

Trade Prospects of China's Agricultural Exports to Countries along the "Belt and Road"

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Abstract: Agricultural economic and trade cooperation is an important part of the "One Belt, One Road" strategy, the introduction and implementation of which provides a unique historical opportunity for the development of China's agricultural trade. This paper selects panel data of China and 15 member countries of the Eurasian Union and ASEAN along the "Belt and Road" from 2000 to 2020. It uses the time-varying stochastic frontier gravity model and the import intensity index to measure China's trade expansion space and other countries' agricultural import dependence. Then, based on these two indicators, using the Boston Matrix analysis method to predict the outlook for agricultural trade between China and those 15 countries and put forward proper policy recommendations. The results show that China's trade prospects with the 15 member countries of the Eurasian Union and ASEAN along the Belt and Road differ in different agricultural market segments. But still, the overall prospects are bright, and there is room for individual countries to expand their trade or become more closely linked to our agricultural markets. China should develop more profound and comprehensive trade cooperation on the silk road for each country with different possibilities to stimulate trade potential and improve the prospects of agricultural exports to various countries.

Keywords: Belt and Road; Agricultural products, Trade efficiency, Trade prospects, Time-varying stochastic frontier gravity model.

1. Introduction

In 2013, President Xi put forward the "Silk Road Economic Belt" and "21st Century Maritime Silk Road" strategies one after another. Agricultural economic and trade cooperation is essential to the "Belt and Road" strategy. In recent years, the agricultural economic cooperation and exchange between China and the countries along the "Belt and Road" have taken on new characteristics and development trends. The study of China's agricultural trade efficiency with these countries, trade potential, factors affecting trade efficiency and potential, etc., will help protect the trade prospects and thus put forward reasonable countermeasure suggestions to promote win-win cooperation between countries.

2. Literature Review

China's trade in agricultural products with countries along the Belt and Road is expanding but unstable. Although the role of intra-industry trade is strengthening, the exchange of farm products is still mainly inter-industry trade. China's agricultural exports have weak comparative advantages, a single-product structure, and weak complementarity. China's trade efficiency and trade potential vary between different agricultural markets and countries. In terms of country, China has high trade efficiency with countries in Southeast Asia and Kyrgyzstan and great potential for agricultural trade with most countries such as Germany, Russia, and Turkey; in terms of product type, exports of vegetables and fruits are more efficient.

This paper takes 15 countries along the route as sample countries, divides agricultural products into different market segments, analyses China's export efficiency and its influencing factors, and measures the export potential while taking into account the farm import demands of the target countries

3. Related Models

3.1. Stochastic frontier gravity model

3.1.1. Theoretical Model

Kalirajan[1] and Armstrong[2] introduce the stochastic frontier approach (SFA) into the gravity model to analyze trade efficiency and potential. This paper draws on Battese and Coelli's [3] in their time-varying stochastic frontier model setting,

$$\ln Y_{ijt} = \ln f(X_{ijt}; \beta) + v_{ijt} - \{\exp[-\eta(t-T)]\}u_{ij} \quad \exp[-\eta(t-T)] > 0 \quad (1)$$

3.1.2. Empirical Models

Based on Armstrong's stochastic frontier gravity model, to estimate the trading frontier, our model only uses core variables such as economic size, geographical distance, borders, and other factors that remain constant in short to medium terms. Instead, the inefficiency term will include those volatile factors in the short run. The specific equation is as follow,

$$\ln EXP_{ijt} = \beta_0 + \beta_1 \ln GDP_{jt} + \beta_2 \ln GDP_{it} + \beta_3 \ln POP_{jt} + \beta_4 \ln POP_{it} + \beta_5 \ln DIST_{ij} + \beta_6 X_{ij} + v_{ijt} - u_{ijt} \quad (2)$$

where the dependent variable EXP_{ijt} denotes the total agricultural exports from country j to country i in year t . The independent variables are the standard core variables of the gravity model.

3.2. Trade inefficiency model

3.2.1. Theoretical Models

Developing a trade inefficiency model is necessary to further study the factors influencing trade inefficiency. The mainstream methods for estimating the effects of exogenous variables on technical efficiency levels are the two-step

method and the one-step method. Many researchers have pointed out that the two-step method has serious problems, while the one-step method can circumvent these problems.

