

Article

The Growth Effect and Its Influencing Factors: Empirical Evidence Regarding China's Fruit and Vegetable Exports to RCEP Countries

Guangji Tong ¹, Rui Hong ^{1,*}  and Lei Shi ²¹ College of Economics and Management, Northeast Forestry University, Harbin 150040, China; tonggj63@nefu.edu.cn² College of Economics and Management, Yancheng Institute of Technology, Yancheng 224051, China; shilei@ycit.edu.cn

* Correspondence: hongrui5510@nefu.edu.cn; Tel.: +86-189-3220-4160

Abstract: Fruit and vegetable products, integral to human nutrition, play a vital role in dietary patterns. Moreover, the Regional Comprehensive Economic Partnership (RCEP) region, a critical market for Chinese fruit and vegetable exports, has observed the growing presence of these Chinese produce groups. The ratification of the RCEP bolsters the liberalization of fruit and vegetable commerce in the region, consequently fostering opportunities for its development. Nonetheless, existing studies have insufficiently addressed fruit and vegetable commerce in the region and its consequent effect on trade expansion. In this context, it is crucial to analyze the trade pattern associated with the swift export growth of fruit and vegetables. This study employs binary marginal analysis and the stochastic frontier gravity model. This study's findings reveal that, with respect to the growth effect, the expansion of China's fruit and vegetable exports to RCEP countries in recent years primarily stems from the contribution of the extensive margin. Considering the factors influencing trade, metrics like free trade agreements (FTAs), the extent of trade liberalization, political expenditure levels, government transparency, and liner transport connectivity significantly impact China's fruit and vegetable exports. Regarding trade efficiency, the current efficiency value of China's fruit and vegetable exports to RCEP countries is relatively low, characterized by substantial country-specific variations and immense future trade potential. The insights gleaned from this research can offer decision-making support for the collaboration on fruit and vegetable trade between China and the RCEP region.

Keywords: RCEP; exports of fruit and vegetables; growth effect; influencing factors

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1. Introduction

1.1. Research Background

Fruits and vegetables, which are major agricultural commodities, are highly nutritious and crucial for human health. Currently, the global agricultural market is facing shocks and uncertainties due to frequent extreme weather events and geopolitical conflicts. These challenges pose serious threats to the global agricultural supply chain and contribute to increased instability and uncertainty. As the largest producer and exporter of fruits and vegetables, China holds significant influence over the global market for these products. Over the past decade, China's total foreign exports of fruit and vegetable products have grown from USD 18.292 billion in 2012 to USD 24.682 billion in 2021, indicating a remarkable increase of 33.48%. This growth rate in fruit and vegetable exports surpasses that of other agricultural exports, positioning China at the forefront of agricultural export growth. Over the past decade, China's exports of fruit and vegetable products to RCEP countries have accounted for more than 50% of its total foreign exports. The RCEP includes ten traditional ASEAN countries and fifteen Asia-Pacific countries, such as China and Japan.

The main objective of the RCEP is to advocate for trade liberalization and facilitation, aiming to promote regional prosperity and contribute to the recovery of the global economy. According to statistics from the Ministry of Commerce, the implementation of the RCEP in 2022 has brought significant advantages in regional trade liberalization. The total import and export amount between China and other RCEP member countries reached USD 1.96 trillion, showing a year-on-year increase of 5.9%. In 2022, the trade of agricultural products between China and RCEP countries accounted for 31.6% of China's total trade in agricultural products, making the RCEP China's largest agricultural trade market. The differences in climate and agricultural resources among the member countries provide a comparative advantage and complementary basis for cooperation. This not only promotes the diversification of China's agricultural imports, but also enhances the advantages of agricultural exports, particularly in fruits and vegetables. China's position as a major exporter of agricultural products is further consolidated.

During this period, the total exports of fruit and vegetable products to RCEP countries have grown by 49.56%, which is 16 percentage points higher than the overall growth rate (As shown in Figure 1). In the context of exporting countries, China primarily exports to four countries within the RCEP: Vietnam, Japan, Thailand, and Malaysia. It is worth mentioning that Vietnam's market share has experienced significant growth, surpassing Japan in 2017 to become the largest market for China's fruit and vegetable products in the RCEP region. China's exports to RCEP countries mainly comprise vegetables, processed fruits and vegetables, including temperate fruits like apples, grapes, oranges, and pears, as well as labor-intensive items such as edible mushrooms and garlic. These exports primarily focus on primary agricultural products, with a smaller proportion of high value-added processed products. To enhance efficiency and resilience, it is necessary to optimize this export structure and increase its adaptability.

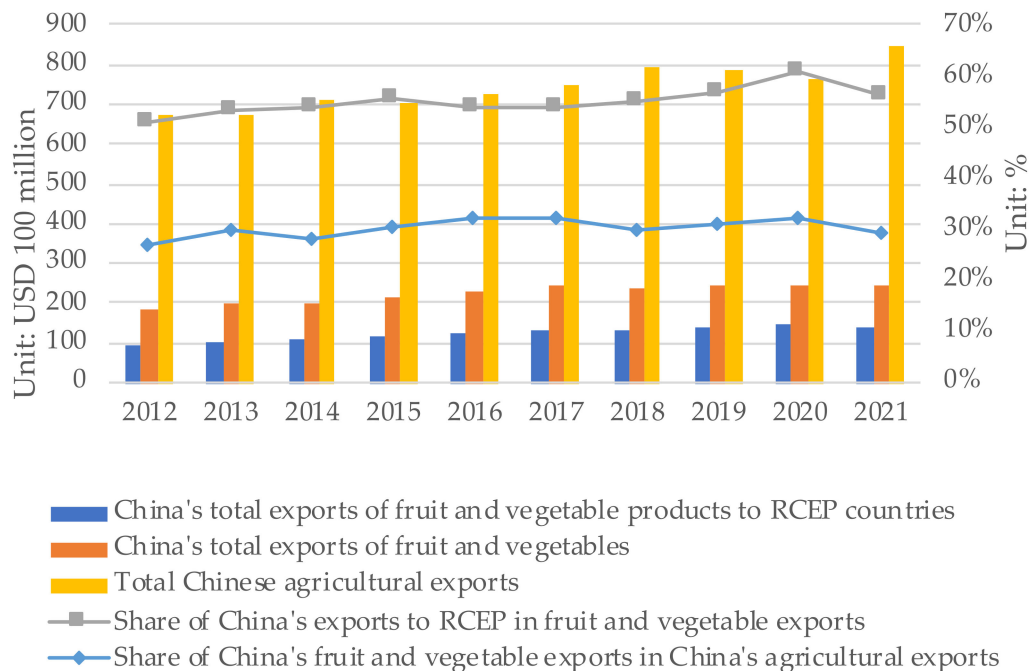


Figure 1. The value of China's export trade in fruit and vegetable products to the rest of the RCEP countries and their share of the total agricultural exports from 2012 to 2021. Note: Data from United Nations Trade Database.

What's the model for the growth of China's fruit and vegetable exports to the rest of the RCEP countries? Additionally, what is the efficiency of this trade and what are the factors that affect it? Conducting research on these topics can help expand China's fruit and vegetable exports, enhance its export competitiveness, improve the resilience of the

fruit and vegetable industry chain and supply chain, and ensure its stability in the global agricultural market.

1.2. Related Research

Over recent years, both domestic and international scholars have maintained keen interest in international agricultural cooperation, actively investigating China's agricultural trade with RCEP countries, the growth impact of agricultural exports, and their influencing factors.

