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Original Paper

Empirical Research of Business Development Potentiality of Cross Border E commerce between China and the Belt & Road Countries

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Abstract

Since the financial crisis, the global economy has fallen into a trough and recovered slowly. Under the double impact of the "new normal" of the internal economy and shrinking external demand, the growth rate of China's traditional foreign trade has shrunk dramatically. In contrast, cross-border e-commerce has become a key support point for China's foreign trade. In addition, the "Belt and Road" strategy is proposed to provide good development conditions for cross-border e-commerce. This paper takes the "Belt and Road" cross-border e-commerce as the background, builds a systematic cross-border e-commerce impact mechanism evaluation system, and analyzes the potential of cross-border e-commerce export from China to the countries along the "Belt and Road" based on the stochastic frontier gravity model. The conclusion is that improving infrastructure and logistics construction, improving the development of e-commerce environment, strengthening financial services, and depreciating RMB can promote cross-border e-commerce export efficiency, and thereby tap the export potential of cross-border e-commerce. Finally, this essay puts forward specific policy recommendations to help the development of cross-border e-commerce, combining the actual conditions of China and the countries along the "Belt and Road".

Keywords

cross-border e-commerce, The Belt and Road, stochastic frontier, export potential, export efficiency

1. Introduction

Affected by the financial crisis and falling global demand, traditional international trade growth rate has gradually slowed down, the Chinese government has responded to the current trend of Internet

development and has issued a series of favorable policies to stimulate the development of China's cross-border e-commerce industry. In order to improve trade, the Chinese government has catered to the current trend of Internet development and has issued a series of favorable policies to stimulate the development of China's cross-border e-commerce industry. With the encouragement of cross-border e-commerce industry policies and the gradual improvement of e-commerce-related infrastructure, China's domestic cross-border e-commerce companies are increasing sharply and the scale of transactions continues to expand. At the same time, the government has implemented various policies to guide the healthy development of cross-border e-commerce enterprises. Since 2015, China's State Council has approved the establishment of integrated pilot zones for cross-border e-commerce. By April 7, 2020, 105 integrated pilot zones for cross-border e-commerce had been established, covering 30 provinces and municipalities. As a result, cross-border e-commerce has formed a good development pattern of land-sea linkage. According to the statistics of *Media Research*, the scale of China's cross-border e-commerce transactions in 2018 totaled 9.1 trillion Yuan, an increase of 19.74% year-on-year. China's cross-border e-commerce user scale reached 110 million, an increase of 69.23% year-on-year. In 2019, it reached 10.8 trillion Yuan, and users reached 1.08 billion. Due to the COVID-19 epidemic in 2020, traditional offline sales are being blocked and online demand is increasing. According to China's Commerce Ministry, from January to February 2020, China's cross-border e-commerce retail imports and exports amounted to 17.4 billion Yuan, an increase of 36.7% year-on-year. This data indicates that cross-border e-commerce transaction has the ability to hedge traditional trade risks. Therefore, it is very essential to do research about Chinese cross-border e-commerce. This paper figures out the obstacles, potential and promotion space of China's cross-border e-commerce.

2. Literature Review

2.1 Research Based on Traditional Gravity Trade Model

Tinbergen (1962) replaces the variables in the law of gravitation with variables related to trade: "quality" is replaced by GDP, and "centroid distance" is replaced by the geographic distance between the two countries, thus proposing a standard gravity trade model that trade volume is positively correlated with GDP of the two countries and negatively correlated with geographic distance. As a new form of cross-border trade, cross-border e-commerce is affected by most traditional trade influencing factors. Therefore, it is widely used in academia that the traditional gravity trade model is used to explain the cross-border e-commerce. Gomez-Herrera et al. (2014) use the gravity model to analyze the drivers and impediments for cross-border e-commerce in the EU. Kim et al. (2017) apply the gravity model to analyze distance effects and express delivery in European Union markets.

However, there is a controversy whether "geographic distance" has an impact on cross-border e-commerce. Smith (1998) proposes "the death of distance": With the rapid development of the global Internet and the interconnection of global communications, cross-border e-commerce can break

through the limitation of geographic distance. Kim et al. (2017) also analyze that the use of the Internet to break through spatial restrictions and achieve zero-distance communication and transactions between buyers and sellers is the biggest difference between cross-border e-commerce and traditional international trade. The relationship between geographic distance and cross-border e-commerce has always been a hot topic for scholars. Hortaçsu et al. (2009) concluded that geographic distance is still a key point hindering the development of cross-border e-commerce by collating data from eBay and MercadoLibre.

2.2 Research Based on Trade Facilitation

The evaluation system in this article is based on the trade facilitation index. The purpose of trade facilitation measures is to reduce trade costs and improve trade efficiency. Wilson et al. (2003) pioneered the establishment of quantitative indicators for trade facilitation, including port efficiency, customs environment, regulatory environment and e-business usage, and applied gravity model to prove that trade facilitation measures can significantly promote the development of export trade. For enterprises, Liu and Yue (2013) believe that the timeliness of logistics is closely related to the customs environment, so it is necessary to improve the facilitation of customs clearance. Hoekman and Shepherd (2015) argue that improving trade facilitation significantly reduces the trade costs of SMEs. The improving hardware infrastructure and ICTs also play a greater role in promoting exports in developing economies, and the advancement of information and communication technologies has a more obvious role in promoting exports in developed economies. The improving hardware infrastructure plays a greater part in promoting exports in developing economies, while the advanced ICTs play prominent role in promoting exports in developed economies (Portugal-Perez & Wilson, 2012).

3. Data and Methodology

3.1 Data

According to the principles of timeliness, data availability and consistency, this paper uses data from 52 countries along the Belt and Road from 2009 to 2017.

