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A STUDY ON THE POTENTIAL OF CHINA'S EXPORT TRADE OF AGRICULTURAL PRODUCTS TO THE TEN ASEAN COUNTRIES ---NEW EVIDENCE FROM THE PANEL CS-ARDL MODEL

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Abstract

This paper constructs a Panel CS-ARDL model using annual data for China and 10 ASEAN countries during the period from 2002 to 2022 to study the long- and short-term trade potentials and impacts of China's exports of agricultural products to the 10 ASEAN countries, and measures the trade potential value of China's exports to the 10 ASEAN countries with reference to the existing literature. The study shows that the trade value of agricultural exports is significantly positively correlated with China's GDP, ASEAN's GDP, and ASEAN's population, while it is significantly negatively correlated with China's population, and the results are consistent in the short and long term. After measuring the trade potential value, it is found that China's agricultural export potential to the ten ASEAN countries is overall better, but it is

characterized by uneven distribution and unbalanced development. Among them, the trade potential value of Indonesia fluctuates greatly, and the trade potential of Malaysia gradually reaches saturation.

Keywords

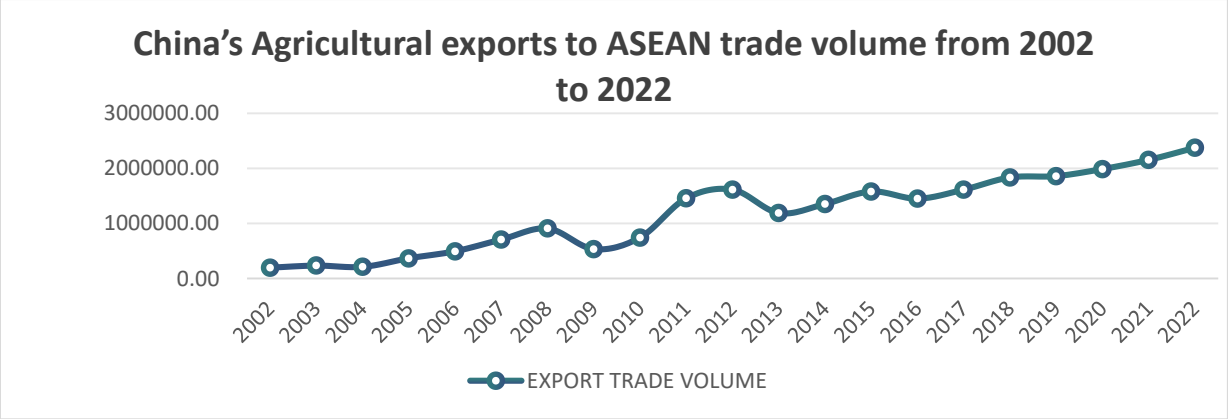
10 ASEAN Countries, Agricultural Export Trade Potential, Panel CS-ARDL

1. Introduction

1.1 Background of the study

Globalization of the economy and the liberalization of international trade have had a major role in the growth of agricultural trade in the last ten years.As the world's second largest economy, China has an important influence on international trade and economic trends.In recent years, China's import and export of agricultural products has grown significantly and has become an important part of world agricultural trade.As a trading partner of China, ASEAN has maintained good trade relations due to the similarity of the agricultural environment with China.

Figure 1.1: *Trends in China's agricultural exports to ASEAN, 2002-2022*



The figure 1.1 showing the total amount of agricultural products exported from China to ASEAN has been on an overall upward trend despite minor fluctuations, with an increase of 1,100% in the 20-year period from 2002 to 2022. In particular, agricultural trade between the two sides has grown significantly since 2004, reflecting the importance of cooperative initiatives such as the Early Harvest Program in strengthening trade ties between the two sides.

China and ASEAN countries are located on different geographic and climatic zones, and this obvious difference in natural conditions, together with their similar cultural backgrounds and adjacent spatial locations, provides excellent conditions for agricultural cooperation between

the two sides. Agricultural development and food security are the basis for peace and stability, development and prosperity, and are also key areas of China and ASEAN cooperation. Although China's trade deficit with ASEAN in agricultural products shows a growing trend, China continues to push for tariff reductions and a free trade process, obviously with deeper considerations in mind.