1.2.1. Related Studies on the Growth Impact of Agricultural Exports and Determinants

Trade openness plays a crucial role in promoting economic prosperity (Dollar, 1992; Sachs, 1995; Edwards, 1998) [1–3]. Different trade theories provide varying explanations for the factors driving trade growth. Classical and neoclassical trade theories, which are grounded in the theory of comparative advantage, propose that a country's trade expansion stems from an increased quantity of products with comparative advantage. On the other hand, new trade theory, which considers diversified demand preferences, suggests that trade growth arises from the development of new products or markets. However, given the growing complexity of the international division of labor and the surge in cross-border investment, neither theory can comprehensively and definitively explain the growth of international trade. Melitz (2003) and other scholars have utilized the concept of enterprise heterogeneity and binary margin theory to explain the trade phenomenon. They divided the growth of a country's trade into the expansion of existing trade and the concentration of trade in new markets [4]. Their research on trade margins has provided a wide range of ideas and has been widely adopted by scholars both domestically and internationally [5–7]. There are differing opinions on the main drivers of a country's trade growth. Some argue that it is primarily driven by the intensive margin, while others believe that the increase in product variety plays a crucial role in trade growth [8–10]. Scholars have extensively analyzed the growth of agricultural trade. For instance, Ge Ming et al. (2021) utilized an improved constant market share (CMS) decomposition model to determine that the fluctuation in China's agricultural exports to the RCEP region was primarily driven by the expansion of import market demand [11]. Similarly, Yang Fengmin et al. (2019) observed significant fluctuations in the contribution of the intensive margin and expansion margin to China's agricultural trade with ASEAN [12]. However, overall, China's agricultural export growth predominantly followed a crude trade growth model characterized by quantitative expansion. Additionally, Zhang Xiaoya et al. (2020) highlighted that in China's bilateral agricultural trade with New Zealand the main driver of export growth was the aggregation margin, while the expansion margin exhibited greater potential [13]. In terms of the growth of fruit and vegetable trade, Liu Yi et al. (2014) argued that China's recent export growth of vegetable products has primarily been driven by expansion in volume, although the ability of this expansion to drive export growth has gradually weakened [14]. However, Xu Rong (2019) and Zhang Shengyong et al. (2016) argued that China's vegetable export growth has maintained its characteristic of gaining in volume, but a trend of price-pull growth has been observed [15,16]. Peng Shiguang et al. (2020) found that China's fruit export trade has mainly expanded through the volume-driven intensive margin, with the contribution of the expansion margin gradually weakening [17]. Scholars' applications of the binary margin model and the expansionary gravity model to the growth of agricultural trade provides a reference for this paper.

1.2.2. Research on China's Agricultural Trade with RCEP Countries

Relevant studies have been conducted on China's agricultural trade with RCEP countries, focusing on various aspects such as the structure of agricultural trade, its comparative advantages, and its complementarities. These studies encompass China, Japan, and South Korea [18–20], as well as subregional cooperation between China and ASEAN and other subregional organizations [21–23]. Holistic studies have also been included. Analyzing

trade characteristics, Lin Qingquan et al. used various indicators to conclude that China's agricultural product trade with RCEP countries is mainly based on complementarity, with some competitiveness [24–27]. However, China's agricultural products have relatively weak international competitiveness compared to other RCEP members. According to Xue Kun et al. (2017), China's trade linkage with Japan, Australia, and New Zealand is lower compared to its trade with the ten traditional ASEAN countries [28]. The authors also suggested that there is potential for improvement in the trade in agricultural products. From a trade efficiency perspective, China's agricultural trade efficiency with RCEP member countries is currently low, indicating room for improvement. Zheng Jian et al. (2019) utilized a stochastic gravity model to analyze China's agricultural exports to RCEP countries and found that the average trade efficiency is 0.3 [29]. Among these countries, Japan, South Korea, and Vietnam present the greatest potential for China's agricultural product exports. Li Ming et al. (2021) employed a stochastic frontier gravity model and discovered that the average annual trade efficiency of China's agricultural exports to RCEP countries is 0.48, with significant variations among countries [30]. Shi Chao (2022) conducted an analysis indicating that the average annual trade efficiency of China's agricultural exports to RCEP is 0.45, and the export trade potential is 4.49 times the actual trade volume [31]. Regarding factors influencing trade, FTAs, import procedure efficiency, liner shipping level, and transport infrastructure have a notable impact on China's trade with RCEP member countries [32–34].

The current research primarily focuses on the overall analysis of China's agricultural trade, with limited analysis on specific types or categories of agricultural products. Additionally, there are fewer studies examining the impact of agricultural export growth and its influencing factors in China's agricultural trade with RCEP countries. This paper contributes to this in the following ways: Firstly, it provides a more specific analysis of China's fruit and vegetable exports to RCEP countries by considering 07, 08, and 20 product categories of HS2 classification. Secondly, the research methodology is more rigorous and logically coherent. This paper employs a binary frontier model to analyze the reasons for trade growth and investigate the role of changes in the number and types of products growing in trade. Furthermore, a stochastic frontier gravity model is used to measure the export trade efficiency of fruit and vegetable products and identify the influencing factors. The utilization of combined models enhances the scope and comprehensiveness of this research, thereby effectively addressing the existing research gap.

2. Materials and Methods

2.1. Research Methods

2.1.1. Binary Marginal Model

The traditional method of analysis primarily focuses on growth factors without generalizing the growth pattern. However, the binary marginal model can effectively address these issues by illustrating the impact of growth factors on the breadth and depth of exports. This paper utilizes the binary marginal model proposed by Hummels and Klenow (2005) to analyze the impact of China's fruit and vegetable export growth on the rest of the RCEP countries [35]. Hummels and Klenow divided the growth of a country's exports into two components: an intensive margin (IM) and an extensive margin (EM). Scholars both domestically and internationally largely agree on the definition of the intensive margin, which refers to the expansion in the number of product exports. However, there are differing opinions on the definition of the extensive margin. In the context of this paper, the extensive margin is defined as the expansion in the variety of product exports.

$$IM_{ej} = \frac{\sum_{i \in K_{ej}} P_{ej} X_{ej}}{\sum_{i \in K_{ej}} P_{wj} X_{wj}} \quad (1)$$

$$EM_{ej} = \frac{\sum_{i \in K_{ej}} P_{wj} X_{wj}}{\sum_{i \in K} P_{wj} X_{wj}} \quad (2)$$

In this context, e represents China, j represents the destination country of Chinese fruit and vegetable exports, i represents Chinese exports of fruit and vegetable products to other countries, K represents all commodities exported by China worldwide, and Kej represents all commodities exported by China to country j .

IM_{ej} represents the value of the intensive margin of China's exports to country j . A higher intensive margin value indicates that China exports more of the same types of fruit and vegetable products. EM_{ej} represents the value of the extensive margin of China's exports to country j . A higher extensive margin value suggests that China exports a wider variety of fruit and vegetable products to country j .

We combined the binary margins of China's fruit and vegetable exports to each RCEP member country to analyze the overall status of China's fruit and vegetable exports to RCEP countries. Here, ∂_{ej} is the share of Chinese fruit and vegetable exports to country j out of Chinese fruit and vegetable exports to RCEP countries. IM_e and EM_e denote the intensive margin and the extensive margin of China's exports of fruit and vegetable products to the RECP region, respectively.

$$IM_e = \prod [IM_{ej}]^{\partial_{ej}} \quad (3)$$

$$EM_e = \prod [EM_{ej}]^{\partial_{ej}} \quad (4)$$

2.1.2. Stochastic Frontier Gravity Model Setting and Variable Selection

1. Stochastic frontier gravity model

The trade gravity model is commonly used to measure trade efficiency. The fitted value estimated using the traditional gravity model is referred to as trade potential, and trade efficiency is calculated as the ratio of actual trade volume to trade potential. However, the traditional trade gravity model does not consider trade barriers and iceberg costs and assumes that there is no trade friction. It also assumes that any factors not included in the model do not affect trade, resulting in measurement errors. To address these limitations, the stochastic frontier approach was introduced into the gravity model and is widely utilized.

$$T_{ejt} = f(x_{ejt}, \beta) \exp(v_{ejt}) \exp(-u_{ejt}), u_{ejt} \geq 0 \quad (5)$$

Taking the logarithm on both sides gives the following:

$$\ln T_{ejt} = \ln f(x_{ejt}, \beta) + v_{ejt} - u_{ejt} \quad (6)$$

Equation (5) is the stochastic frontier gravity equation. T_{ejt} denotes the trade volume of exports from country e to country j in period t . X_{ejt} denotes the main factors affecting the actual trade volume. β is a surrogate estimator for the explanatory variables, V_{ejt} is subject to random disturbance and follows a normal distribution with zero mean, and U_{ejt} is a trade inefficiency term that denotes the resistance to trade not introduced in the equation and is usually assumed to follow a seminormal distribution.

There is no friction between trades if U_{ejt} does not exist, in which case the trade value of country e with country j is maximized.

$$T_{ejt}^* = f(x_{ejt}, \beta) \exp(v_{ejt}) \quad (7)$$

T_{ejt}^* denotes trade potential, indicating the maximum level of trade that could be achieved in the current environment.

