect is positively correlated to China's cross-border exports and are significant at the 5% level. The POLS model's coefficients, model FE2, and PPML model are negatively correlated with the dependent variables but not significant. It probably because the model considers the characteristics that the importing country's population growth rate does not change with the cross-section of the country, but change over time. So, it is positively related to the explanatory variable. According to model FE3, for every 1% increase in the population of importing countries, every increase in China's cross-border e-commerce exports increased by 0.08%.

The distance coefficient is negatively correlated with the dependent variable: According to the PPML results, for every 1% increase in distance, trade decreases by about 0.4%. Its effect is lower than the effect of distance on traditional international trade (generally, about 0.6%). This finding may be consistent with the fact that the impact of distance on e-commerce trade is reduced, but its impact is still significant. Even if you can trade through the Internet, the goods and services will not be transferred free of charge across borders. For trade, distance is still a variable that cannot be ignored.

For dummy variables, they have the expected positive sign of coefficients. Due to the multicollinearity, the dummies of colonial relations are eliminated. Because there are not colonial relations between China and major trading countries, it is simple to quantify the impact of other dummy variables on trade. In terms of geographical proximity dummies, countries with a common border are 44% higher than countries without a common border ( $\exp[0.37]-1 = 0.44$ ); Similarly, countries with a common language trade 114% more than countries without a common language ( $\exp[0.76]-1 = 1.14$ ); Countries with free trade agreements among countries were 32% higher than those without ( $\exp [0.28]-1 = 0.32$ ). The growth rate of the bilateral exchange rate is negatively correlated with China's cross-border e-commerce exports. The coefficient is about -0.01. However, the *t*-test is not significant. The key variable TFI is positively correlated with China's cross-border e-commerce exports as expected. And the coefficient at the 1% significance level of model FE1 and model FE3 is about 4.3. For every 1% increase in trade facilitation, China's cross-border e-commerce exports grow by about 4.3%. The reason why these two models calculate TFI variables significantly may be that the time fixed effect is taken into account. So TFI changes over time. The following analysis mainly starts with the subdivided trade facilitation indicators, aiming at high-income countries, upper-middle-income countries, and lower-middle-income countries.

### Empirical results of sub-indicators

Based on the gravity model, these four indicators are added as independent variables to obtain the following equation:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} / D_{ij}^{\beta_0(1-\sigma)} \exp \left( \begin{array}{l} \beta_4 Pop_i + \beta_5 Pop_j + \beta_6 Contig_{ij} + \beta_7 Comlang_{ij} + \\ \beta_8 Evercol_{ij} + \beta_9 FTA_{ij} + \beta_{10} XCHR_{ij} + \beta_{11} PLEN_{ij} + \\ \beta_{12} LGEN_{ij} + \beta_{13} FURS_{ij} + \beta_{14} CUSE_{ij} \end{array} \right) \eta_i \quad (16)$$

We can see from Fig. 2 that the TFI secondary indicators in high-income countries from 2007 to 2018 showed a slow-growth trend. Among them, the legal environment indicators have risen the fastest, with the fastest growth in 2009. The infrastructure index and technology maturity index showed a steady growth trend. The Customs Environmental Index has declined since 2010 and started to rise in 2012. The political environment index proliferated between 2009 and 2010.