In conclusion, the significance of studying the export potential of Chinese agricultural products to the ten ASEAN countries lies in promoting economic cooperation between China and ASEAN, facilitating cooperation in agricultural products, fostering the development of regional integration and improving the lives of the people. This will help build a more open and interconnected regional economic pattern, promote agricultural modernization and agricultural product quality improvement, enhance regional economic prosperity and people's well-being, and realize the common interests of both sides.

1.2 Scope of the study

In terms of sample selection, the 10 ASEAN countries were chosen as the scope of the study, including Vietnam, Laos, Thailand, Myanmar, Singapore, the Philippines, Malaysia, Indonesia, Brunei, and Cambodia.In terms of time span, China officially joined the WTO since 11 December 2001, so this paper will select 2002 to 2022 as the time series, a total of 20 years.

In selecting the range of agricultural products, the range of agricultural products referred to in this paper will be based on the majority of academic studies using classifications referenced in the United Nations Conference on Trade and Development database based on the Standard International Trade Classification (SITC).The definition of agricultural products includes some subcategories in SITC0 (foodstuffs and live animals), SITC1 (beverages and tobacco), SITC4 (animal and vegetable oils, fats, and waxes), and SITC22 (roughage, non-food materials, except fuels).

In this paper, agricultural trade data are from the United Nations Development Programme (UNDP) and the United Nations Statistics Division Commodity Trade Statistics Database (COMTRADE). This paper also includes data on China's Ministry of Agriculture and Rural Development (MARD) in the data study.All agricultural trade values are in constant 2000 United States dollars.

1.3 Advantages of the study

Based on a large amount of literature reading, we found that most scholars have used gravity models to study inter-country trade issues and have achieved a lot of results, but there are also common problems, including a narrow range of agricultural products, a short data time span, and a lack of dynamic considerations. In addition, the research steps of scholars are too complicated, and they often ignore unobservable factors that measure long-term effects and some factors with cross-effects. Therefore, the innovation of this paper is to reveal the changes and reasons in China's agricultural product export potential to the ten ASEAN countries in the past 20 years, and provide a new research methodology (CS-ARDL) to optimize the research process, solve the cross-sectional dependence and endogeneity problems in the empirical model, and reveal the long-term and short-term dynamics of the research object.

1.4 Expected benefit

In this paper, we will explore the long- and short-term impacts of trade with the help of a new research methodology, the CS-ARDL modeling.In addition, the potential of agricultural markets in ASEAN countries will be analyzed, as well as the problems that exist. The study of trade potential is of great significance in analyzing China's trade situation and formulating relevant policies. By measuring China's trade potential and analyzing the structural factors determining the potential, the conclusions will provide recommendations for China's agricultural sector and agricultural import/export enterprises, as well as references for China's further development of ASEAN's agricultural market potential and further expansion of the agricultural market space, thus providing a reference for improving China's trade performance.

2. Theoretical Foundation

2.1 Literature review

Concerning the trade in agricultural products between China and ASEAN, there are some issues that merit investigation.The study by Muhammad Saqib Irshad (2014) examines the impact of trade free trade agreements between China and ASEAN countries. Using qualitative and descriptive methods, he examined the impact of the free trade agreement on both parties. Hu Chao (2009) used the CGE model to analyse the starting point, dynamics, trade relations and trade welfare effects of the rapid development of agricultural trade since the start of the construction of the CAFTA, and concluded that there is a huge potential for agricultural trade in

the CAFTA. John Wong, Sarah Chan (2003) used the trade gravity model to analyse that with the establishment of the FTA, trade and investment between China and ASEAN economies will grow significantly. In addition, regarding the trade potential model,scholars have done a lot of research on trade efficiency measurement, and most of them use the gravity model. For example, Yang (2014) used the theoretically sound trade gravity model to study the impact of the exports of CAFTA , focusing on trade creation and transfer effects.Wu (2020) calculated the export trade potential of Chinese electronic information products to ASEAN.The trade efficiency of agricultural products between China and ASEAN was estimated based on a stochastic frontier gravity model with a stochastic perturbation term introduced to overcome the unavoidable noise problem of macro statistics.It can be seen that most scholars choose to introduce the gravity model in trade research, which can really help us analyze the trade potential and effects well.