Table 1. Sample Countries along the Belt and Road

ASEAN	Singapore, Malaysia, Philippines, Laos, Thailand, Cambodia, Vietnam, Indonesia
West Asia and North Africa	Iran, Turkey, Jordan, Lebanon, Israel, Saudi Arabia, Oman, UAE, Qatar, Kuwait, Bahrain, Greece, Cyprus, Egypt
South Asia	India, Bangladesh, Pakistan, Nepal, Sri Lanka
Central Asia	Kazakhstan, Tajikistan, Kyrgyzstan
CIS & Mongolia	Russia, Azerbaijan, Armenia, Georgia, Ukraine, Moldova, Mongolia
Central and Eastern Europe	Poland, Hungary, Czech Republic, Slovakia, Slovenia, Latvia, Estonia, Croatia, Bosnia and Herzegovina, Montenegro, Serbia, Albania, Romania, Bulgaria, Lithuania, Macedonia

3.2 Introduction of Stochastic Frontier Gravitation Model

In order to solve the problem of production efficiency, Meeusen and Broeck (1997) and Aigner et al. (1997) first propose the stochastic frontier method, which defined production efficiency as the ratio of actual output to theoretical maximum output. The formula for applying the stochastic frontier method to the gravity model is as follows:

$$T_{ijt} = f(x_{ijt}, \beta)\exp(v_{ijt})\exp(-u_{ijt}), u_{ijt} \geq 0 \quad (1)$$

$$lnT_{ijt} = lnf(x_{ijt}, \beta) + v_{ijt} - u_{ijt}, u_{ijt} \geq 0 \quad (2)$$

$$u_{ijt} = \alpha' z_{ijt} + \varepsilon_{ijt} \quad (3)$$

$$T^*_{ijt} = f(x_{ijt}, \beta)\exp(v_{ijt}) \quad (4)$$

$$TE_{ijt} = \frac{T_{ijt}}{T^*_{ijt}} = \exp(-u_{ijt}) \quad (5)$$

Where T_{ijt} represents the actual trade volume between country i and country j in period t; x_{ijt} is the core variable affecting the trade volume in the gravity model, such as economic size, population, distance, etc.; β is the parameter to be estimated. Formula (2) is the logarithmic form of Formula (1).

In stochastic frontier gravitation model, v_{ijt} represents measurement and specification error. u_{ijt} stands for trade inefficiency, including factors that promote or restrict trade. In this paper, the inefficiency effects are modeled in terms of other variables, as suggested by Battese and Coelli (1995) and expressed as Formula (3), where z_{ijt} is a vector of explanatory variables associated with the technical inefficiency effects, α' is a vector of unknown parameters to be estimated, and ε_{ijt} represents random disturbance term. u_{ijt} and v_{ijt} are independent of each other, and u_{ijt} follows a truncated normal distribution.

In Formula (4) and (5), T^*_{ijt} is the trade potential, which stands for the maximum trade volume that country i can trade with country j in period t; TE_{ijt} is trade efficiency, which is the ratio of actual trade volume to trade potential.

The trade development potential can be judged by trade efficiency: when $u_{ijt} = 0$, $TE_{ijt} = 1$, and there is no trade inefficiency between two sample countries, the trade volume reaches the maximum, so the actual trade volume is equal to the trade potential; when $u_{ijt} > 0$, $TE_{ijt} \in (0,1)$, and there is trade inefficiency between two sample countries, so the actual trade volume is less than the trade potential.

3.3 Specific form of the Stochastic Frontier Gravity Model

The stochastic frontier gravity model and its variables are specifically shown in formula (6) and Table 2:

$$lnT_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnPOP_{it} + \beta_4 lnPOP_{jt} + \beta_5 lnDPGDP_{ijt} + \beta_6 lnDIS_{it} + \beta_7 CTG_{it} + \beta_8 CLG_{it} + v - u \quad (6)$$

Where T_{ijt} represents the volume of China's cross-border e-commerce exports to country j in year t. However, cross-border e-commerce data is difficult to obtain directly, so this paper refers to the method of Chinese scholars and adopts the cross-border e-commerce data processing method released by *iResearch*, as shown in formula (7):

T_{ijt} = Scale of China's cross-border e-commerce transactions in period t × (China's exports to country j in period t /China's total exports in period t) (7)

Table 2. Model Variables, Expected Symbols, Theoretical Explanations and Data Sources

Variable	Meaning	Expected Symbol	Theoretical Explanation	Data Source
T_{ijt}	Volume of China's cross-border e-commerce exports to country j in year t	/	/	*iiMedia Research* & China's Customs
GDP_{it} GDP_{jt}	China's GDP in year t GDP of country j in year t	+	GDP_{it} reflects the economic scale, demand and factor endowment of both sides.	World Bank (*WDI)*
POP_{it} POP_{jt}	China's population in year t Population of country j in year t	+	The more population, the greater production and demand.	
$DPGDP_{ijt}$	Absolute value of GDP per capita difference between China and country j in year t	+	According to the H-O theory, the greater the difference in per capita GDP between the import and export countries, the stronger the complementary advantages, and the better the cross-border e-commerce transactions can be promoted.	
DIS_{ij}	Geographic distance between China and country j	-	The longer the distance, the higher the transportation cost, thus hindering the export of cross-border E-commerce.	*CEPII*
CTG_{ij}	Dummy variable. If the number is 1, it means that China borders country j	+	If two countries are adjacent, the transportation cost will be reduced and cross-border e-commerce export will be promoted	
CLG_{ij}	Dummy variable. If the number is 1, it means that China has common language with country j	+	The two countries use the same language to facilitate exchanges and promote cross-border e-commerce exports	

3.4 The Specific Form of the Inefficiency Model

This paper applies the method of constructing the trade facilitation indicator system (Wilson et al., 2003) currently used by most scholars in the field of cross-border e-commerce, based on the authority, operability and quantification of data. Also, this paper combines the background of "Internet +" and the characteristics of financial services, and finally sets five first-level indicators: infrastructure and

logistics, customs environment, regulatory environment, e-commerce, financial services, and further refines these five first-level indicators divided into 17 secondary evaluation indicators. Since the value range of 17 secondary indicators is different, in order to make the data more intuitively comparable, this paper unitizes the data of these 17 secondary indicators, and then assigns the same weight to each unitized secondary indicator to construct the primary indicators.

Table 3. Cross-border E-commerce Evaluation Index System

Primary Indicator	Secondary Indicator	Code	Range	Data Source
Infrastructure and Logistics (FRA)	Quality of roads	X_1	1-7	The Global Competitiveness Report (World Economic Forum)
	Quality of railroad infrastructure	X_2	1-7	
	Quality of port infrastructure	X_3	1-7	
	Quality of air transport infrastructure	X_4	1-7	
Regulatory Environment (REG)	Public trust in politicians	X_5	1-7	
	Judicial independence	X_6	1-7	
	Burden of government regulation	X_7	1-7	
	Efficiency of legal framework in settling disputes	X_8	1-7	
	Transparency of government policymaking	X_9	1-7	
E-commerce (ICT)	Availability of latest technologies	X_{10}	1-7	
	Firm-level technology absorption	X_{11}	1-7	
	Individuals using Internet	X_{12}	0-100	
Financial Services (FIS)	Financing through local equity market	X_{13}	1-7	
	Ease of access to loans	X_{14}	1-7	
	Venture capital availability	X_{15}	1-7	
Customs Environment (CUS)	Prevalence of trade barriers	X_{16}	1-7	
	Burden of customs procedures	X_{17}	1-7	

Note. In the range of values, 1 (0) = worst and 7 (100) = best.