Based on the actual trade volume and trade potential, the corresponding trade efficiency can be calculated with the formula shown below:

$$TE_{ejt} = T_{ejt} / T_{ejt}^* = \exp(-u_{ejt}) \quad (8)$$

TE_{ejt} in Equation (8) represents trade efficiency, which is the ratio of the actual trade level to the maximum trade level.

2. Stochastic frontier gravity model setting

To investigate the efficiency and potential of China's fruit and vegetable exports to RCEP countries, a stochastic frontier gravity model was constructed. This model is based on Armstrong's model (2007), informed by the research of Li Chun Mei et al. and tailored to the specifics of the fruit and vegetable trade [36,37]. The specific model is as follows:

$$\ln T_{ejt} = \alpha_0 + \alpha_1 \ln GDP_{et} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln POP_{et} + \alpha_4 \ln POP_{jt} + \alpha_5 \ln Dist_{ej} + \alpha_6 LAND_{ej} + v_{ejt} - u_{ejt} \quad (9)$$

3. Variable selection

In Equation (9), e represents the exporting country, China; j represents the destination country for the exports; and T_{ejt} is the explanatory variable, which denotes the total amount of fruit and vegetable products that China exports to the rest of the RCEP countries during period t . V_{ejt} is the random error term and U_{ejt} is the trade inefficiency term, denoting the resistance to trade not introduced into the equation. The explanatory variables and their corresponding economic interpretations are as follows:

GDP_{et} and GDP_{jt} represent the level of economic development of China and RCEP member countries during period t , respectively. Typically, a country's import and export demand, as well as its export capacity, are positively correlated with its level of economic development. This implies that higher GDP corresponds to greater export capacity and import demand (Fan Qian, 2021; Zhou Shudong et al., 2018) [38,39].

POP_{et} and POP_{jt} represent the population size of China and the RCEP member countries during period t , respectively. As a general rule, a larger population in a country corresponds to a larger demand scale and, consequently, a larger scale of trade in both imports and exports (Zhao Jinxing et al., 2018; Tan Xiujie et al., 2015) [40,41].

$DIST_{ej}$ represents the distance between China and the capitals of RCEP member countries. Typically, the distance between two countries is directly proportional to trade costs: a greater distance correlates with higher trade costs and increased trade barriers (Li Dan et al., 2016) [42].

$LAND_{ej}$ indicates whether China and the RCEP members share a common border. Generally, in bilateral trade, the existence of a shared border tends to reduce both trade transportation costs and trade barriers (Wang Fengting et al., 2019) [43].

2.1.3. Trade Inefficiency Modeling and Variable Selection

1. Trade inefficiency modeling

After evaluating trade efficiency, and in light of the review of theoretical models, we used the one-step method of Battese (1995) [44] to measure the factors influencing trade efficiency. With reference to previous scholarly practice (Cheng Yunjie et al., 2022; Yang Jie et al., 2020) [45,46] the trade inefficiency model is constructed as follows:

$$u_{ejt} = \beta_0 + \beta_1 TDF_{jt} + \beta_2 IVF_{jt} + \beta_3 GVS_{jt} + \beta_4 GVC_{jt} + \beta_5 SHIP_{jt} + \beta_6 FTA_{ejt} + \varepsilon_{ejt} \quad (10)$$

2. Variable selection

In Equation (10), U_{ejt} is the explanatory variable representing the trade inefficiency term. ε_{ejt} is the random disturbance term and the economic meanings of the remaining explanatory variables are as follows:

TDF_{et} and IVF_{jt} represent trade freedom and investment freedom, respectively. The degrees of trade and economic freedom serve as indicators of the economic environment in the importing country. Higher degrees of freedom correspond to greater economic liberalization and lower barriers to trade (Cao Fangfang et al., 2021; Song Yanwen et al., 2021) [47,48].

GVS_{jt} and GVC_{jt} represent government expenditure and government integrity, respectively. Government expenditure reflects the extent of a country's investment in infrastructure, with a higher score indicating a higher level of infrastructure (Liu Hongman et al., 2017) [49]. Government integrity, on the other hand, represents the quality of the country's political system, with a higher score suggesting a more favorable trade environment (Chang Xiangyang et al., 2018) [50].

$SHIP_{jt}$ represents the liner shipping connectivity index. This index reflects the status of maritime infrastructure and the development of the maritime network in the importing country. A higher index suggests superior maritime infrastructure and enhanced transport capacity (Wang Rui et al., 2016) [51].

FTA_{ejt} reflects the level of integration between the importing and exporting countries. The level of trade facilitation between the two countries elevates once a free trade agreement (FTA) has been signed and is in effect (Cao An et al., 2018) [52].

2.2. Data Sources and Descriptions

As of now, RCEP members comprise the ten ASEAN countries, Japan, Australia, New Zealand, and other nations, totaling 15 countries, in addition to China. This study utilizes import and export trade data, specifically for fruits and vegetables identified using a 4-digit HS code, extracted from the UN-COMTRADE database spanning the years 2012 to 2021. The remaining variables are shown in Table 1.

Table 1. Model variable selection and source.

Model	Variable Abbreviations	Variable Connotation	Data Source
Stochastic frontier gravity model	GDP	Gross Domestic Product (GDP) is a measure of the economic development of a country, expressed in US dollars.	World Bank Open Data
	POP	POP is the amount of people in a country.	
	Dist	Dist is a measure of the distance in kilometers between the capitals of two countries.	CEPII Database
	LAND	LAND is used to define whether there is a common border between two countries. The variable is a dummy variable and is represented by 0 and 1.	
Trade inefficiency model	TDF IVF GVS GVC	TDF means trade freedom IVF means invest freedom GVS means government expenditure GVC means government integrity	2012–2021 Index of Economic Freedom World Rankings
	SHIP	SHIP are measures of the degree of connectivity of countries to global shipping networks.	World Bank Database
	FTA	FTA is a measure of the existence of a free trade agreement between two countries. The variable is a dummy variable and is represented by 0 and 1.	China Free Trade Zone Service Network

In the stochastic frontier gravity model, the GDP and population data for China and RCEP are sourced from the World Bank, with GDP expressed in constant 2015 US dollars to eliminate the influence of inflation. DIST and LAND data were procured from the CEPII database, where LAND is represented by dummy variables that take the value of 1 if a common border exists and 0 otherwise. In the trade inefficiency model, the trade freedom index (TDF), investment freedom index (IVF), public expenditure index (GVS), and public governance index (GVC) are drawn from economic freedom data co-published by the Heritage Foundation and the Wall Street Journal. The liner shipping connectivity index

(SHIP) is sourced from the World Bank database. The FTA data are obtained from the China Free Trade Zone Service Network, and this study employs a dummy variable for representation, which assumes a value of 1 if the two countries have a free trade agreement and 0 otherwise.

The study analyzed the variables using descriptive statistics and the results are presented in the following Table 2.

Table 2. Descriptive statistical analysis of empirical data.

Variable	Obs	Mean	Std. Dev.	Min	Max
T_{ejt}	150	19.204	2.145	14.245	22.037
GDP_{et}	150	27.607	0.107	27.441	27.791
GDP_{jt}	150	23.268	2.168	18.362	26.819
POP_{et}	150	21.047	0.015	21.024	21.069
POP_{jt}	150	17.327	1.872	12.897	21.065
$DIST_{ej}$	150	8.181	0.562	6.862	9.309
$LAND_{ej}$	150	0.267	0.444	0	1
TDF_{jt}	150	3.442	0.98	1.604	4.734
IVF_{jt}	150	4.364	0.106	4.036	4.552
GVS_{jt}	150	3.927	0.443	2.708	4.443
GVC_{jt}	150	0.565	0.994	−1.498	2.325
$SHIP_{jt}$	150	0.172	0.906	−2.07	1.616
FTA_{ejt}	150	0.113	0.318	0	1

3. Results of China's Fruit and Vegetable Export Growth to RCEP Countries

3.1. Intensive Margin of China's Exports of Fruit and Vegetables to RCEP Countries

The aggregated difference in the marginal value of China's fruit and vegetable exports to RCEP countries from 2012 to 2021 becomes more pronounced, as depicted in Table 3. The intensive margin of China's fruit and vegetable exports to Myanmar and Cambodia increased significantly, rising from 0.19 and 0.2 in 2012 to 0.74 and 0.33 in 2021, indicating an increase in the volume of similar agricultural products exported by China. Conversely, the intensive margin of China's fruit and vegetable exports to India, Thailand, Laos, and Indonesia experienced a downward trend during the sample period, implying a declining contribution of growth to the original fruit and vegetable export volume. For all other countries, their intensive margins experienced minor fluctuations within a relatively stable range. Moreover, calculations of the agglomeration margin contribution over the sample period using the logarithmic difference method revealed that the growth in China's fruit and vegetable exports to Malaysia, India, Indonesia, the Philippines, Japan, and New Zealand was primarily driven by the intensive margin, contributing 107%, 134%, 116%, 124%, 119%, and 132%, respectively. The intensive margins of China's fruit and vegetable exports to Thailand all exceed 0.5, but these margins contribute negatively, suggesting limited potential for growth in the quantity of fruit and vegetable products exported from China to Thailand, with more opportunities for expansion in the diversity of export types.