However, a reading of the literature reveals that most cross-country studies in the economics literature incorrectly assume that errors are independently distributed across cross-sections; whereas, in reality, variables in cross-country studies are interdependent and cannot be segmented into independent parts for study, especially in the long run.Therefore, applying the CS-ARDL method to analyze long-run heterogeneous data in the presence of common correlation effects would be a more robust study than the panel dynamic OLS method, the panel fully corrected OLS method, and the panel pooled and mean group method.

2.2 Theoretical foundation

2.2.1 Trade potential theory

Trade potential theory is a theoretical framework to explain trade flows and trade growth. According to the theory, trade potential refers to the maximum trade scale that a country or region can achieve in international trade. Trade potential theory usually involves five theories: economic size, economic structure, production factors, trade policy and market demand.

2.2.2 Panel data

Panel data combines cross-sectional data and time series data. Panel data is more capable of detecting and measuring effects that cannot be observed in cross-sectional or time series data. Panel data makes data more variable, covariance smaller, degrees of freedom higher, and makes more complex research possible. In panel data analysis, a combination of cross-sectional (N) and time series (T) is used, where N is the number of groups (companies, countries,

industries, individuals, etc.); T is the number of years. When conducting research, the specific research method needs to be determined based on the size of N and T.

2.2.3 Cross-Sectionally Augmented Auto Regressive Distributed Lagged Model (CS-ARDL)

The Auto-regressive Distributed Lag Stability Model (ARDL) is an econometric model used to study the long-run and short-run relationships between various time series variables. Essentially, the CS-ARDL model enhances the ARDL model with a linear combination of the cross-sectional means of the dependent variable and all regressors, with the goal of capturing the cross-sectional correlation in the error term. The temporal dynamics, cross-sectional heterogeneity, and cross-sectional dependence are considered through the (CS - ARDL) modeling approach.Typically, as shown in Chudik and Pesaran (2015), our choice of pooled mean group (PMG) and mean group (MG) in panel CS ARDL is determined by the specification test . The CS-ARDL model is estimated using the mean group (MG) and pooled mean group (PMG) estimators.In order for the model to be estimated for every cross-country unit, the temporal dimension (T) must also be sufficiently big. To guarantee the validity of these estimators, a significant number of lagged cross-sectional averages must be provided.

The study in this paper includes 11 economies, including China and the ten ASEAN countries, and the data range covers 20 years from 2002 to 2022. It can be seen that the sample data is huge, so the potential dependence and endogeneity are high.The study uses this paper will refer to the existing literature to set up the baseline equation for:

$$\text{Trade}_{it} = \alpha_i + \beta 1_i GDP + \beta 2_i People + \beta 3_i Dist + \beta 4 icafta + \varepsilon_{it} \quad (1)$$

$$\text{Trade}_{jt} = \alpha_j + \beta 1_j GDP + \beta 2_j People + \beta 3_j Dist + \beta 4_j cafta + \varepsilon_{jt} \quad (2)$$

where β_1,β_2,β_3,$\beta_4$denote the correlation coefficient, which is an important factor to look at when analyzing the regression results because it shows how much the GDP， people,distance and the establishment of CAFTA of countries i and j affect their bilateral trade. For example, if $\beta_1 < 0$, then country is GDP negatively affects bilateral trade, and if $\beta_1 > 0$, then country is economic size facilitates trade.And ε_{ij} is the random error term.Where, all the explanatory variables except the dummy variables are taken as logarithmic.Trade_{ijt} is the total amount of agricultural products (in thousands of US dollars) exported by China to the ten ASEAN countries in one year

2.2.4 CS-ARDL TEST with unit root test

Unit root test is the key to test the smoothness of the data. It checks the characteristics of the variables of interest to avoid the problem of spurious regressions associated with non- or countries in a panel data set have different dynamic heterogeneity. The issue of heterogeneity has become central to the econometric analysis of panel data (Smith, 1995).According to the existing literature studies, unit root test techniques have been improving in recent years. The second generation panel unit root test was developed to capture the effect of cross-sectional dependence in panels. It compensates for the shortcomings of the first generation panel unit root test. This is because it does so by augmenting the standardized dependence on the cross-section average lag level and the cross-section first difference. Its main advantage is its ability to capture cross-sectional dependence and produce robust estimates for both micro and macro panels.We use the cross-sectional augmented Dickey–Fuller (CADF) Panel unit root test to estimate the following regression for cross-sectional dependency (CD) in the series:

$$\Delta y_{it} = \alpha_i + K_i t_i + \beta_i y_{it-1} + \gamma_i y_{t-1} + \varphi_i \Delta y_t + \varepsilon_{it} \quad (3)$$

t = 1, ..., T, i = 1, ..., N and y_t indicates the cross-sectional mean of y_{it}, which is derived from $y_t = N^{-1}PN_i=1y_{it}$. The null hypothesis of Equation is: βi = 0 for all i and the alternative hypothesis is : $\beta_i < 0$ for some i.