The inefficiency model and its variables are specifically shown in formula (8) and Table 4:

$$u_{ijt} = \alpha_0 + \alpha_1 FRA_{jt} + \alpha_2 REG_{jt} + \alpha_3 ICT_{jt} + \alpha_4 FIS_{jt} + \alpha_5 CUS_{jt} + \alpha_6 TAR_{jt} + \alpha_7 EXC_{ijt} + \alpha_8 FTA_{ijt} + \alpha_7 SCO_{ijt} + \alpha_7 WTO_{ijt} \quad (8)$$

Table 4. Model Variables, Expected Symbols, Theoretical Explanations and Data Sources

Variable	Meaning	Expected Symbol	Theoretical Explanation	Data Source
FRA_{jt}	Infrastructure and Logistics	-	These variables reflect the degree of trade facilitation. The larger these variables are, the more obvious they will promote cross-border e-commerce exports.	The Global Competitiveness Report (World Economic Forum)
REG_{jt}	Regulatory Environment	-		
ICT_{jt}	E-commerce	-		
FIS_{jt}	Financial Services	-		
CUS_{it}	Customs Environment	-		

TAR_{jt}	Average most-favored-nation tariff rate	+	Importing countries' tariff increases hinder exports.	World Bank (*WDI)*
EXC_{ijt}	Exchange rate (country j's currency/ RMB)	+	RMB appreciation hinders exports.	
FTA_{ijt}	Dummy variable. If the number is 1, it means that China and country j sign a free trade agreement	-	Various cooperation agreements promote cross-border e-commerce exports.	China FTA Network http://www.fta.mofcom.gov.cn/english/index.shtml
SCO_{ijt}	Dummy variable. If the number is 1, it means that Country j is a member of SCO	-		Shanghai Cooperation Organization http://www.sco-ec.gov.cn/
WTO_{ijt}	Dummy variable. If the number is 1, it means that Country j is a member of WTO	-		WTO https://www.wto.org/

Note. "i" refers to China.

3.5 Model Checking

In this paper, the maximum likelihood estimates tool FRONTIER4.1 is used to build the stochastic frontier model. It is necessary to use the likelihood ratio (LR) test to validate the model because the stochastic frontier model has very high requirements on the function form.

According to Table 5, the LR statistic of "there is no cross-border e-commerce export barrier" is much greater than the critical value of 1%. The null hypothesis is rejected at a 1% significance level, which means that it is necessary to use the stochastic frontier gravity model.

Table 6 shows that CTG, CUS, TAR, and FTA fail to pass the critical value of 5%, indicating that these are not important variables affecting cross-border e-commerce exports. Given that the stochastic frontier analysis is highly dependent on the functional form of the model, these variables should be eliminated.

The final function of the stochastic frontier gravity model is:

$$lnT_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnPOP_{it} + \beta_4 lnPOP_{jt} + \beta_5 lnDPGDP_{ijt} + \beta_6 lnDIS_{it} + \beta_7 CLG_{it} \quad (9)$$

$$u_{ijt} = \alpha_0 + \alpha_1 FRA_{jt} + \alpha_2 REG_{jt} + \alpha_3 ICT_{jt} + \alpha_4 FIS_{jt} + \alpha_5 EXC_{ijt} + \alpha_6 SCO_{ijt} + \alpha_7 SCO_{ijt} \quad (10)$$

Table 5. Generalized Likelihood Ratio Test of Hypotheses for the Model

Null Hypothesis	Restricted Model	Unrestricted Model	LR Statistic	Critical Value of 1%	Decision
No cross-border e-commerce export barrier	-493.945	-361.063	265.763	26.217	Rejected

Table 6. Generalized Likelihood Ratio Test of Hypotheses for the Variables

Null Hypothesis	Restricted Model	Unrestricted Model	LR statistic	Critical Value of 5%	Critical Value of 1%	Decision
No *CTG*	-361.201	-361.063	0.277	3.841	6.635	Not rejected
No *CLG*	-388.807	-361.063	55.489	3.841	6.635	Rejected
No *FRA*	-397.663	-361.063	73.201	3.841	6.635	Rejected
No *REG*	-385.095	-361.063	48.063	3.841	6.635	Rejected
No *FIS*	-363.261	-361.063	4.397	3.841	6.635	Rejected
No *ICT*	-365.660	-361.063	9.195	3.841	6.635	Rejected
No *CUS*	-362.603	-361.063	3.081	3.841	6.635	Not rejected
No *EXC*	-381.689	-361.063	41.253	3.841	6.635	Rejected
No *TAR*	-361.709	-361.063	1.292	3.841	6.635	Not rejected
No *FTA*	-361.967	-361.063	1.808	3.841	6.635	Not rejected
No *SCO*	-419.143	-361.063	116.160	3.841	6.635	Rejected
No *WTO*	-370.483	-361.063	18.840	3.841	6.635	Rejected

4. Empirical Results and Discussion

4.1 Analysis of Influence Factors

In this paper, one-step estimation is used in the stochastic frontier gravity model, and the empirical results are shown in Table 7. Model *a* contains all explanatory variables; Model *b* to *e* are the regression models with the insignificant variables *CTG*, *CUS*, *TAR*, and *FTA* deleted respectively; Model *f* is the regression model after removing all the insignificant variables, that is, the final function of the stochastic frontier gravity model.

According to model *f*, the GDP of China and the import country, population size (POP), per capita income gap (DPGDP), and common language (CLG) have positive effects on cross-border e-commerce exports, while geographic distance(DIS) has negative effects on cross-border e-commerce exports Impact. Infrastructure and logistics (FRA), e-commerce (ICT), financial services (FIS), foreign currency exchange rate against the RMB (EXC), SCO member, and WTO member are significantly negatively related to export inefficiency term (*u*). Therefore, the empirical results are in line with expectations.

It is worth noting that the coefficient of GDP of countries along the “Belt and Road” is 0.553, which is significantly greater than China’s (0.192), and also China’s GDP has only passed the 10% significance level. This shows that the economic scale of importing countries along the Belt and Road has a greater impact on China’s cross-border e-commerce exports; the coefficient of China’s population size is 42.759, much larger than the importing countries, which shows that China’s population size can significantly promote cross-border e-commerce exports. For China, an export-oriented country, the

increase in population size can bring about higher productivity and has a significant impact on China's cross-border e-commerce exports.