According to the one-step method, the technical inefficiency effect u_{ijt} could be specified in equation (3),

$$u_{ijt} = \delta z_{ijt} + \omega_{ijt} \quad (3)$$

where u_{ijt} is a non-negative truncation of the $N(z_{ijt}\delta, \sigma^2)$ -distribution, z_{ijt} are the various exogenous variables affecting the trade inefficiency term, and ω_{ijt} is the random disturbance term.

$$\ln Y_{ijt} = \ln f(X_{ijt}; \beta) + v_{ijt} - (\delta z_{ijt} + \omega_{ijt}) \quad (4)$$

We apply the stochastic frontier approach to equation (4) to measure the regression results to obtain calculation results of the stochastic frontier gravity model and the trade inefficiency model simultaneously.

3.2.2. Empirical Models

This paper constructs the following trade inefficiency model,

$$u_{ijt} = \delta_0 + \delta_1 GEI_{it} + \delta_2 COR_{it} + \delta_3 INF_{it} + \delta_4 TAF_{it} + \delta_5 FTA_{ijt} + \delta_6 WTO_{ijt} + \delta_7 APEC_{ijt} + \omega_{ijt} \quad (5)$$

of which, GEI_{it} and COR_{it} characterize the political-institutional environment of the importing country; INF_{it} is air cargo volumes chosen as a proxy and expected to be u_{ijt} ; TAF_{it} is the average tariff level of importing countries;

FTA_{ijt} , WTO_{ijt} and $APEC_{ijt}$ mean whether the country i has a free trade agreement with China in year j , whether they are all WTO members, and whether they are all APEC members, respectively, all of which are dummy variables

3.3. Import intensive index

Brown[4] proposed the trade intensity index and later refined it by Kojima[5] and others to indicate the degree of close trade links between trading countries. The formula for calculating import intensive index is as follows,

$$MII_{ij}^k = \frac{M_{ij}^k / M_i^k}{X_j^k / X_w^k - X_i^k} \quad (6)$$

where M_{ij}^k is the total amount of product k imported by country i from country j . M_i^k is the total amount of imports of product k from country i . X_j^k is the total amount of the country j 's exports of product k . X_w^k is the total amount of world exports of product k . X_i^k is the total amount of country i 's exports of product k .

When the index is greater than 1, the target country is more dependent on that country's export market and vice versa; when the index is 1, the target country is as import-intensive as the rest of the world market and has a moderate dependence on that country's export market

3.4. Trade prospects

Wang Yue and Chen Jingming[6] proposed a trade prospect analysis method using the Boston Matrix analysis, which divides trade prospects into four regions for analysis.

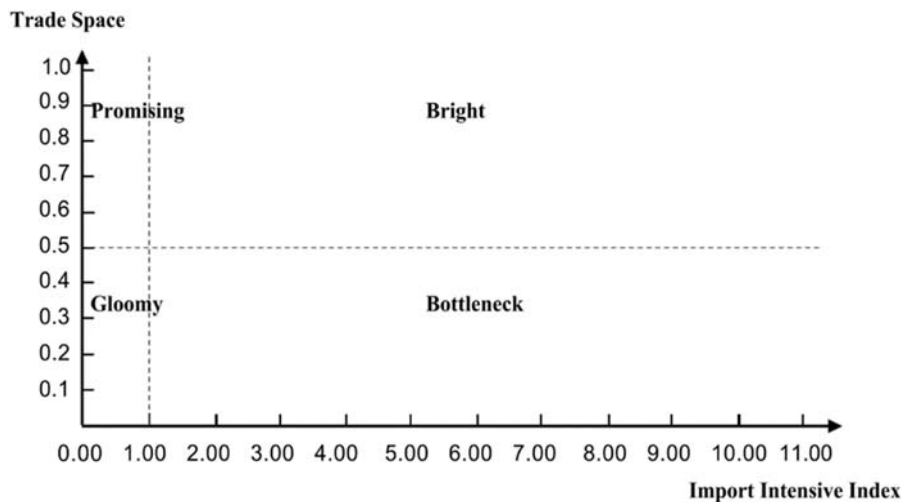


Figure 1. Four quadrants of trade prospects classification

The horizontal coordinate is the import intensive index. $MII_{ij}^k > 1$ the vertical coordinate is the room for trade expansion, $TS \geq 0.5$ means there is more room for trade expansion, while the opposite is less. According to product cycle theory, product competitiveness includes an upward phase, a dominant phase, and a declining phase. Trade space has the characteristic of being easier to release and harder to increase. The trade prospects obtained from the cross-analysis of import intensive index and trade space will definitely have a certain degree of movement.

4. Empirical Analysis

4.1. Data sources

In this paper, we select five countries of the Eurasian Union and the 10 ASEAN countries as sample countries. We use the data on China's agricultural exports to them during 2000-2020 as sample data. Some of the missing data were processed by interpolation.