The cross-sectional augmented panel unit root (CIPS) test statistic as follows:

$$CIPS(N,T) = N^{-1}\sum_{i=1}^{N} t_i(N,T) \quad (4)$$

t_i(N, T) in Equation indicates the statistic for β_i. We have applied the cross-sectional dependency (CD) test to check CD in the variables.

3. Empirical analysis

3.1 Slope homogeneity test

We use the test to check for slope homogeneity. Table 3.1 illustrates that the null hypothesis of slope homogeneity is rejected in any scenario where the probability values are less than 0.01. As a result, we must determine whether the panel data exhibits heterogeneity. Based

on our analysis, we may conclude that heterogeneous model coefficients and country-specific slope variations indicate the necessity of using heterogeneous panel methodologies.

Table 3.1: *Slope Homogeneity Test*

Slope Homogeneity Tests	Statistic	P-value
$\tilde{\Delta}$ test	8.094^{***}	0.000
$\tilde{\Delta}$ adj test	9.642^{***}	0.000

Note: ***, **, and * denote statistical significant level at 1%, 5%, and 10%, respectively.

3.2 Cross-sectional dependence test

The cross-section dependence of all the variables in the panel data is demonstrated by the results of the Pesaran (2015) cross-dependency test, which are shown in Table 3.2. In other words, there is interdependence among nations, which means that an impact in one nation might have a cascading effect and spread to other nations. This implies that a second-generation unit root test is required.

Table 3.2: *Cross-sectional Dependence Test*

Slope Homogeneity Tests	Statistic	P-value
Lntrade	35. 801***	0.000
Lngdp	36.814***	0.000
Lnpeople	38.991***	0.000
Lnchinagdp	39.243***	0.000
Lnchinapeople	39.243***	0.000

Note: ***, **, and * denote statistical significance level at 1%, 5%, and 10%, respectively.

3.3 Panel uint-root test

Before estimating the parameters of the panel data model, a panel unit root test must be performed for testing the smoothness and level of integration of the variables. Here, the second generation of panel unit root tests are used, including the Pesaran cross-sectional augmented IPS (CIPS) test and the cross-sectional ADF (CADF) test. Table 3.3 presents the results of the CIPS and CADF tests, in levels and in first differences. The results indicate that the variables Lngdp is stationary in level, that is, I(0) and that the variables Lntrade and Lnpeople are stationary in first difference, that is, I(1) and the variables Lnchinagdp and Lnchinapeople are not stationary in level or first difference.

Table 3.3 : *Results of Panel Uint-root*

Variable	Level		First-difference		Order
	Intercept	Intercept and trend	Intercept	Intercept and trend	
Cross-sectionally Augmentted IPS (CIPS)					
Lntrade	-2.764***	-2.982***	-4.220***	-4.276***	I(1)
Lngdp	-2.880***	-2.997***	-2.959***	-3.319***	I(0)
Lnpeople	-4.024***	-4.527***	-3.593***	-4.818***	I(1)
Lnchinagdp	2.610	1.700	2.610	1.700	—
Lnchinapeople	2.610	1.700	2.610	1.700	—
Cross-sectionally Augmentted Dicky-Fuller (CADF)					
Lntrade	-2.752***	-2.731*	-5.250***	-5.404***	I(1)
Lngdp	-3.656***	-3.043***	-3.862***	-4.044***	I(0)
Lnpeople	-2.172*	-2.732*	-3.199***	-3.835***	I(1)
Lnchinagdp	2.610	1.700	2.610	1.700	—
Lnchinapeople	2.610	1.700	2.610	1.700	—

Note: ***, **, and * denote statistical significance level at 1%, 5%, and 10%, respectively.=

3.4 Panel cointegration test

Table 3.4 presents the results of the Westerlund (2007) cointegration test. As the results of the test show, the statistical results reject the hypothesis of non-cointegration at the panel level rather than at the individual level. Therefore, it is necessary to estimate the long-run equilibrium relationship between the variables.