The factor of whether China is bordered by the sample countries is eliminated because of insignificance. Due to the combined effects of the improvement of infrastructure and logistics, the development of Internet information technology, and the acceleration of the global economic and trade integration process, the advantages of neighboring countries may be greatly weakened. Meanwhile, most of the countries adjacent to China, along the Belt and Road, are small countries, where logistics, the Internet, and the economy are relatively backward. As a result, the significance of the factor is further weakened.

The customs environment (CUS) and tariff rate (TAR) are not significant. The possible reason is that China has cooperated with the countries along the Belt and Road to promulgate many customs and tariff preferential policies to improve the efficiency of customs clearance. For example, China has cooperated with countries such as Mongolia, Kazakhstan, and Vietnam, and successively opened seven "green channels" for the rapid clearance of agricultural and sideline products at border ports, and promoted China-Europe postal trains. In addition, there are more customs and tariff preferential policies among the members in the FTA, the SCO, and the Lancang-Mekong cooperation, thus weakening customs and tariff effects.

Nevertheless, the regulatory environment (REG) and export inefficiency (u) are significantly positively correlated, with a coefficient of 5.247, which means that the improvement of the regulatory environment will hinder the export of cross-border e-commerce in China. The possible reason is that the more developed the regulatory environment is, the more perfect the system and policies are, so it is easy to produce trade protectionism, such as EU green barriers, and certain restrictions are imposed on imported products. These countermeasures have hindered China's cross-border e-commerce exports. According to data from the Chinese Ministry of Commerce, China is the country with the largest number of WTO anti-dumping and anti-subsidy cases. According to WTO data, of the 236 anti-dumping and 380 anti-subsidy cases in the WTO in 2014, China accounted for 63 and 90, respectively, accounting for 26.69% of the total anti-dumping cases and 23.68% of the total number of anti-subsidy cases. Thirteen of the Belt and Road countries selected in this paper are EU member states (Czech Republic, Slovakia, Slovenia, Poland, Greece, Bulgaria, Cyprus, Croatia, Hungary, Latvia, Lithuania, Estonia, and Romania).

The free trade agreement (FTA) is not significant, which does not meet expectations. The possible reason is that the countries that have signed the agreements in the sample are only Georgia, Pakistan and ASEAN countries. In more detail, the low volume of cross-border e-commerce transactions between Georgia and China has weakened this effect, while various indicators such as infrastructure, logistics, and e-commerce in ASEAN are generally more developed, so they do not reflect the representativeness of free trade agreements.

Table 7. Maximum Likelihood Estimates for Parameters of SFA and Inefficiency Effects

	Variable	*a*	*b*	*c*	*d*	*e*	*f*
Stochastic Frontier Gravity Model	Constant	-894.376***	-889.374***	-894.380***	-894.410***	-894.371***	-889.300***
		(-893.529)	(-889.377)	(-894.473)	(-894.795)	(-893.831)	(-867.615)
	GDP_{it}	0.191*	0.204*	0.162*	0.230**	0.185*	0.192*
		(1.858)	(1.922)	(1.570)	(2.218)	(1.740)	(1.801)
	GDP_{jt}	0.559***	0.559***	0.561***	0.553***	0.546***	0.553***
		(11.546)	(11.945)	(11.752)	(14.189)	(11.682)	(15.399)
	POP_{it}	43.009***	42.731***	43.045***	42.958***	43.031***	42.759***
		(263.839)	(261.011)	(263.757)	(262.171)	(254.450)	(256.934)
	POP_{jt}	0.238***	0.238***	0.231******	0.233***	0.257***	0.237***
		(4.573)	(5.198)	(4.458)	(5.861)	(5.396)	(6.333)
	$DPGDP_{ijt}$	0.126***	0.126***	0.126***	0.134***	0.132***	0.127***
		(4.134)	(4.187)	(4.040)	(4.635)	(4.591)	(4.387)
	DIS_{ij}	-1.383***	-1.333***	-1.362***	-1.369***	-1.421***	-1.348***
		(-10.655)	(-12.610)	(-10.591)	(-12.707)	(-11.583)	(-14.548)
	CTG_{ij}	-0.053		-0.054	-0.057	-0.086	
		(-0.500)		(-0.492)	(-0.614)	(-0.755)	
	CLG_{ij}	0.950***	0.978***	0.950***	0.964***	0.955***	0.988***
		(6.827)	(7.513)	(6.675)	(8.117)	(6.931)	(7.645)
Inefficiency Model	Constant	4.834***	4.709***	4.205***	4.509***	4.861***	4.122***
		(9.300)	(8.488)	(9.630)	(10.275)	(9.040)	(10.492)
	FRA_{jt}	-6.108***	-6.051***	-5.988***	-6.163***	-6.145***	-6.108***
		(-8.247)	(-8.291)	(-7.849)	(-8.324)	(-8.875)	(-7.517)
	REG_{jt}	5.958***	5.786***	4.935***	5.915***	6.104***	5.247***
		(7.256)	(7.244)	(6.207)	(7.086)	(7.179)	(6.496)
	ICT_{jt}	-2.444***	-2.426***	-2.453***	-1.875***	-2.582***	-2.347***
		(-2.823)	(-2.905)	(-2.887)	(-2.387)	(-3.005)	(-3.032)
	FIS_{jt}	-1.235*	-1.125*	-1.249*	-1.706***	-1.315**	-1.542***
		(-1.825)	(-1.691)	(-1.850)	(-2.705)	(-2.017)	(-2.728)
	CUS_{it}	-1.769*	-1.628*		-1.533*	-1.731*	
		(-1.879)	(-1.784)		(-1.688)	(-1.835)	
	TAR_{jt}	-0.016	-0.013	-0.008		-0.014	
		(-0.684)	(-0.590)	(-0.351)		(-0.591)	
	EXC_{ijt}	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
		(-9.295)	(-10.428)	(-8.901)	(-6.373)	(-10.137)	(-11.555)
	FTA_{ijt}	-0.226	-0.245	-0.219	-0.283*		
		(-0.924)	(-1.171)	(-0.886)	(-1.676)		

parameter	SCO_{ijt}	-3.957***	-3.801***	-3.902***	-4.525***	-3.923***	-4.083***
		(-4.925)	(-5.559)	(-5.086)	(-13.932)	(-5.448)	(-12.400)
	WTO_{ijt}	-0.619***	-0.618***	-0.646***	-0.595***	-0.628***	-0.653***
		(-4.089)	(-3.907)	(-4.465)	(-3.793	(-4.035)	(-4.385)
	σ^2	0.382***	0.385***	0.381***	0.430***	0.383***	0.401***
		(10.733)	(10.274)	(7.877)	(10.622)	(10.235)	(8.764)
	γ	0.538***	0.546***	0.541***	0.632***	0.536***	0.575***
		(10.035)	(9.642)	(9.367)	(13.162)	(9.168)	(8.453)
	Log-likelihood	-361.063	-361.201	-362.603	-361.709	-361.967	-363.666

Note. *, *** and *** indicates significance at 10, 5 and 1% respectively.