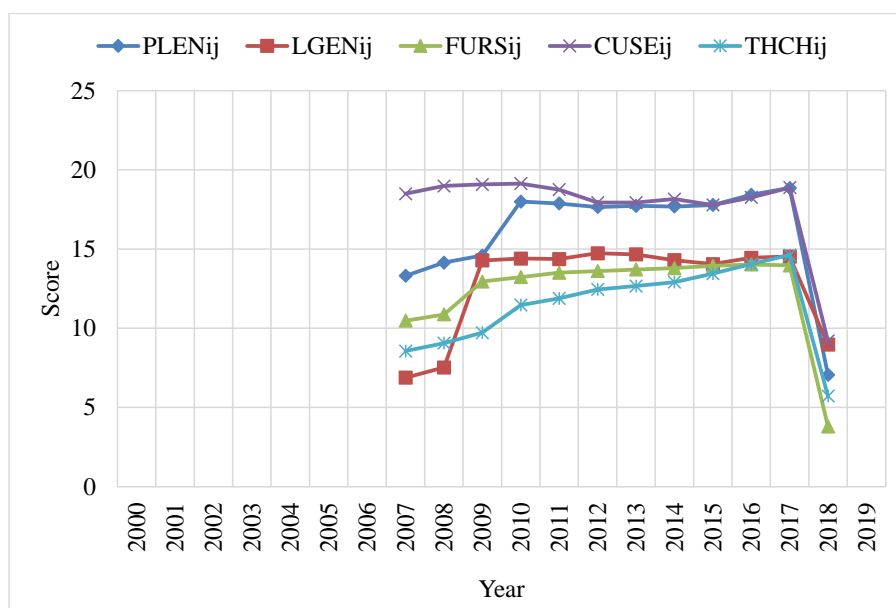


Figure 2. Line chart of secondary indicators of TFI in high-income countries

Fig. 3 shows a line chart of the development of TFI secondary indicators in upper-middle-income countries over time. The technology maturity index has been rising steadily from 2007 to 2017. Other indicators have declined after 2014. Among them, political indicators have fallen the fastest. The legal environment has proliferated from 2007 to 2010, with the most rapid growth rate.

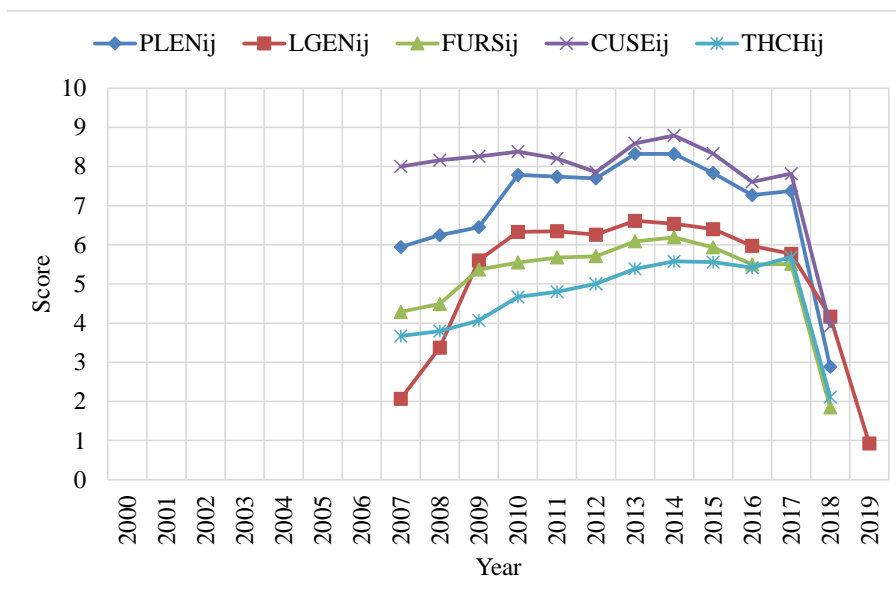


Figure 3. Line chart of secondary indicators of TFI in upper-middle-income countries

Same as above, Fig. 4 shows a line chart of the TFI secondary indicators in lower-middle-income countries over time.