Table 3.4 : *Westerlund Panel Cointegration Test*

Statistic	Value	Z-value	P-value
Gt	-3. 487***	-6.662	0.000
Ga	-5.590***	-3.656	0.000
Pt	-9.810***	-5.044	0.000
Pa	-6.541***	-2.736	0.000

Note: ***, **, and * denote statistical significance level at 1%, 5%, and 10%, respectively.

3.5 CS-ARDL estimation results

Table 3.5 presents the results of the CS-ARDL model for the long and short-term relationships.The coefficient on the error correction term (ECT) is negative and significant.The results show that, as expected, the coefficient of the Error Correction Term (ECT) is negative and significant. Also, the long- run results based on the CS-ARDL estimator suggest that a 1% increase in Lngdp, Lnpeople, Lnchinagdp and Lnchinapeople, stimulates Lntrade by 0.081%, 0.018%, 0.050%, -0.116%respectively.

Table 3.5 : *CS-ARDL Estimation*

	Coefficient	Std.Err.	Z-statistics	P-value
Short-run				
ECT	-0.0820***	0.070	-16.02	0.000
ΔLngdp	0.088***	0.021	4.21	0.000
ΔLnpeople	0.020***	0.007	2.92	0.004
ΔLnchinagdp	0.062*	0.034	1.83	0.068
ΔLnchinapeople	-0.126***	0.038	-3.30	0.001
Long-run				
Lngdp	0.081***	0.019	4.20	0.000
Lnpeople	0.018***	0.006	3.16	0.000
Lnchinagdp	0.050*	0.030	1.68	0.052
Lnchinapeople	-0.116***	0.036	-3.25	0.001
Root MSE	0.06			

Note: ***, **, and * denote statistical significance level at 1%, 5%, and 10%, respectively.

3.6 Trade Potential Estimation Coefficients

Referring to the methods of other scholars, we calculated the trade potential of the ten ASEAN countries,as shown in the table 3.6.The calculation method is as follows: divide the theoretical export value by the actual export value in 20 years to get the coefficient of export trade potential a.

Table 3.6: *Trade Potential Estimation Coefficients of China for the Ten ASEAN Countries*

Year	VNM	MMR	KHM	PHL	LAO	THA	IDN	MYS	SGP	BRN
2002	0.398	0.335	0.229	0.281	0.233	0.370	0.457	0.379	0.301	0.247
2003	0.420	0.386	0.408	0.353	0.296	0.382	0.416	0.409	0.321	0.259
2004	0.442	0.358	0.387	0.397	0.278	0.394	0.412	0.409	0.301	0.248
2005	0.415	0.413	0.389	0.420	0.282	0.406	0.423	0.447	0.320	0.252
2006	0.427	0.401	0.383	0.432	0.286	0.418	0.426	0.453	0.306	0.253
2007	0.447	0.415	0.380	0.435	0.290	0.430	0.432	0.462	0.310	0.253
2008	0.468	0.413	0.387	0.448	0.294	0.442	0.437	0.474	0.324	0.254
2009	0.468	0.428	0.386	0.454	0.298	0.454	0.444	0.479	0.320	0.254
2010	0.471	0.427	0.393	0.458	0.302	0.466	0.451	0.484	0.333	0.254
2011	0.475	0.431	0.397	0.462	0.306	0.468	0.454	0.489	0.329	0.255
2012	0.477	0.435	0.378	0.466	0.310	0.477	0.449	0.454	0.331	0.255
2013	0.479	0.439	0.395	0.470	0.314	0.484	0.430	0.470	0.334	0.256
2014	0.481	0.443	0.401	0.474	0.318	0.491	0.465	0.467	0.337	0.256
2015	0.484	0.448	0.410	0.478	0.322	0.498	0.421	0.465	0.339	0.257
2016	0.486	0.452	0.403	0.482	0.326	0.505	0.457	0.462	0.342	0.257
2017	0.489	0.456	0.405	0.486	0.330	0.512	0.442	0.460	0.345	0.258
2018	0.491	0.460	0.406	0.490	0.334	0.519	0.449	0.457	0.347	0.258
2019	0.493	0.464	0.408	0.494	0.338	0.526	0.46	0.455	0.350	0.259
Year	VNM	MMR	KHM	PHL	LAO	THA	IDN	MYS	SGP	BRN
2020	0.496	0.469	0.410	0.498	0.342	0.533	0.466	0.452	0.353	0.259
2021	0.498	0.473	0.412	0.502	0.346	0.540	0.473	0.450	0.355	0.259

2022	0.501	0.477	0.414	0.506	0.350	0.547	0.445	0.447	0.358	0.260

We can draw conclusions:

(1) The trade potential coefficients of the ten ASEAN countries are all less than 0.8, which shows that ASEAN is still an important market for my country’s agricultural exports.