4.2 Analysis of the Export Potential of Cross-border E-commerce

For cross-border e-commerce exports, the higher the value, the higher the cross-border e-commerce export efficiency, while the lower the value, the greater the cross-border e-commerce export potential to explore. As can be seen from Figure 1, China's average export efficiency for 52 countries along the Belt and Road is 0.603, of which 30 countries are above the average level and 22 countries are below the average level. The cross-border e-commerce export efficiency of China to Kyrgyzstan (0.939), Russia (0.935), Vietnam (0.914), Kazakhstan (0.912) and Tajikistan (0.903) exceeds 0.9, while the cross-border e-commerce export efficiency of China to Azerbaijan (0.271), Mongolia (0.220), Macedonia (0.215), Serbia (0.201), Armenia (0.180), Moldova (0.172), Nepal (0.169) and Bosnia and Herzegovina (0.091) is less than 0.3. It can be seen that the gap between countries varies greatly, and there are obvious regional differences.

It can be seen from Figure 2 that China's export efficiency to Central Asian countries is much higher than other regions. The reasons are as follows. First, Central Asian countries have issued digital financial development strategies. Second, Central Asian countries' e-commerce is developing rapidly. According to the China Council for the Promotion of International Trade, the number of online shoppers in Kazakhstan reached more than 2.3 million in 2018, and online shopping transactions reached 259.5 billion tenge (about 753 million US dollars), an increase of 50% over the previous year.

The efficiency of ASEAN countries is also at the forefront, for the following reasons. First, the transportation and logistics infrastructure of ASEAN countries other than Cambodia is very advanced, and especially, Singapore is the world's second largest container port. Second, ASEAN is China's first free trade zone partner and has a mature foreign trade cooperation mechanism. 93% of products under the FTA have zero-tariff trade, and the FTA was further upgraded in 2015, further reducing non-tariff and tariff barriers, and strengthening links with China in service trade and investment. Eventually, many Chinese and overseas Chinese are active in the ASEAN region, resulting in ASEAN's cultural customs similar to China.

The efficiency of China's cross-border e-commerce exports to Central & Eastern Europe and Western

Asia & North Africa fluctuates around the average export efficiency, and meanwhile the efficiency of China's cross-border e-commerce exports to South Asia and the CIS & Mongolia is below average. Due to their geographical location, South Asia and the CIS & Mongolia mainly rely on land transportation, which shows that the key to the development of the Belt and Road is the construction of infrastructure and logistics.

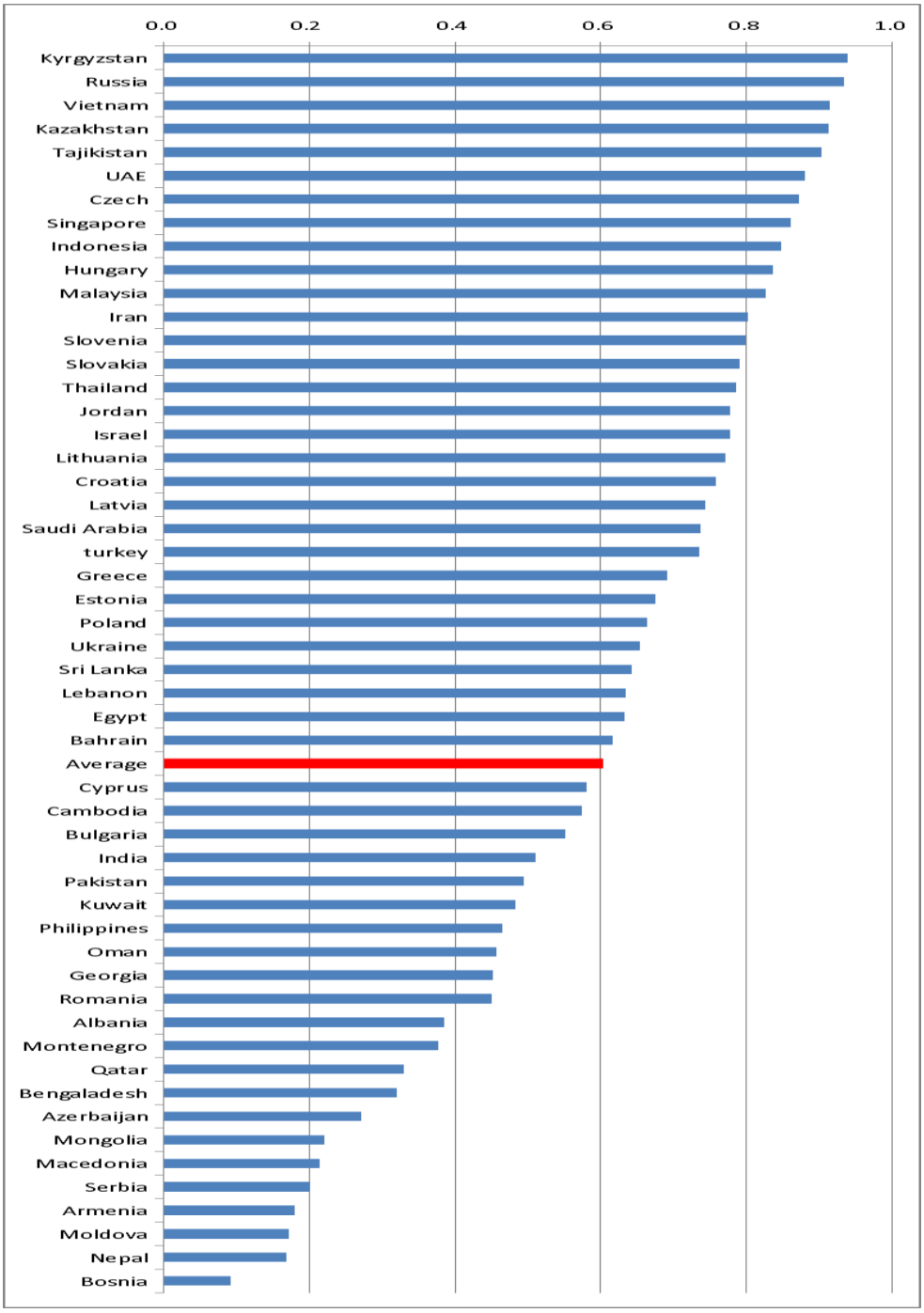

Figure 1. The Average Efficiency of China's Cross-border E-commerce Exports to Countries along the Belt and Road from 2009 to 2017