Data sources include UN Statistics trade database, World Bank WDI database, French CEPII-GRAVITY database, WGI database, www.transparency.org website, RTA

database of regional trade agreements, etc.

model's suitability and the specific form of the model.

4.2. Trade efficiency measurement

4.2.1. Analysis of Time-varying Stochastic Frontier Gravity Models

The study uses a likelihood ratio test to determine the

Table 1. Likelihood ratio test

Original assumption	Constraint models	Unconstrained models	LR statistic	1% threshold	Test conclusion
No trade inefficiencies	-405.20	-225.58	359.24	11.34	Rejection
Trade inefficiencies do not change	-225.58	-219.11	12.94	6.63	Rejection
No introduction of common boundary variables	-219.11	-216.67	4.88	6.63	Cannot refuse
No introduction of common language variables	-219.11	-217.90	2.41	6.63	Cannot refuse

After hypothesis testing, we obtain,

$$\ln \text{EXP}_{ijt} = \beta_0 + \beta_1 \ln \text{GDP}_{jt} + \beta_2 \ln \text{GDP}_{it} + \beta_3 \ln \text{POP}_{jt} + \beta_4 \ln \text{POP}_{it} + \beta_5 \ln \text{DIST}_{ij} + v_{ijt} - u_{ijt} \quad (7)$$

4.2.2. Trade Inefficiency Model Analysis

This paper uses a one-step approach to estimate the trade inefficiency model with $\gamma = 0.895$, indicating the stochastic frontier model is reasonably and trade inefficiency is the most crucial factor impeding bilateral trade.

Table 2. Results of the trade inefficiency model

Stochastic frontier function		Trade inefficiency function	
variables	coefficient	variables	coefficient
$\ln \text{GDP}_{jt}$	5.724*** (0.765)	GEI_{it}	-0.692*** (0.142)
$\ln \text{GDP}_{it}$	1.074*** (0.110)	COR_{it}	-0.028*** (0.004)
$\ln \text{POP}_{jt}$	-63.600*** (10.922)	INF_{it}	-0.012** (0.004)
$\ln \text{POP}_{it}$	0.065 (0.107)	TAF_{it}	0.048*** (0.012)
$\ln \text{DIST}_{ij}$	-2.312*** (0.885)	FTA_{ijt}	-0.849*** (0.106)
		WTO_{ijt}	-0.491*** (0.124)
		APEC_{ijt}	-0.736*** (0.122)
σ^2	0.097 (0.570)	γ	0.895** (0.094)
LogLikelihood	-183.28	LR	443.85

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3. Trade efficiency (TE) and trade space (TS)

Country	Food & live animal		Beverages & Tobacco		Non-edible raw materials		Animal and vegetable oils and fats		Agricultural product	
	TE	TS	TE	TS	TE	TS	TE	TS	TE	TS
Armenia	0.15	0.85	0.02	0.98	0.64	0.36	0.02	0.98	0.15	0.85
Belarus	0.16	0.84	0.06	0.94	0.20	0.80	0.01	0.99	0.16	0.84
Kazakhstan	0.04	0.96	0.68	0.32	0.35	0.65	0.50	0.50	0.04	0.96
Kyrgyzstan	0.89	0.11	0.01	0.99	0.45	0.55	0.76	0.24	0.89	0.11
Russia	0.03	0.97	0.56	0.44	0.62	0.38	0.16	0.84	0.03	0.97
Brunei	0.07	0.93	0.09	0.91	0.57	0.43	0.30	0.70	0.07	0.93
Indonesia	0.12	0.88	0.24	0.76	0.63	0.37	0.73	0.27	0.12	0.88
Cambodia	0.72	0.28	0.62	0.38	0.16	0.84	0.14	0.86	0.72	0.28
Laos	0.81	0.19	0.35	0.65	0.38	0.62	0.04	0.96	0.19	0.81
Myanmar	0.52	0.48	0.41	0.59	0.25	0.75	0.27	0.73	0.48	0.52
Malaysia	0.53	0.47	0.57	0.43	0.76	0.24	0.83	0.17	0.53	0.47
Philippines	0.32	0.68	0.33	0.67	0.40	0.60	0.41	0.59	0.32	0.68
Singapore	0.14	0.86	0.74	0.26	0.71	0.29	0.23	0.77	0.14	0.86
Thailand	0.28	0.72	0.24	0.76	0.25	0.75	0.72	0.28	0.28	0.72
Vietnam	0.84	0.16	0.34	0.66	0.24	0.76	0.68	0.32	0.84	0.16

4.3. Import intensive index measurement

represent import dependence, are shown below.