Table 3. Intensive margins of Chinese exports of fruits and vegetables to the rest of the RCEP countries from 2012 to 2021.

Partner	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Rate of Contribution
Malaysia	0.62	0.76	0.73	0.69	0.64	0.57	0.54	0.69	0.54	0.51	1.07
India	0.06	0.08	0.05	0.04	0.05	0.03	0.07	0.03	0.03	0.02	1.34
Indonesia	0.66	0.60	0.57	0.67	0.63	0.53	0.45	0.55	0.68	0.64	1.16
Thailand	0.66	0.71	0.71	0.72	0.65	0.59	0.65	0.62	0.63	0.58	−0.43
Philippines	0.61	0.56	0.49	0.51	0.54	0.59	0.60	0.63	0.63	0.6	1.24
Brunei	0.13	0.13	0.07	0.1	0.12	0.12	0.13	0.13	0.24	0.24	−0.29
Vietnam	0.42	0.44	0.46	0.6	0.53	0.53	0.58	0.56	0.59	0.66	−0.05
Laos	0.5	0.74	0.69	0.94	0.67	0.1	0.51	0.32	0.25	0.39	0.45
Myanmar	0.19	0.84	0.76	0.86	0.82	0.82	0.81	0.72	0.76	0.74	−0.7
Cambodia	0.2	0.42	0.73	0.5	0.36	0.34	0.53	0.51	0.27	0.33	0.29
Japan	0.36	0.38	0.39	0.37	0.36	0.36	0.35	0.33	0.35	0.36	1.19
Republic of Korea	0.42	0.39	0.39	0.42	0.54	0.55	0.52	0.4	0.37	0.38	0.38
Australia	0.16	0.15	0.14	0.13	0.14	0.12	0.11	0.13	0.13	0.14	−0.5
Singapore	0.14	0.15	0.15	0.15	0.15	0.13	0.13	0.13	0.22	0.17	0.82
New Zealand	0.1	0.1	0.11	0.11	0.12	0.11	0.11	0.1	0.12	0.12	1.32

Note: Data from United Nations Trade Database.

3.2. Extensive Margins of Chinese Exports of Fruits and Vegetables to RCEP Countries

The difference in the extensive marginal change of China's fruit and vegetable exports to RCEP countries from 2012 to 2021 is minor. As shown in Table 4, the extensive margins of China's fruit and vegetable exports to Brunei, Cambodia, Laos, Australia, and Singapore demonstrated an irregular upward trend. The extensive margins of China's fruit and vegetable exports to Laos increased the most, suggesting that diversification in the types of fruit and vegetable exports can stimulate export growth to Laos. However, the extensive margins of China's fruit and vegetable exports to India, Thailand, Vietnam, and Laos exhibited a decreasing trend, and the other countries maintained a stable range. Further calculation using the logarithmic difference method indicates that the growth in China's fruit and vegetable exports to Thailand, Brunei, Vietnam, Myanmar, and Australia during the study period was driven by the extensive margin, contributing 143%, 129%, 105%, 170%, and 150%, respectively. The contribution from the extensive margin greatly exceeds that from the intensive margin, suggesting that China's exports of fruit and vegetables to these five countries have become more diverse. The extensive margin of China's fruit and vegetable exports to Malaysia, India, Indonesia, the Philippines, and Japan used to reach up to 90%; however, the contribution from the extensive margin for these countries is less than 0. This suggests that China's fruit and vegetable exports to these countries are highly diversified, leaving less opportunity for increasing exports of new varieties, resulting in a decrease in the number of export types.

Table 4. Extensive margins of Chinese exports of fruits and vegetables to the rest of the RCEP countries from 2012 to 2021.

Partner	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Rate of Contribution
Malaysia	0.98	0.99	0.98	0.97	0.99	0.99	0.99	0.99	0.99	0.99	−0.07
India	0.74	0.59	0.75	0.60	0.78	0.95	0.27	0.69	0.83	0.80	−0.34
Indonesia	0.96	0.97	0.95	0.95	0.97	0.97	0.97	0.99	0.99	0.98	−0.16
Thailand	0.95	0.99	0.94	0.94	0.94	0.99	0.93	0.94	0.93	0.95	1.43
Philippines	0.9	0.99	0.99	0.99	0.99	0.98	0.99	0.99	0.99	0.99	−0.24
Brunei	0.72	0.46	0.79	0.78	0.86	0.88	0.90	0.63	0.71	0.89	1.29
Vietnam	0.59	0.99	0.99	0.42	0.41	0.42	0.49	0.99	0.98	0.99	1.05
Laos	0.19	0.15	0.07	0.39	0.13	0.59	0.28	0.33	0.46	0.75	0.55
Myanmar	0.62	0.75	0.84	0.81	0.52	0.51	0.35	0.94	0.98	0.59	1.70
Cambodia	0.23	0.40	0.56	0.79	0.83	0.84	0.73	0.83	0.62	0.67	0.71

Table 4. Cont.

Partner	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Rate of Contribution
Japan	0.98	0.98	0.94	0.98	0.98	0.97	0.98	0.98	0.95	0.97	−0.19
Republic of Korea	0.84	0.90	0.89	0.85	0.81	0.78	0.78	0.95	0.88	0.90	0.62
Australia	0.88	0.88	0.88	0.96	0.89	0.91	0.98	0.92	0.93	0.93	1.50
Singapore	0.92	0.90	0.90	0.93	0.94	0.98	0.94	0.98	0.98	0.99	0.18
New Zealand	0.82	0.73	0.70	0.68	0.69	0.68	0.68	0.73	0.78	0.78	−0.32

Note: Data from United Nations Trade Database.

3.3. Total Binary Margins of China's Fruit and Vegetable Exports to RCEP Countries

Overall, the growth of China's fruit and vegetable exports to RCEP countries during the period analyzed can be attributed to the combined effect of the intensive and extensive margins. The extensive margin value exceeds the intensive margin, suggesting that China's fruit and vegetable export growth to the rest of the RCEP countries is primarily driven by the extensive margin. This indicates that the current surge in exports is largely due to an increase in the variety of exported fruit and vegetable products. In terms of dual-margin contributions, China contributes 80.20% to the extensive margin and 19.80% to the intensive margin of RCEP fruit and vegetable exports. China's fruit and vegetable exports are playing an increasingly significant role in extensive margins. The previous growth model, which prioritized quantity over quality, is evolving. As indicated in Table 5, the extensive margin of China's fruit and vegetable exports to RCEP countries has been on a fluctuating upward trend since 2012. This trend is largely driven by China's open trade strategy and the positive impact of the RCEP, leading to an increase in the variety of fruit and vegetable exports from China.

Table 5. Binary margins of China's exports of fruit and vegetable products to RCEP countries from 2012 to 2021.

Year	Intensive Margin	Extensive Margin
2012	0.39	0.89
2013	0.44	0.89
2014	0.43	0.89
2015	0.47	0.83
2016	0.45	0.86
2017	0.41	0.87
2018	0.49	0.78
2019	0.45	0.92
2018	0.48	0.96
2019	0.48	0.96
Rate of contribution	0.198	0.802

Note: Data from United Nations Trade Database.

4. Results of Empirical Analysis of Efficiency and Factors Affecting Trade in Fruit and Vegetable Products

This study evaluates the level and potential of trade development by estimating a stochastic frontier gravity model and a trade inefficiency model for China's fruit and vegetable exports to RCEP countries, utilizing Frontier 4.1 software.

4.1. Model Applicability Testing

To ensure the reliability of the model, the construction of the model needs to undergo a likelihood ratio test prior to estimation. The results of these tests are presented in Table 6.