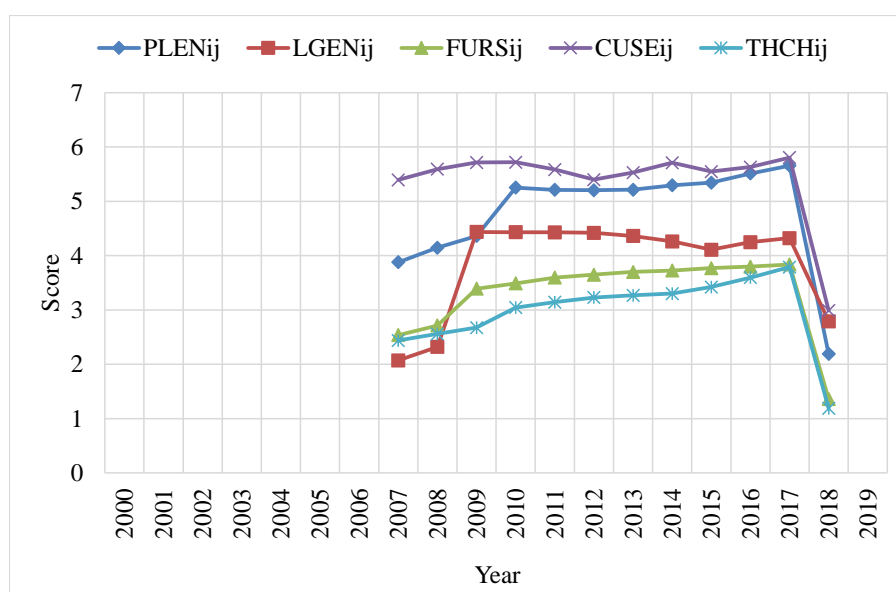


Figure 4. Line chart of secondary indicators of TFI in lower-middle-income countries

It is worth noting that the trends of these variables cannot be compared horizontally. Because they have different weights when they are composed of secondary indicators, we can only see the development trend of the secondary indicators from the line chart. So, it is essential to make the gravity regression of TFI secondary indicators. The regression allows us to see the impact of these secondary indicators on China's cross-border e-commerce exports and compare them horizontally. According to the results of model FE2, the influences of various indicators in countries with different income levels are compared and summarised. Table 5 shows the TFI sub-index coefficients of each region.

Table 5: TFI sub-index coefficient results

Income Group/Index	PLEN	LGEN	FURS	CUSE
High-income Countries	2.20	-3.61	5.13	5.19
Upper-middle-income Countries	-2.77	-3.51	8.91	5.01
Lower-middle-income Countries	-2.70	-2.29	2.15	2.93

In terms of political environment indicators (2.20 for high-income countries, -2.77 for upper-middle-income countries, and -2.70 for lower-middle-income countries): except for the high-income countries, political indicators have a negative impact on trade flows in both upper-middle-income and lower-middle-income economies. It means that the cross-border e-commerce policies of upper-middle-income and lower-middle-income countries are less attractive to enterprises than high-income countries. It even hinders the export of Chinese enterprises. For high-income countries, an advanced and sound political environment can attract cross-border e-commerce enterprises and FDI.

In terms of legal indicators (the high-income countries' coefficient is -3.61, the upper-middle-income countries is -3.51, and the lower-middle-income countries is -2.29): for all trading partners, legal environment indicator is a hindrance to China's cross-border e-commerce exports. The legal environment of importing countries is a hindrance to the export of Chinese enterprises. First, China's intellectual property awareness is weak, its legislation on intellectual property is imperfect, and there is a lack of intellectual property talent in Chinese enterprises. In such an environment, the advantages of technology and intellectual property, the ingenious application of intellectual property in trade, and the establishment of the domestic technical barriers of importing country have hindered the export of China's cross-border e-commerce. Second, the strict protection of intellectual property rights in importing countries raises the cost of importing technology for Chinese exporters and discourages them from exporting.

However, it is believed that the legal environment's obstruction to China's cross-border e-commerce exports is temporary. In the long run, Chinese export enterprises should strengthen their intellectual

property rights and legal awareness and conform to international trade's current legal environment. Furthermore, they should try to move from Made in China to Created in China, which will benefit exports. However, due to the lack of data, the opinion only exists at the level of reasoning.

In terms of infrastructure indicators (the high-income countries' coefficient is 5.13, the upper-middle-income countries is 8.91, and the lower-middle-income countries is 2.15): for lower-middle-income countries, the rapid improvement of infrastructure plays an important role in cross-border trade. For high-income and upper-middle-income countries, the benefits of advanced infrastructure are also sustainable. With the rapid development of e-commerce, infrastructure construction, such as broadband and mobile networks, is becoming more important. Also, sea, air and land transport infrastructure also ensure the normal operation of logistics.