The Import Trade Intensity Index calculation results, which

Table 4. Import intensive index

Country	Food & live animal	Beverages & Tobacco	Non-edible raw materials	Animal and vegetable oils and fats	Agricultural product
Armenia	0.08	0.07	0.94	0.00	0.11
Belarus	0.38	3.70	0.11	0.13	0.41
Kazakhstan	2.51	3.36	0.66	0.04	2.55
Kyrgyzstan	11.33	0.24	1.24	0.04	9.85
Russia	2.18	0.55	3.23	0.24	2.15
Brunei	1.24	0.05	4.16	0.52	1.38
Indonesia	4.51	20.96	3.38	2.63	4.76
Cambodia	3.36	2.68	7.94	0.66	3.10
Laos	1.39	3.59	0.36	0.03	1.41
Myanmar	15.35	24.03	16.54	0.05	14.10
Malaysia	8.85	7.52	3.54	2.93	7.59
Philippines	6.88	15.63	8.24	0.19	7.47
Singapore	3.67	2.62	4.73	3.51	3.34
Thailand	11.02	3.02	5.76	3.67	10.40
Vietnam	10.28	11.76	7.64	0.89	9.71

4.4. Analysis of trade prospects

agricultural market and the four market segments, obtained by using the Boston Matrix analysis, is shown below.