Table 6. Results of model applicability tests.

Original Hypothesis	Constrained Model	Unconstrained Model	LR Statistic	1% Threshold	Test Conclusion
No trade inefficiencies	−204.66	−24.21	360.89	9.21	Rejection
Trade inefficiencies remain constant	−24.21	−16.12	16.18	11.345	Rejection

The results of the model applicability test reveal that the LR statistics of the two hypotheses are 360.89 and 16.18, and the initial hypotheses of the nonexistence of trade inefficiency terms and the nonvariation in inefficiency terms over time are both rejected at a 1% significance level. The results suggest that the stochastic frontier gravity model is appropriately constructed, and, simultaneously, that a time-varying stochastic frontier gravity model should be utilized for measuring trade efficiency.

4.2. Analysis of Stochastic Frontier Gravity Model Results

Upon passing the model applicability test, this study estimates the constructed stochastic frontier gravity model and conducts regression analyses by specifying time-invariant and time-varying models. The estimation results are displayed in Table 7. The γ values of the time-varying and time-invariant models are 0.996 and 0.989, respectively, which are significant at the 1% level. This further validates the existence of trade inefficiency terms and demonstrates the applicability of the stochastic frontier gravity model. The η in the time-varying model is significantly negative at the 1% level, which also suggests an increase in the trade inefficiency term.

Table 7. Stochastic frontier gravity model estimation results.

Variables	Time-Invariant Model		Time-Varying Model	
	Coefficient	T-Values	Coefficient	T-Values
GDP _{et}	4.355 ***	29.627	5.401 ***	16.832
GDP _{jt}	0.147	−0.922	0.134	0.977
POP _{et}	−51.923 ***	−152.324	−54.732 ***	−95.220
POP _{jt}	0.118	1.045	0.896 ***	4.065
DIST _{ej}	−0.738	−1.054	−0.517 **	−1.960
LAND _{ej}	0.027	−0.067	2.553 ***	−2.870
Constant term	90.612 ***	91.173	98.535 ***	85.857
σ^2	13.458 *	1.905	3.760 *	1.822
γ	0.996 ***	431.393	0.989 ***	170.691
η	—	—	−0.023 ***	−5.632
log likelihood	−24.212	—	−16.121	—
LR test	360.892 ***	—	377.074 ***	—

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

The regression results of the time-varying stochastic frontier gravity model reveal that China's level of economic development, population, and the presence of a common border significantly influence China's export of fruit and vegetable products to the rest of the RCEP countries.

GDP_{et}, representing the size of China's economy, has a significantly positive coefficient at the 1% level. This aligns with classical trade theory, implying that as China's economic development level rises, its foreign exports also increase. GDP_{jt} represents the level of economic development of RCEP member countries. Its coefficient is positive but not significant, indicating that while an improved economic development level of importing countries facilitates demand for fruits and vegetables, the effect is not pronounced.

Both POP_{et} and POP_{jt} pass the 1% significance test, but their coefficients are in opposite directions. This implies that growth in China's population could significantly dampen fruit and vegetable exports by increasing domestic market demand. Population growth in importing countries can increase their market demand for fruit and vegetable products, thereby boosting exports of Chinese fruit and vegetable products.

$DIST_{ej}$ and $LAND_{ej}$, representing the distance between the capitals of exporting and importing countries and the bilateral existence of a common border, pass the 5% and 1% significance tests, respectively. The negative coefficient of $DIST_{ej}$ suggests that the distance between importing and exporting countries can impede the trade of fruit and vegetable products between the two countries. The export of Chinese fruits and vegetables is less favorable with greater distance and higher transport costs. Simultaneously, the coefficient value of -0.517 , which is relatively small, suggests that the inhibiting effect of geographical distance on bilateral trade is decreasing. This is due to the enhancement of maritime infrastructure and the formation of a global maritime network.

4.3. Analysis of Trade Inefficiency Modeling Results

This study uses a one-step approach to estimate the trade inefficiency model in order to investigate the factors influencing trade inefficiency. According to the model regression results (Table 8), factors such as FTAs (free trade agreements), trade freedom, political spending, government integrity, and the liner connectivity index significantly influence trade efficiency.

Table 8. Estimation results of the trade inefficiency model.

Stochastic Frontier Gravity Model			Trade Inefficiency Modeling		
Variables	Coefficient	T-Values	Variables	Coefficient	T-Values
GDP_{et}	4.635 ***	233.416	TDF_{jt}	-0.020 ***	-2.055
GDP_{jt}	0.161 ***	-9.923	IVF_{jt}	-0.016	-0.724
POP_{et}	-52.769 ***	-845.577	GVS_{jt}	-0.063 **	-1.964
POP_{jt}	0.393 ***	25.363	GVC_{jt}	-0.073 ***	-4.195
$DIST_{ej}$	-0.137 ***	-3.302	$SHIP_{jt}$	-0.249 ***	-6.957
$LAND_{ej}$	0.295 ***	21.943	FTA_{ejt}	-0.141 **	-2.128
Constant	90.672 ***	92.007	Constant	14.072 ***	5.994
term			term		
σ^2	1.687 ***	5.414	γ	0.989 ***	171.562
log					
likelihood	-113.008		LR test	183.299 ***	

Note: ** and *** indicate significance at 5%, and 1% levels, respectively.

Both the trade freedom index (TDF_{jt}) and the investment freedom index (IVF_{jt}) exhibit a positive effect on trade efficiency. This suggests that an efficient trade openness regime can effectively improve trade efficiency. The level of government expenditure (GVS_{jt}) and the level of government integrity (GVC_{jt}) significantly negatively impact trade inefficiency. This implies that improvements in infrastructure by the importing country's government and the level of government policy execution can enhance trade facilitation and boost the export of Chinese fruit and vegetable products. The liner connectivity index ($SHIP_{jt}$) is significantly negative at the 1% level, suggesting that enhancements in maritime infrastructure and networks in RCEP member countries can significantly improve trade efficiency. The liner connectivity index ($SHIP_{jt}$) is significantly negative at the 1% level, suggesting that enhancements in maritime infrastructure and networks in RCEP member countries can significantly improve trade efficiency. FTA_{ejt} (free trade agreements) have a significant negative impact on trade inefficiency. This implies that FTAs between importing and exporting countries enhance trade efficiency and reduce trade barriers, further underscoring the importance of signing RCEP trade agreements. The above findings suggest that the removal of trade barriers in future agricultural trade within the RCEP region could focus

on improving the investment and trade environment and maritime transport infrastructure. The above findings suggest that the removal of trade barriers in future agricultural trade within the RCEP region could focus on improving the investment and trade environment and maritime transport infrastructure.

4.4. Trade Efficiency and Potential Analysis

The trade efficiency of China's fruit and vegetable exports to the rest of the RCEP countries is evaluated using the one-step approach of the stochastic frontier gravity model. This model also explores the market potential of China's fruit and vegetable exports to RCEP member countries. From 2010 to 2019, the average trade efficiency of China's fruit and vegetable products exported to RCEP member countries stood at 44.16%. There are substantial differences in trade efficiency among these countries, indicating that China has significant export potential to member countries within the RCEP region. This study references Zhao Jinxin et al. (2019) [40], who categorized the markets of RCEP member countries into iceberg, developing, and expansionary segments based on trade efficiency scores, as illustrated in Table 9.

Table 9. Efficiency market classification of fruit and vegetable products exported from China to RCEP countries.

Market Type	Trade Efficiency Value Range	Country Name
Iceberg markets	0.0–0.3	Australia, Philippines, Cambodia, New Zealand, India, Brunei, Laos, Myanmar
Developing markets	0.3–0.5	Singapore, Indonesia
Expansionary markets	0.5–0.8	Thailand, Vietnam
Mature markets	0.8–1.0	Korea, Malaysia, Japan

In terms of average export efficiency, the “iceberg market” encompasses eight countries: Australia, the Philippines, New Zealand, India, Brunei, Laos, and Myanmar. This comprises half of the total number of RCEP countries. Currently, China's exports to the iceberg market are not fully developed, yet they present vast trade prospects. China can capitalize on the enforcement and implementation of the RCEP agreement to enhance bilateral trade cooperation in fruit and vegetable products, in addition to agricultural cooperation. Developing markets encompass Singapore and Indonesia. China's exports of fruit and vegetables to these developing markets are less efficient, providing more room for export growth. Thailand and Vietnam represent expansionary markets, indicating that the trade efficiency of China's fruit and vegetable exports to these countries is in a growth phase, demonstrating high potential. Although Vietnam's average potential is lower, the scale of China's fruit and vegetable exports to Vietnam has been increasing year by year, with a rapid growth in trade efficiency, reaching a mature stage. Mature markets include South Korea, Malaysia, and Japan. China's fruit and vegetable exports to these countries have achieved a certain scale with a high level of trade efficiency. There is a need to optimize the structure of fruits and vegetables, improve the added value of products, and explore new growth areas.