Regarding customs environment indicators (5.19 for the high-income countries, 5.01 for the upper-middle-income countries, and 2.93 for the lower-middle-income countries): The level of customs environment of all trading partners has a positive influence on trade flow. The customs environment of high-income countries is better than that of upper-middle-income and lower-middle-income countries. However, in recent years, with the development of economic integration, the customs environment of upper-middle-income economies have developed rapidly, customs clearance procedures have simplified, and management has been relatively transparent, which has reduced the trade cost of cross-border e-commerce exports. From a horizontal comparison, lower-middle-income countries' customs environment index has the greatest impact on China's cross-border e-commerce export. It indicates that its customs environment has developed rapidly in recent years and achieved significant economic effects. Since the establishment of the China-ASEAN Free Trade Area, the 10 ASEAN countries' average tariff on more than 90% of Chinese products has been reduced from 12.8% to 0.6%.

### **Limitations of the study**

In terms of data, there are only data from 2000 to 2014 in the CEPII website. The other data from 2015 to 2018 are collected from the World Bank and the World Competitiveness Report. The difference in data statistics and sources makes it possible for the data to be biased.

Secondly, the international assessment standards for trade facilitation are not uniform, and various standards have different connotations. Therefore, there is no unified and authoritative system and index for trade facilitation. This paper adopts the indicators of the World Economic Forum's Global Competitiveness Report. It selects some indicators that can explain the economy to measure trade facilitation, which may not be comprehensive and authoritative. Besides, Iraq and Taiwan were not included in the report because its trade facilitation indicators were missing.

Besides, because the stationary test and multicollinearity test were not passed, the technical readiness indicator of TFI, colonial variables and Chinese population were deleted. It leads to the paper not being able to study their relationship.

Finally, for bilateral variables (bilateral exchange rates and bilateral trade facilitation indicators in this paper), since they are the product of country  $i$ 's variables and country  $j$ 's variables, by definition, the newly generated variable will change in both directions. It has the advantage of avoiding multiple linearisation problems with importing or exporting countries. By multiplying them together, a country-pair variable formed. However, such variables make the model more difficult to interpret. We cannot distinguish how much of the change in this variable is due to the exporter and how much is due to the importer.

### **CONCLUSION AND RECOMMENDATIONS**

Through the gravity model, this paper analyses the cross-border e-commerce in China. Based on the basic gravity model (the basic variables include the GDP, population, and geographical distance between the two countries), I added the level of trade facilitation of the 50 partners with the largest trade with China as the explanatory variable. At the same time, taking into account whether the country has signed a bilateral free trade agreement with China, whether there is a colonial relationship, whether it uses common language, and bilateral exchange rate, the improved gravity model equation is obtained. Using the gravity model, an OLS estimation and PPML estimation of the impact of the trade facilitation



index on China's cross-border e-commerce exports was made. The test results have shown that trade facilitation has a significant positive effect on cross-border e-commerce exports. According to the World Bank standard, 50 trading partner countries are divided into high-income countries, upper-middle-income countries, and lower-middle-income countries. Then the trade facilitation index was divided into five primary indexes. Furthermore, they were added into the gravity model. By adding data of different income levels into the gravity model of the subdivided indicators, it is concluded which aspect of the trade facilitation indicator should be developed in priority. The results are as follows.

High-income countries and lower-middle-income countries should focus on improving the level of the customs environment. The empirical results have shown that the improvement of the customs environment has the most significant impact on trade. The level of customs environment can be improved by streamlining customs procedures and lowering trade barriers. First, simplify the custom procedures. At present, some countries have implemented an all-weather customs clearance system to ensure the smooth flow of customs clearance. In addition, the establishment of an international customs clearance system can improve the efficiency of customs clearance. Second, implement international exchanges and cooperation. High-income countries should continue to implement open cooperation with other countries to achieve mutual complementarity. Lower-middle-income countries have a relatively low level of facilitation because of their late start in trade facilitation and a lack of deep border cooperation with other countries. The governments of these countries should actively exchange and cooperate and absorb the experiences of high-income countries.

Upper-middle-income countries should focus on improving the level of infrastructure. It has the greatest impact on cross-border export. The construction of the port, aviation, and other transportation facilities is the basis for transporting goods and services. Communication facilities such as power supply quality, mobile network, and fixed telephone are also essential for cross-border e-commerce transactions. It means not only the construction of new facilities but also the orderly maintenance of existing facilities and the enhancement of their transport and supply capacity.