The outlook between China and the 15 countries in the

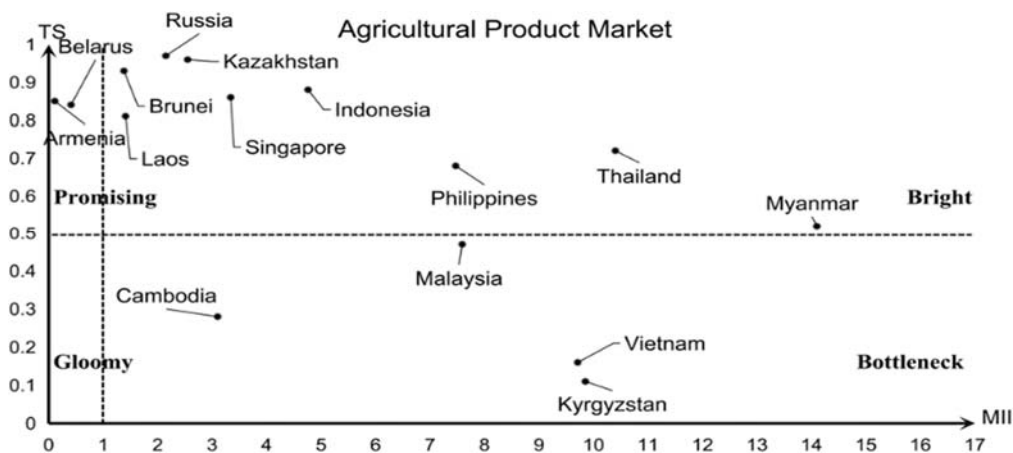


Figure 2. Trade outlook for the agricultural product market

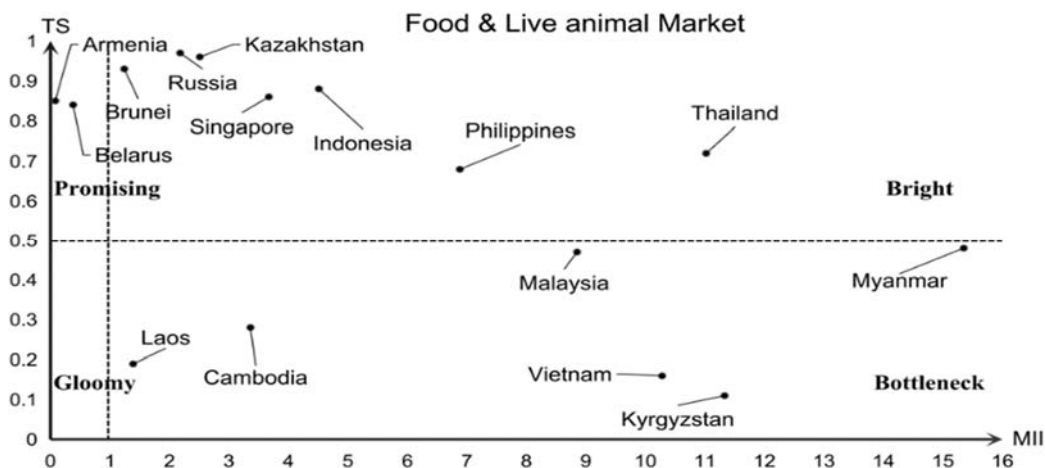


Figure 3. Trade outlook for the food & live animal market



Figure 4. Trade outlook for the beverages & tobacco market

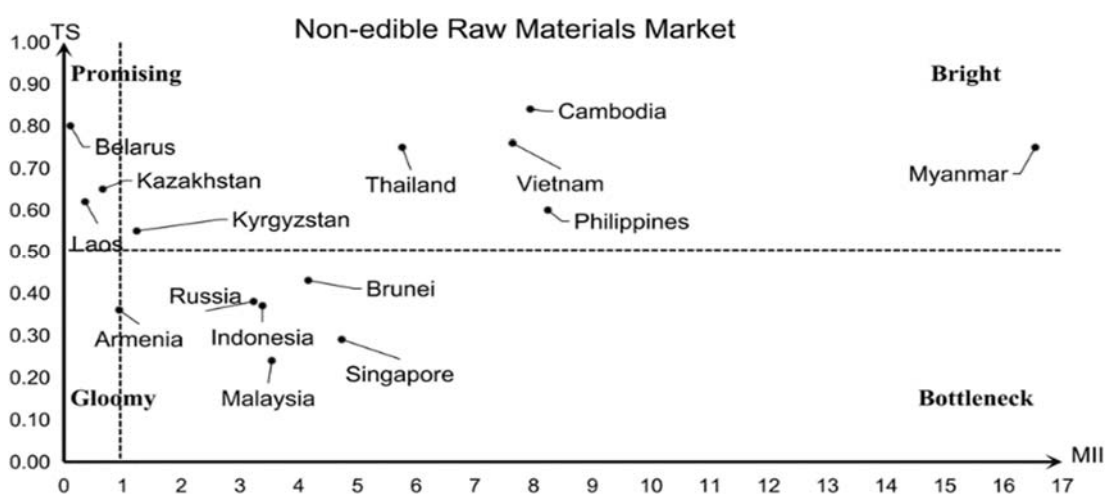


Figure 5. Trade outlook for the non-edible raw materials market

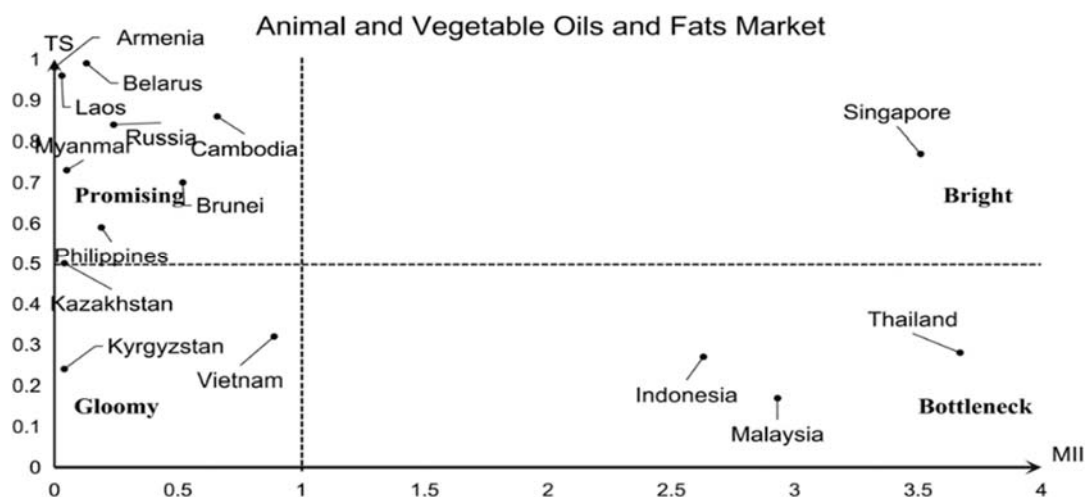


Figure 6. Trade outlook for the animal and vegetable oils and fats market

5. Conclusions and Recommendations

The efficiency of China's agricultural exports to the 15 countries is still relatively low, and the room for trade expansion needs further exploration and release. Although the degree of linkage between China's agricultural export market and the agricultural import markets of the 15 countries varies

in different market segments, the connection is generally strong. Besides, the target countries along the route highly depend on China's agricultural imports. Last, the outlook for China's trade with the 15 countries is bright. Especially in the food and live animal products market, where China has a strong export capacity, and a more optimistic outlook than other market segments, the animal and oil products market

has significant scope for improvement. We make the following recommendations: focus on policy communication, facility connectivity, and trade facilitation to improve the efficiency of China's agricultural trade with the 15 countries along the route on all fronts. Continue to strengthen cooperation with countries with bright trade prospects. Enhance the competitiveness of domestic agricultural products in the world market.

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