5. Discussion

Firstly, in terms of the growth pattern of fruit and vegetable products, the findings of this paper are mostly consistent with previous studies. For example, Yan Xiaoting et al. (2016) argued that the extensive margin is the main reason for the growth of China's exports of fruit products to the ASEAN region, and the contribution of the intensive margin to export growth is gradually weakening [53]. According to Liu Yi et al. (2014), China's contribution to the growth of its foreign exports of vegetable products primarily stems from the extensive of product variety [14]. Tan Jinrong et al. (2013) argue that the

extensive margin has a greater pulling effect on the growth of China's agricultural exports to Vietnam [54]. Zhang Xiaoya et al. (2020) find that the extensive margin accounts for a higher share of China's contribution to the growth of New Zealand's agricultural exports [13]. This aligns with the findings of this paper, which also indicate that the extensive margin plays a more significant role in the growth of fruit and vegetable exports compared to the intensive margin.

Secondly, regarding the efficiency of fruit and vegetable exports and its influencing factors, Li Ming (2021) examines the efficiency of fruit and vegetable exports and its influencing factors. He finds that the efficiency of China's agricultural exports to RCEP countries is below 0.5, with varying levels across different countries. The relationship between China's economic and population size and its agricultural exports is significantly positive, while the relationship between geographical distance and agricultural exports is significantly negative. Factors such as limited trade and investment liberalization, inadequate government support, and government integrity have a constraining impact on improving trade efficiency [30]. According to Xia Wenhao (2021), the economic and population sizes of China and the importing countries in the RCEP region have a significant impact on the export of agricultural products. Additionally, it is found that geographical distance can hinder the export of agricultural products. The study also highlights the importance of trade openness and investment freedom in the importing countries, as they contribute to enhancing trade efficiency [33]. According to Chen Yusheng (2022), China's agricultural exports to the RCEP region are deemed to be less efficient and have considerable room for improvement. The economic size of both China and the importing countries has a positive impact on China's agricultural exports. Free Trade Agreements (FTAs) and the level of government expenditure plays an important role in expanding trade. The existing literature supports the notion that China's agricultural exports to the RCEP region are less efficient and exhibit notable differences among countries [32]. Economic size positively influences China's exports, while factors such as the distance between importing and exporting countries and China's population size have a significant negative effect on exports. Furthermore, trade freedom, government expenditure levels, and FTAs have the potential to enhance trade efficiency, which aligns with the findings of this study.

However, the results of this paper differ from previous studies in the following ways:

In terms of research methodology, the combined use of the binary margin model and the stochastic frontier gravity model can provide valuable insights into trade growth patterns, trade efficiency, and their influencing factors. For instance, previous studies by Yang Fengmin et al. (2019) [12], Fan Qian (2021) [38], and Xu Rong (2019) [15] have analyzed the growth pattern of China's agricultural exports. However, these studies have not examined the current export trade efficiency and its influencing factors. Zhou Shudong et al. (2018) [54] and Cheng Yunjie et al. (2022) [39] conducted an analysis on the trade efficiency of China's exports to the region and identified the influencing factors. However, their analysis did not incorporate the binary marginal model to examine the trade pattern of China's exports to the region. Therefore, it was not possible to analyze whether the growth in China's agricultural export trade was due to an expansion in the volume of exports or an expansion in the range of products exported.

Furthermore, the study focuses specifically on fruit and vegetable products within the agricultural sector. This specific classification of the research allows for a more detailed analysis of trade growth patterns and factors that contribute to trade fluctuations. Consequently, the conclusions and proposed countermeasures are more specific and targeted. Studies conducted by Shi Chao et al. (2021) and others examine agricultural products as a whole, encompassing a broader research sample that does not capture the nuances of specific agricultural product classes [31,33].

In addition, this paper has some shortcomings in terms of research and possible directions for future in-depth research.

Firstly, this study focuses on specific countries within the RCEP region. Furthermore, future analysis can be divided into various regions based on the geographical location of these countries in order to obtain more specific results.

From a product classification perspective, this study provides a comprehensive analysis of fruit and vegetable products without specific categorization. However, in the future, it would be beneficial to conduct a more detailed and categorized study to explore the factors contributing to the growth of trade in different types of fruit and vegetable products.

Furthermore, from a research methodology perspective, this study utilizes the binary margin analysis method to distinguish trade growth into the intensive margin and the expansion margin. In future studies, the intensive margin can be further divided into volume growth and price growth using existing methods. Additionally, conducting a thorough analysis of the sources of fruit and vegetable export growth can enhance the credibility and realism of the research findings.

6. Conclusions and Implications

6.1. Conclusions

Firstly, the results from the HK binary marginal decomposition analysis method demonstrate that the growth of China's fruit and vegetable exports to the rest of the RCEP countries is a combined result of the intensive margin and the expansion margin. This is primarily attributed to the expansion margin, indicating that China's fruit and vegetable exports to the rest of the RCEP countries are becoming increasingly diversified. From the perspective of the contribution of the binary margin, fruit and vegetable products are not like agricultural products as a whole, and the expansion margin of China's fruit and vegetable exports is playing an increasingly large role, and the crude growth mode of "focusing on quantity but not on quality" has been transformed, with the structure of fruit and vegetable exports being continuously optimized and the quality of exports being improved. Secondly, the empirical analysis results of the stochastic frontier gravity model reveal that the size of China's economy and the population size of the importing country significantly boost China's fruit and vegetable exports. Conversely, the distance between the importing and exporting capitals, the size of China's population, and a shared border significantly hinder China's fruit and vegetable exports. The economic size of the importing country can enhance China's fruit and vegetable exports, but the effect is not significant. This may be associated with other factors like the capacity for demand and resource endowment. Thirdly, factors such as FTAs, the degree of trade liberalization, the level of political spending, the integrity of the government, and the liner connectivity index can significantly enhance the trade efficiency of China's fruit and vegetable exports to RCEP countries. Investment freedom can increase the volume of Chinese fruit and vegetable exports to RCEP countries, but the effect is not substantial. This suggests that the improvement of trade efficiency in China's fruit and vegetable exports to the rest of the RCEP countries is not separate from the optimization of the trade environment in the importing countries, in particular the improvement of transport conditions and the degree of trade openness to the outside world. Investment freedom has the potential to boost China's exports of fruit and vegetable products from RCEP countries, although its impact is not substantial. The reason for this insignificance could be attributed to China's recent focus on outward investment in technology and services, primarily targeting Europe and countries along the Belt and Road path. Consequently, there has been relatively less investment in agriculture within the RCEP region. Finally, the average trade efficiency of fruit and vegetable products exported from China to RCEP member countries over the past ten years stands at 0.44. This suggests significant room for export growth and developmental potential following the implementation of the RCEP. There are substantial differences in trade efficiency among countries. China's exports of fruit and vegetable products to countries like Japan, South Korea, Malaysia, and Vietnam, where market expansion and trade efficiency levels are higher, can further improve export quality and efficiency through the implementation of the RCEP. From a trade potential and expansion

perspective, countries like Cambodia, New Zealand, and India may have space for growth, but their external dependence is minimal. Their import scale is not substantial, limiting the impact on the growth of China's fruit and vegetable export. By strengthening trade cooperation with countries like the Philippines, Japan, Thailand, and Vietnam, which are in the process of developing their export scale, we can optimize the fruit and vegetable trade structure and broaden the trade scope.

6.2. Implications

Following empirical analysis, and considering the present state of RCEP development, enhancing China's fruit and vegetable trade with the rest of the RCEP countries is proposed. This can be achieved by addressing issues related to the trade structure of fruit and vegetable products, technical barriers, and branding advantages, in line with the further development and enhancement of the RCEP agreement.