(2) Since 2002, although the export trade potential coefficient of my country's agricultural products to other ASEAN countries except Indonesia has fluctuated, the overall trend is still upward. This shows that since 2002, the establishment of CAFTA has greatly promoted the development of bilateral trade. But it is undeniable that the curve trend changes are becoming more flat, which shows that the market development space is also shrinking to varying degrees.

(3)Indonesian trade potential fluctuates greatly. This may be related to the strict control of import and export goods under multilateral trade agreements. Its trade department regularly releases policy documents such as adjusting tariff schedules and prohibiting technical standards for export goods.

(4)Malaysian trade potential coefficient is gradually declining. This may be because Malaysia continues to seek stimulus from trade with other countries to bring economic growth, while China's agricultural product trade has gradually reached saturation and begun to show a lack of trade potential.

4. Conclusion & suggestions

This paper constructs the Panel CS-ARDL model of China's agricultural export trade to the 10 ASEAN countries during the 20-year period from 2002 to 2022, and analyzes its influencing factors, and measures the value of the trade potential of the 10 ASEAN countries during the 20-year period, and obtains the following conclusions:

(1) China's agricultural export trade with the ten ASEAN countries is on a continuous upward trend, with an increasing share of exports. Based on the analysis of the data results, it can be predicted that in the future, the ten ASEAN countries will still be the number one partner of China's agricultural products trade, and this trend will further consolidate and deepen the cooperative relationship between the two sides.

(2) After the results of the study, it is shown that the GDP and population size of ASEAN countries as well as China's GDP and population size, and the establishment of the free trade zone have a significant impact on the scale of agricultural trade, which is consistent with our

previous hypothesis. Meanwhile, robustness analyses indicate the reliability of the results. Together, these factors contribute to the growth of the scale of China's agricultural exports to ASEAN, injecting new impetus into their economic cooperation and trade relations.

(3) According to the Trade Potential Study, all 10 ASEAN countries are considered to have high trade potential, a trend that is expected to continue for some time. However, despite the overall high market potential, the utilisation of market potential has been uneven across countries. This uneven market development has led to a gradual compression of market space. Some countries may face the challenge of market saturation and increased competition, particularly in specific product areas or regional markets.

4.1 Suggestions

Based on the empirical analysis of China's agricultural products export trade potential to ten ASEAN countries, the following suggestions are drawn:

(1) China and ASEAN have obvious complementary advantages in agricultural trade. China should adjust the structure of agricultural products exported to ASEAN and focus on cultivating agricultural products with obvious complementary advantages. Chinese agricultural production operators should increase technical investment in complementary agricultural products, improve the added value of agricultural products and export competitiveness, and endeavour to expand exports of such agricultural products to ASEAN.

(2)The ten ASEAN countries should endeavour to develop their own economies, which will further stimulate the demand for China's high-quality and diversified agricultural products by improving the people's living standards and enhancing their purchasing power, ensuring a sustained and stable growth in trade and promoting the common prosperity of both economies.

(3)Relevant departments in China should actively take policy measures to increase the variety of agricultural products for export, focus on the quality of agricultural products, improve competitiveness and expand market share.

(4)The Chinese government should actively make use of the Belt and Road Initiative and the CAFTA platform to sign more preferential trade arrangements with ASEAN Governments, promote trade liberalization and facilitation, and strengthen agricultural trade exchanges and cooperation. This includes measures to continuously reduce high tariffs on agricultural products and reduce non-tariff barriers.

(5)China and 10 ASEAN countries should increase investment in transport infrastructure In particular, countries bordering China, such as Laos, Vietnam and Myanmar, should pay more attention to railway, road transport and intermediate transport, and build a safe and complete transport system to reduce transport costs and improve trade efficiency.

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