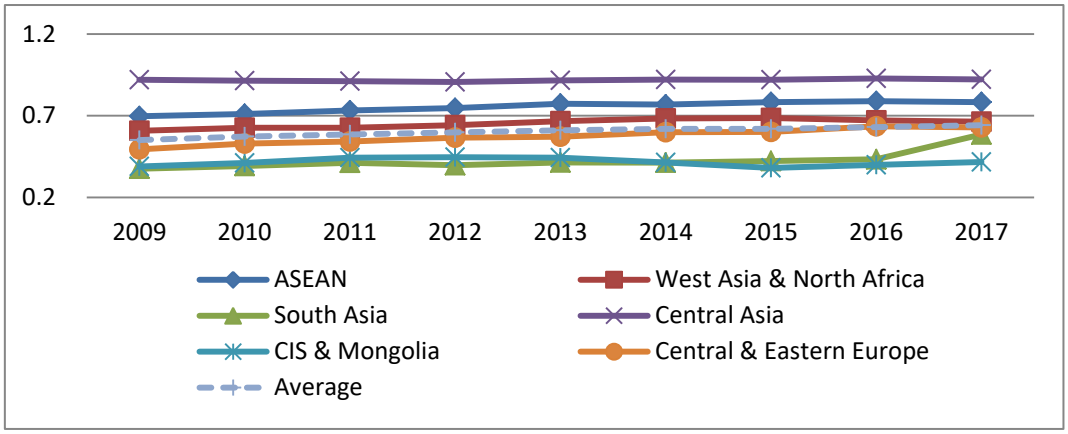

Figure 2. The Efficiency Changes of China's Cross-border E-commerce Exports to Countries along the Belt and Road

It can be seen from Table 8 that in 2017, China's cross-border e-commerce exports to 52 countries along the Belt and Road were RMB 2004.921 billion, the export potential was RMB 293.985 billion, and there is still RMB 192.1102 billion for expansion. China's expandable exports to 7 ASEAN countries are 48.380 billion Yuan; China's expandable exports to 14 countries in West Asia & Egypt are 38.743 billion Yuan; China's expandable exports to 5 countries in South Asia are 80.071 billion Yuan; China's expandable exports to 3 Central Asian countries are 1.524 billion Yuan; China's expandable exports to 6 CIS countries & Mongolia are 16.053 billion Yuan; China's expandable exports to 16 countries in Central and Eastern Europe are 23.384 billion Yuan. Among them, the largest exportable area for China's cross-border e-commerce is South Asia.

Table 8. China's Export Potential to Cross-border E-commerce in Countries along the Belt and Road in 2017

Country	Cross-border e-commerce exports (billion Yuan)	Export Potential T* (billion Yuan)	Technical Efficiency TE	Expandable Exports (billion Yuan)
ASEAN	**956.134**	**103.294**	**0.783**	**48.380**
Singapore	160.317	25.819	0.858	6.196
Malaysia	148.540	17.660	0.835	6.574
Indonesia	123.773	13.961	0.878	6.187
Thailand	137.249	13.327	0.787	6.329
Cambodia	17.033	1.786	0.66	1.821
Vietnam	255.033	14.073	0.934	3.181
Philippines	114.189	16.669	0.529	18.092
West Asia & North Africa	**428.443**	**70.722**	**0.663**	**38.743**
Iran	66.182	9.632	0.945	7.301
turkey	64.532	10.086	0.805	5.663

Jordan	9.984	1.808	0.755	0.651
Lebanon	7.160	1.536	0.58	1.026
Israel	31.759	3.872	0.823	1.805
Saudi Arabia	65.435	9.830	0.703	4.645
Oman	8.249	1.879	0.517	1.552
The United Arab Emirates	102.288	15.790	0.85	3.400
Qatar	5.991	2.437	0.395	2.645
Kuwait	11.085	2.445	0.483	2.903
Bahrain	3.214	0.607	0.469	0.553
Greece	16.920	3.997	0.766	1.935
Cyprus	1.867	1.285	0.462	0.635
Egypt	33.779	5.520	0.732	4.029
South Asia	**379.314**	**76.036**	**0.585**	**80.071**
India	242.303	49.504	0.915	44.541
Pakistan	64.992	9.423	0.922	11.767
Bangladesh	54.018	12.828	0.346	17.298
Sri Lanka	14.558	1.960	0.631	1.504
Nepal	3.443	2.321	0.113	4.961
Central Asia	**64.821**	**11.499**	**0.922**	**1.524**
Kazakhstan	41.182	6.357	0.936	1.038
Tajikistan	4.634	1.014	0.896	0.205
Kyrgyzstan	19.005	4.128	0.934	0.281
CIS & Mongolia	**180.361**	**24.570**	**0.412**	**16.053**
Russia	152.522	14.375	0.946	3.122
Ukraine	17.950	4.083	0.604	2.628
Georgia	3.250	0.514	0.523	0.666
Azerbaijan	1.378	1.593	0.229	2.065
Armenia	0.512	0.337	0.206	0.541
Moldova	0.349	0.340	0.2	0.523
Mongolia	4.400	3.329	0.174	6.508
Central & Eastern Europe	**176.209**	**32.436**	**0.628**	**23.384**
Poland	63.647	9.948	0.855	9.445
Lithuania	5.699	0.712	0.79	0.380
Estonia	3.584	0.513	0.755	0.481
Latvia	4.089	0.597	0.801	0.390
Czech	31.312	4.420	0.868	0.996
Slovakia	9.720	1.520	0.817	0.661
Hungary	21.542	4.733	0.844	1.171
Slovenia	10.281	0.895	0.862	0.458
Croatia	4.130	1.158	0.79	0.438
Bosnia	0.281	0.403	0.113	0.633
Montenegro	0.472	0.246	0.472	0.319

Serbia	1.943	1.346	0.264	1.931
Albania	1.617	0.473	0.415	0.526
Romania	13.454	4.048	0.504	4.179
Bulgaria	4.163	1.187	0.649	1.087
Macedonia	0.278	0.236	0.249	0.290
Total	**2004.921**	**293.985**	**0.627**	**192.102**

This paper further divides the countries along the "Belt and Road" into four quadrants by taking the cross-border e-commerce export efficiency as the abscissa axis and the cross-border e-commerce export growth rate as the ordinate axis from 2009 to 2017. The four quadrants are export development zone, export core zone, export remodeling zone and export key zone, which are shown in Figure 3 and Table 9.