Firstly, agricultural export structures need optimization. The RCEP agreement has bolstered trade ties among countries and fostered regional economic cooperation. In recent years, there has been a consistent increase in the total volume of Chinese fruit and vegetable exports, along with an expansion in the variety of these products exported to RCEP countries. To begin with, to enhance the competitiveness of China's fruit and vegetable products in the international market, it is recommended to focus on optimizing the export of agricultural products. This can be achieved by deepening the supply side structural reform of fruit and vegetable exports, increasing investment in the research and development of fruit and vegetable products, extending the industrial chain of fruit and vegetable products, and producing processed fruit and vegetable products with higher added value (Felipe, 2013) [55]. Next, it is important to focus on strengthening brand building and marketing promotion. This can be achieved through a two-pronged approach. First of all, leveraging traditional promotion channels such as production and marketing, docking meetings, import and export fairs, and other established avenues. Then, utilizing online platforms like network media and online agricultural exhibitions to enhance brand visibility and marketing efforts. These initiatives aim to establish a strong brand image for agricultural products and effectively promote specialty agricultural products in overseas markets, thereby increasing international visibility and influence. Additionally, financial support and policy assistance will be provided to enhance the international competitiveness of leading enterprises. It is crucial to cultivate these leading enterprises, integrate core resources, and encourage collaboration among small- and medium-sized microenterprises to create synergies and collectively expand into international markets.

Secondly, we must improve the safety and quality of fruit and vegetable products. The quality and safety of these products are crucial, as they are a significant part of daily diets. To begin with, we need to reinforce the quality and safety controls for fruit and vegetable exports. Efforts should be concentrated on reducing the use of pesticides and chemical fertilizers at the source of production and promoting ecological farming. A fruit and vegetable product safety and quality management system should be established to ensure overall control of the safety of these products, thereby ensuring their global marketability. Further, we must increase sampling efforts for exported fruit and vegetable products to prevent the export of "problematic" produce, adhering to a quality-first principle. Additionally, it is crucial to establish a robust traceability system for agricultural products. This can be achieved by leveraging advanced technology to mark and record the production, processing, and circulation information of fruit and vegetable products. Such a system will enable product traceability, thereby enhancing product transparency and credibility.

Thirdly, the enhancement of free trade zones should be promoted. Since the signing of the China–ASEAN Framework Agreement on Comprehensive Economic Cooperation between China and 10 ASEAN countries in 2002, the Early Cargo Receipt Program in 2004, and the completion of the China–ASEAN FTA in 2010, a total of 500 types of agricultural products have been traded at zero tariffs over 20 years. Today, 95% of agricultural products from both sides have seen their tariffs reduced to zero. With the signing of the RCEP and the

expansion of the economy, the need to upgrade the traditional free trade zones has become more pressing. To begin with, it is necessary to enhance the infrastructure of the FTAs. This includes improving transport infrastructure, such as railways, roads, and international air freight, to increase capacity. This will help reduce logistics costs and improve the efficiency of the movement of goods and people. Next, it is important to develop a robust financial system and financial infrastructure within the FTAs. This can be achieved by providing convenient financial services to support trade settlement, trade financing, and investment. Additionally, there is a need to enhance the level of trade digitalization facilities. Utilizing information technology can promote digital customs declaration and single-window construction, simplifying customs procedures and processes. This will enable online customs declaration, automatic examination and supervision, and improve the overall facilitation of acceptance.

Finally, robust exchange and cooperation with non-RCEP countries should be encouraged. While the RCEP currently surpasses the Comprehensive and Progressive Trans-Pacific Partnership (CPTPP) in terms of global economic influence, it does not include all Asia-Pacific countries, with large nations like India opting out of the agreement. Moving forward, we should strive to enhance the rules, foster close relations with member nations based on the principle of active cooperation with “all countries, regions, and enterprises willing to cooperate with us, including the United States, localities, and enterprises” [56], and further reinforce exchanges and cooperation with other non-RCEP countries in the Asia-Pacific region. We should encourage more countries to actively join the RCEP and continuously broaden the scope and influence of the RCEP. This plays a critical role in reducing resistance to economic and trade exchanges caused by political and diplomatic imbalances, bridging the fragmentation of the international trading system, advancing global trade liberalization, and protecting global economic integration. To enhance communication and cooperation with non-RCEP countries, it is important to establish bilateral and regional dialogue and exchange mechanisms. This can be achieved by organizing regular thematic forums, establishing exchange platforms, and conducting high-level meetings, economic and trade dialogues, and other activities. Additionally, expanding multilateral humanistic exchanges and cooperation is crucial. This can be accomplished through initiatives such as promoting mutual visits, academic exchanges, and educational cooperation to foster mutual trust and enhance cooperation.

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References

1. Dollar, D. Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976–1985. *Econ. Dev. Cult. Chang.* **1992**, *40*, 523–544. [[CrossRef](#)]
2. Sachs, J.; Warner, A. Economic Reform and the Progress of Global Integration. *Harv. Inst. Econ. Res. Work. Pap.* **1995**, *35*, 1–118.
3. Edwards, S. Openness, Productivity and Growth: What do We Really Know? *Econ. J.* **1998**, *108*, 383–398. [[CrossRef](#)]