The political and legal environments in upper-middle-income and lower-middle-income countries have a negative impact on cross-border e-commerce. At present, to realise economic interests, high-income countries actively guided and promoted the negotiation process of trade facilitation. Nevertheless, for other countries, trade facilitation forces them to take on financial and technological pressures to adopt a cautious and negative attitude. Overall, trade facilitation has become an inevitable trend. As the non-high-income countries, it should continue to introduce issues such as technical assistance and differential treatment into the agenda of trade facilitation. They should prepare for the availability of technical assistance and strive for more equitable treatment and rights.

As analysed above, especially the impact of COVID-19 in 2020, cross-border e-commerce trade has witnessed explosive growth. However, rapid development also brings many severe challenges. Demand for Internet and mobile data services has increased. Both operators and governments urgently need to adjust network capacity and spectrum. Power supply departments need to improve the quality of power supply to adapt to most offline activities' shift to online activities. Besides, new health regulations in countries have disrupted cross-border logistics. It has greatly reduced the capacity to transport goods across borders and raised transport prices.

These issues need governments to consult and coordinate with each other actively. E-commerce and cross-border e-commerce trade are governments solutions to the COVID-19 pandemic, and this epidemic highlights its importance. Therefore, it is more urgent for countries to improve trade facilitation to cross-border e-commerce. While promoting trade facilitation, high-income countries should find their position in international trade. High-income countries with more mature technological capacity should impart their experience to other countries and help them find management procedures that suit their characteristics. As for upper-middle-income and lower-middle-income countries, they should actively participate in international forums on trade facilitation to learn from high-income countries' advanced experience. They should pursue their interests in multilateral trade negotiations.

## REFERENCES

- Anderson, J. E., & Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, 93(1), 170–192. doi:<https://doi.org/10.1257/000282803321455214>
- Anderson, J. E., Vesselovsky, M., & Yotov, Y. V. (2013). *Gravity, scale and exchange rates* (Tech. Rep.). Massachusetts, MA: National Bureau of Economic Research.
- Coase, R. H. (1937). The nature of the firm. *Economica*, 4(16), 386-405.
- Dollar, D., Hallward-Driemeier, M., & Mengistae, T. (2004). *Investment climate and international integration* (Policy research working paper series WPS 3323). Washington, DC, WA: World Bank Group.
- Guasch, J. L., & Kogan, J. (2001a). *Inventories in developing countries: Levels and determinants a red flag for competitiveness and growth*. Washington, DC, WA: The World Bank.
- Guasch, J. L., & Kogan, J. (2001b). *Investment climate and international integration* (Policy research working paper series WPS 2252). Washington, DC: World Bank Group.
- Huang, L., Wu, Y.-L., & Cheng, C.-B. (2018). Retailers optimal inventory policies for cross-border e-commerce. *International Journal of Business and Administrative Studies*. doi:<https://doi.org/10.20469/ijbas.4.10005-1>
- Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *The American Economic Review*, 70(5), 950–959.
- Qalati, S. A., Ahmed, N., Mei, J., Thu, T. T. H., & Sohu, J. M. (2020). Stay home stay safe: general public knowledge, attitude and behavior regarding COVID-19 during the lockdown in developing countries. *International Journal of Humanities, Arts and Social Sciences*, 6(2), 69-77. doi:<https://doi.org/10.20469/ijhss.6.20002-2>
- Shepherd, B., Doytchinova, H., & Kravchenko, A. (2019). *The gravity model of international trade: A user guide*. Retrieved from <https://bit.ly/3bjhQZE>
- Silva, J. S., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, 88(4), 641-658. doi:<https://doi.org/10.1162/rest.88.4.641>
- Tinbergen, J. (1962). Shaping the world economy: Suggestions for an international economic policy. *American Journal of Agricultural Economics*, 46(1), 270-273. doi:<https://doi.org/10.2307/1236502>
- Williamson, O. (1985). *The economic institutions of capitalism: Simon and schuster*. New York, NY: Free Press.
- Yang, L. (2007). Research review for the impact of WTO trade facilitation measures. *Journal of Capital University of Economics and Business*, 4, 104-108.
- Yong, B. T. B., Si, F. L., & Lun, D. L. M. (2020). *Chinese cross-border e-commerce development report (2018-2019)*. Beijing, China: Chemical Industry Press.