The export core zone is characterized by "high export efficiency and high export growth rate". Countries in export core zone include: Indonesia (IDN), Thailand (THA), Vietnam (VNM), Iran (IRN), Israel (ISR), Sri Lanka (LKA), Russia (RUS), Poland (POL), Lithuania (LTU), Estonia (EST), Latvia (LVA) and Slovenia (SVN). The export core zone maintains a high cross-border e-commerce export growth rate due to its leading logistics facilities (FRA average coefficient is 0.622) and e-commerce level (ICT average coefficient is 0.599). Among these countries, Thailand and Vietnam are the most representative. In addition to joining the China-ASEAN Free Trade Area, these two countries have also joined the Lancang-Mekong Cooperation and the Greater Mekong Subregion Cooperation, which has more effectively promoted trade integration and accelerated The development of cross-border e-commerce.

The export key zone is characterized by "high export efficiency and low growth rate". Countries in export key zone include: Singapore (SGP), Malaysia (MYS), Turkey (TUR), Jordan (JOR), Lebanon (LBN), Saudi Arabia (SAU), United Arab Emirates (ARE), Bahrain (BHR), Greece (GRC), Egypt (EGY), Kazakhstan (KAZ), Tajikistan (TJK), Kyrgyzstan (KGZ), Ukraine (UKR), Czech Republic (CZE), Slovakia (SVK), Hungary (HUN) and Croatia (HRV). Due to developed logistics facilities (average FRA coefficient is 0.631) and e-commerce level (average ICT coefficient is 0.709), China's potential for cross-border e-commerce exports to countries in the export key zone has been fully explored. The main reason for the low export growth rate is that China's market share of its cross-border e-commerce exports has become saturated. It is worth mentioning that Turkey has implemented Turkism due to historical reasons, which has led to poor relations with China. Turkey is skeptical of the majority of the strategic cooperation between the two sides, and often conducts anti-dumping investigations against China. Also, Turkey is at high risk of war and turmoil due to its geographical location. These two factors contributed to low growth rate of China's export to Turkey. In addition, the Ukrainian crisis is one of the most important factors leading to low growth rate of China's export to Ukraine.

The export development zone is characterized by "low export efficiency and high growth rate". Countries in export development zone include: Cambodia (KHM), Philippines (PHL), Oman (OMN), Qatar (QAT), India (IND), Pakistan (PAK), Bangladesh (BGD), Nepal (NPL), Georgia (GEO), Bosnia and Herzegovina (BIH), Montenegro (YUG), and Albania (ALB). The high growth rate and low export efficiency indicate that China's cross-border e-commerce exports to these countries are growing rapidly, but the export obstacles are relatively large, mainly due to the backwardness of infrastructure and logistics and e-commerce level (FRA average coefficient is 0.521, ICT average coefficient is 0.599). China should strengthen cooperation with countries in the zone in infrastructure and logistics, digital finance, and e-commerce.

The export remodeling zone is characterized by "low export efficiency and high growth rate". Countries in export remodeling zone include: Mongolia (MNG), Kuwait (KWT), Cyprus (CYP), Azerbaijan (AZE), Armenia (ARM), Moldova (MDA), Serbia (SRB), Romania (ROM), Bulgaria (BGR), and Macedonia (MKD). China's cross-border e-commerce exports to such countries are more hindered and export efficiency is lower, mainly due to the backwardness of transportation logistics (the average FRA coefficient is 0.5). For Mongolia, due to its history and geographical location, the relationship between Mongolia and China is very complicated, and the low trust in China's cooperative relationship has hindered the cross-border e-commerce between the two sides. The other nine countries are located in Central and Eastern Europe, far away from China, with lower transportation efficiency, longer time, and high cost, which has led to the "double-low" phenomenon. From the above analysis, it can be seen that the construction of infrastructure and logistics is the core of the Belt and Road cross-border e-commerce.

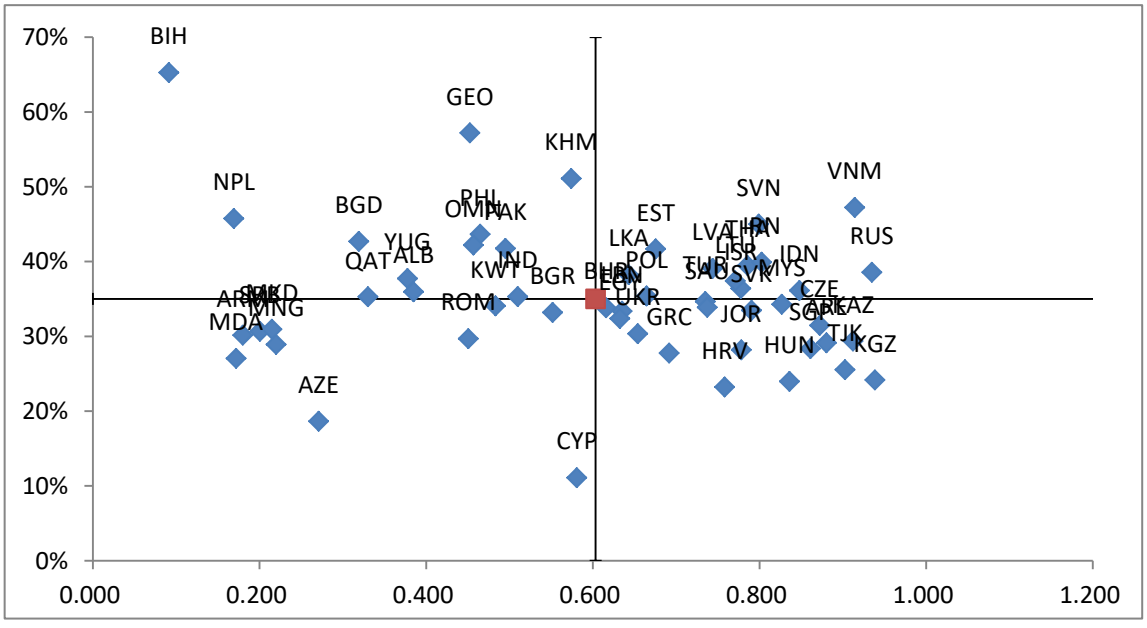

Figure 3. China's Average Cross-border E-commerce Export Efficiency and Export Growth Rate for Countries along the Belt and Road