4. Melitz, M.J. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica* **2003**, *71*, 1695–1725. [\[CrossRef\]](#)
5. Felbermayr, G.; Kohler, W. Exploring the Intensive and Extensive Margins of World Trade. *Rev. World Econ.* **2006**, *142*, 642–674. [\[CrossRef\]](#)
6. Elhanan, H.; Marc, M.; Yona, R. Estimating Trade Flows: Trading Partners and Trading Volumes. *Q. J. Econ.* **2008**, *123*, 441–487.
7. Bernard, A.B.; Jensen, J.B.; Redding, S.J.; Schott, P.K. The Margins of US Trade. *Am. Econ. Rev.* **2009**, *99*, 487–493. [\[CrossRef\]](#)
8. Baier, S.L.; Bergstrand, J.H.; Feng, M. Economic integration agreements and the margins of international trade. *J. Int. Econ.* **2014**, *93*, 339–350. [\[CrossRef\]](#)
9. Bernard, A.B.; Eaton, J.; Jensen, J.B.; Kortum, S. Plants and Productivity in International Trade. *Am. Econ. Rev.* **2003**, *93*, 1268–1290. [\[CrossRef\]](#)
10. Feenstra, R.C. Restoring the product variety and procompetitive gains from trade with heterogeneous firms and bounded productivity. *J. Int. Econ.* **2018**, *110*, 16–27. [\[CrossRef\]](#)
11. Ge, M.; Gao, Y.D. Research on the Dynamics of China's Agricultural Exports to RCEP Countries. *J. Stat. Inf.* **2021**, *36*, 41–51.
12. Yang, F.M.; Wen, F.; Wei, L.H. An Analysis on the Influencing Factors of China's Agricultural Export to ASEAN Market: An Empirical Study Based on Binary Margin. *Int. Bus. Res.* **2019**, *40*, 25–38.
13. Zhang, X.Y.; Xiao, H.F. China-New Zealand bilateral agricultural exports growth—Based on the analysis of dual marginal perspective. *World Agric.* **2020**, *05*, 63–75.
14. Liu, Y.; Yang, S.W. Influence Factors and the Dual Margin of Chinese Agricultural Products Export Growth: In the Example of Vegetable Export. *Ind. Econ. Rev.* **2014**, *5*, 70–81.
15. Xu, R.; Xiao, H.F. Analysis of ternary marginal characteristics and influencing factors of vegetable export in China. *J. Henan Agric. Univ.* **2019**, *53*, 995–1002.
16. Zhang, S.Y.; Wang, S.W. Ternary-Margin Analysis on Vegetable Export Growth from China to ASEAN. *J. Huazhong Agric. Univ. Soc. Sci. Ed.* **2016**, *1*, 85–90.
17. Peng, S.G.; Zhou, Y.H. Growth Reasons of China's Fruit Trade: Based on the Perspective of Three Margins. *J. Agro-For. Econ. Manag.* **2020**, *19*, 10–23.
18. Fan, J.H.; Zhu, F.L.; Zhu, D.W. Effect and Potential Analysis of RCEP on China's Export of Agricultural Products to Japan. *Acta Agric. Jiangxi* **2023**, *35*, 179–184.
19. Geng, Y.Q.; Li, N. Research on the Agricultural Products Trade Problems in the FTA of China, Japan and South Korea. *Econ. Probl.* **2014**, *10*, 97–102.
20. Si, W.; Huang, C.Q.; Wang, J.M. The Influences Facts and Decompositions of Agricultural Trade between China, Japan and South Korea. *Issues Agric. Econ.* **2012**, *33*, 16–21.
21. Yang, F.M.; Tian, Y.Y. Comparative Analysis of the Competitiveness of China, Japan and South Korea's Agricultural Products Exports: Based on the Perspective of Export Technology Complexity. *J. Tech. Econ. Manag.* **2022**, *1*, 88–93.
22. Yang, Y.; Li, M.J.; Wang, X. Research on the development path of agricultural trade between China and ASEAN under the background of RCEP. *Rural Econ. Sci. Technol.* **2022**, *33*, 132–134.
23. Tan, Y.W.; Li, C.X.; Chen, Z.G. Influence and Countermeasures of COVID-19 on Agricultural Supply Chain between China and ASEAN. *Issues Agric. Econ.* **2020**, *10*, 113–121.
24. Lin, Q.Q.; Zheng, Y.; Yu, J.H. Competitiveness and Complementarity of Agricultural Trade Between China and RCEP Members. *Asia-Pac. Econ. Rev.* **2021**, *01*, 75–81.
25. Wang, F.Y. Study on Food Security and It's Cooperation among China, Japan and Korea. *Asia-Pac. Econ. Rev.* **2016**, *2*, 91–99.
26. Ma, H.K.; Mao, S.P. Research on the Green Ecological Transformation of Agricultural Support Policy in China Based on Comparative Analysis of China, Japan and South Korea. *Reform Econ. Syst.* **2020**, *2*, 157–165.
27. Feng, Z.X.; Li, C. Analysis on the Competitive Advantage and Its Motivation of China's Agricultural Export under the Proceeding of RCEP. *J. Xi'an Jiaotong Univ. Soc. Sci.* **2022**, *42*, 53–64.
28. Xue, K.; Zhang, J.G. Study on the Impact of RCEP on China's Agricultural Trade from the Perspective of Tariff Reduction. *World Agric.* **2017**, *4*, 137–143.
29. Zhen, J.; Wang, X.M. Agricultural trade potential and influencing factors of RCEP member countries: An empirical analysis based on stochastic frontier gravity model. *Xinjiang State Farms Econ.* **2019**, *8*, 28–36.
30. Li, M.; Yu, Y.; Xu, Y.Y. The efficiency and potential of China's agricultural products exports to RCEP member countries—Analysis based on stochastic frontier gravity model. *World Agric.* **2021**, *8*, 33–43.
31. Shi, C.; Hu, L.Q. Study on factors affecting agricultural trade efficiency between China and other RCEP members from the perspective of rural revitalization. *Soc. Sci. Guangxi* **2022**, *3*, 78–87.
32. Chen, Y.S.; Wang, Y.M. Research on the structure, efficiency and influencing factors of agricultural products trade between China and RCEP member countries—Based on empirical analysis of sub-products. *World Agric.* **2021**, *12*, 72–83.
33. Xia, W.H.; Zhang, Y.Z. RCEP, agricultural trade expansion and efficiency improvement. *World Agric.* **2021**, *10*, 70–80.
34. Sun, S.F.; Chen, Z. Impact of Economic Openness on International Competitiveness of Agricultural Products Under the background of Belt and Road Initiative: Based on the Statistics of RCEP Member Countries. *World Econ. Stud.* **2018**, *3*, 81–94.
35. Hummels, D.; Klenow, P.J. The Variety and Quality of a Nation's Exports. *Am. Econ. Rev.* **2005**, *95*, 704–723. [\[CrossRef\]](#)
36. Armstrong, S. Measuring Trade and Trade Potential: A Survey. *Asia Pac. Econ. Pap.* **2007**. [\[CrossRef\]](#)

37. Li, C.M.; Luo, H.T. Research on the export trade potential and influencing factors of China to RCEP member countries based on the extended trade gravity model. *Bus. Econ.* **2021**, *9*, 463.
38. Fan, Q. Analysis of the factors influencing China's agricultural exports to countries along the Belt and Road based—Based on the perspective of dual margins Chinese Full Text, Journal of Price. *Monthly* **2021**, *4*, 43–50.
39. Zhou, S.D.; Zheng, J. China's Trade Efficiency with RCEP Partner Countries and Influencing Factors—An Empirical Analysis Based on Stochastic Frontier Gravity Models. *Inq. Into Econ. Issues* **2018**, *7*, 89–97.
40. Zhao, J.X.; Tian, Z.H. Agricultural Export Efficiency of China to Belt and Road Countries. *J. Northwest AF Univ. Soc. Sci. Ed.* **2019**, *19*, 111–117.
41. Tan, X.J.; Zhou, M.R. Export Potential of 21st-Century Maritime Silk Road and Its Determinants: An Empirical Research Based on Stochastic Frontier Gravity Model. *J. Int. Trade* **2015**, *2*, 3–12.
42. Li, D.; Xia, Q.; Zhou, H. Study on the agricultural trade potential between China and Central and Eastern European countries in the context of “One Belt, One Road”: An Empirical Analysis Based on Stochastic Frontier Gravity Models. *Xinjiang State Farms Econ.* **2016**, *6*, 24–32.
43. Wang, F.T.; Tian, Y.; Cheng, B.D. Research on agricultural export trade between China and countries along the 21st Century Maritime Silk Road. *Int. Econ. Coop.* **2019**, *2*, 80–90.
44. Battese, G.E.; Coelli, T.J. A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empir. Econ.* **1995**, *20*, 325–332. [[CrossRef](#)]
45. Cheng, Y.J.; Liu, X. Research on the efficiency and potential of agricultural products import trade between China and RCEP Countries. *Chin. J. Agric. Resour. Reg. Plan.* **2022**, *43*, 252–262.
46. Yang, J.; Qi, C.J. An Empirical Analysis on the Trade Potential of Export to China from Countries Along the Silk Road Economic Belt —Based on TPI and an Expanded Framework of Stochastic Frontier Gravity Model. *J. Int. Trade* **2020**, *6*, 127–142.
47. Cao, F.F.; Sun, Z.L.; Li, X.D. Analysis of influencing factors of China's import of Latin American agricultural products and trade efficiency calculation—Empirical analysis based on the time-varying stochastic frontier gravity model. *World Agric.* **2021**, *4*, 13–22.
48. Song, W.Y.; Han, W.H.; Yang, Q.Q. Agricultural Trade Efficiency in China Under the Background of the Belt and Road. *J. Cap. Univ. Econ. Bus.* **2021**, *3*, 63–74.
49. Liu, H.M.; Wang, M.X. The Influence of Institutional Environment on the Efficiency of China's Agricultural Products Trade along the “Belt and Road”. *Econ. Probl.* **2017**, *07*, 78–84.
50. Chang, X.Y.; Wang, X.M.; Han, Z.X. Agricultural trade potential between China and countries along the Belt and Road: An Empirical Analysis Based on a Heterogeneous Stochastic Frontier Gravity Model. *World Agric.* **2018**, *4*, 87–95.
51. Wang, R.; Hua, D.W. Study on China's export potential of agricultural products to countries along the Silk Road Economic Belt: An Empirical Analysis Based on Stochastic Frontier Gravity Models. *J. Agrotech. Econ.* **2016**, *10*, 116–126.
52. Cao, A.; Wang, J.J.; Huang, R.M. Estimation on the Efficiency and Potential of China Agricultural Products Export Trade along the Belt and Road. *Stat. Decis.* **2018**, *34*, 113–117.
53. Yan, X.T.; Qi, C.J. The Margins of China's Fresh Agricultural Products Exports to ASEAN Countries and It's Influencing Factors: Taking Fruit Export as an Example. *J. Stat. Inf.* **2016**, *4*, 67–73.
54. Tan, J.R.; Liu, L.; Wang, R.; Ye, T.T. China-Vietnam Agricultural Product Export Growth of Dual Marginal Analysis. *J. Agric. Econ.* **2013**, *10*, 56–63.
55. Jesus, F.; Utsav, K.; Norio, U.; Arnelyn, A. Why has China succeeded? And why it will continue to do so. *Camb. J. Econ.* **2013**, *37*, 791–818.
56. Xi, J.P. Remarks at the symposium of experts in the economic and social fields. *Shanghai J. Econ.* **2020**, *10*, 9–11.

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