Table 9. Comparison of the Average Values of the Four Zones

Zone / Average Value	Development Zone (low-high) (First Quadrant)	Core Zone (double-high) (Second Quadrant)	Remodeling Zone (double-low) (Third Quadrant)	Key Zone (high-low) (Fourth Quadrant)
Technical Efficiency	0.386	0.780	0.332	0.781
China's Export Growth Rate	0.445	0.395	0.274	0.299
Exports(billion Yuan)	17.197	31.169	1.949	20.553
GDP(billion dollar)	243.899	384.100	54.060	215.051
DPGDP(dollar)	9725.046	8125.352	7412.584	11000.809
POP(million)	148.481	58.831	5.988	20.631
DIS(km)	5038.609	5725.973	6205.599	6176.685
FRA	0.521	0.622	0.500	0.631
REG	0.586	0.579	0.533	0.600
ICT	0.599	0.685	0.633	0.709
FIS	0.588	0.589	0.509	0.602
EXC	58.646	669.930	35.228	17.769

5. Conclusion

This paper analyzes the influence factors of China's cross-border e-commerce exports to 52 countries along the Belt and Road from 2009 to 2017 based on the stochastic frontier gravity model, and estimates China's potential for cross-border e-commerce exports.

The results show that:

(1) From the perspective of macroeconomic and natural factors, the larger the GDP of China and import country, the population and the GDP per capita gap between China and import country, the more China's cross-border e-commerce exports to the country along the Belt and Road. The use of a common language has a positive effect on China's cross-border e-commerce exports to the country along the Belt and Road, while geographical distance has a negative effect on exports. Additionally, whether China and the import country are adjacent does not have a significant impact.

(2) From the unique factors of cross-border e-commerce, the improvement of the quality of infrastructure and logistics, e-commerce environment and financial services can increase China's cross-border e-commerce exports to the country along the Belt and Road. Moreover, the depreciation of the RMB and the importing country being the SCO or WTO members are beneficial to exports.

(3) From 2009 to 2017, China's average export efficiency to 52 countries along the Belt and Road was 0.603, of which 30 countries were above the average level and 22 countries were below the average level. China's export efficiency to Central Asian countries is much higher than other regions.

6. Policy Recommendations

6.1 For the Government

First, China should help countries with backward infrastructure along the Belt and Road jointly build a logistics and transportation system. The government should focus on strengthening the construction of railways, ports, and aviation that are important for trade, thus forming a linkage among sea, land, and air. The cooperation between cross-border e-commerce companies and logistics companies and countries along the Belt and Road should be promoted, focusing on the logistics system construction in areas with backward infrastructure (such as South Asia and West Asia). Due to the financial crisis in 2008, many infrastructure projects in Central Asia have stalled. In order to restart these projects, many relevant preferential policies have been introduced in Central Asian countries to attract funds. China can take this opportunity to start investing in infrastructure and logistics related projects in Central Asia at a lower cost to better promote cross-border e-commerce exports.

Second, build an e-commerce platform with information features. In order to improve the level of information connectivity, follow-up such as fiber optic cable communication is essential. When the level of information interconnection reaches a certain benchmark, build an electronic information industry to improve the e-commerce platform, thereby further promoting the development of cross-border e-commerce. China should strengthen cooperation and investment in Internet and ICTs with countries along the Belt and Road so that the “Digital Silk Road” can be built where data and information can be shared among the countries.

Third, jointly build a Belt and Road financial service integration system. Many countries along the Belt and Road are relatively backward, seriously inadequate in terms of investment in infrastructure construction. Even if capital is invested in infrastructure construction, the construction period is very long. Therefore, it is necessary to realize the bilateral or multilateral investment and financing links between China and the countries along the Belt and Road. Bilateral and multilateral financial cooperation is the basic guarantee for the continuous and efficient operation of infrastructure construction. From then on, the Asian Investment Bank and the Silk Road Fund play a predominant role to help strengthen the cooperation of multilateral financial services, improve the financial environment of cross-border e-commerce under the Internet background, promote the internationalization of RMB, implement bilateral currency swap cooperation in countries along the Belt and Road and build a fully functional, risk-controllable, real-time and efficient global RMB cross-border payment and clearing system. Therefore, a stable and efficient financial service system can be achieved. Under the COVID-19 epidemic, the difficulty of financing has made SMEs even worse. Therefore, it is necessary to increase policy support and accelerate digital transformation and the application of smart supply chain finance to further promote the healthy and orderly development of cross-border e-commerce.

Fourth, accelerate the implementation of cross-border e-commerce cooperation strategy. Various economic cooperation organizations, such as the SCO, WTO, Lancang-Mekong Cooperation, have

enabled China and relevant countries to better improve logistics, customs, finance, infrastructure and other related systems that are conducive to the development of cross-border e-commerce. The joint development of cooperation laws and regulations has made the operation of cross-border e-commerce business more standardized. Actively participating in free trade zone negotiations can also provide a supportive policy environment for the development of cross-border e-commerce.

6.2 For Enterprises

First, strengthen the establishment of overseas warehouses. The construction of the Belt and Road overseas warehouse can enable consumers to receive goods quickly after placing an order, effectively improve transportation efficiency, reduce transportation links, and also facilitate product after-sales processing, thereby effectively reducing logistics and operating costs. Also, the short-term logistics lag and the long-term difficulty in global stocking can be effectively alleviated through overseas warehouses during the COVID-19 epidemic. Therefore, Chinese cross-border e-commerce companies should actively cooperate with local companies and related logistics companies to jointly promote the establishment of overseas warehouses in countries along the Belt and Road.

Second, strengthen information construction and improve service levels. In order to increase the number of orders, cross-border e-commerce enterprises and platforms should further improve the rapid and effective supply and demand matching and docking technology to accurately locate customer groups, and at the same time, enterprises should strengthen product quality follow-up. Especially during the COVID-19 epidemic, for urgently needed products such as Masks and hand sanitizers, a quick and convenient purchase channel should be established to meet consumer demand. Meanwhile, enterprises and platforms should strengthen cooperation with financial institutions on the basis of high-quality information matching and high-quality service level to improve the efficiency of payment and settlement and the efficiency of cross-border e-commerce transactions, thereby better promoting cross-border e-commerce development.

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