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ARTICLE

The Value-Added Effect of Trade Facilitation under RCEP: Empirical Analysis of China's Tropical Fruit Imports from ASEAN

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ABSTRACT

This study explores the effect of trade facilitation under the Regional Comprehensive Economic Partnership (RCEP) on Southeast Asia's agricultural trade, focusing on China's imports of tropical fruits from ASEAN. While existing research links trade facilitation to general merchandise trade, this paper addresses the gap in perishable agricultural products by employing panel data (2014–2024) from 7 ASEAN countries. A comprehensive Trade Facilitation Index (TFI) is constructed via principal component analysis (PCA), and an extended gravity model with fixed effects is applied. Results show that a 0.1 unit increase in ASEAN's TFI raises China's tropical fruit import value by 8.23% ($p < 0.01$), confirming the hypothesis. Robustness checks, including variable replacement and sample adjustments, validate the findings. Policy implications emphasize RCEP's role in reducing non-tariff barriers, such as improving infrastructure and customs efficiency. The study contributes to the literature by quantifying the value-retention effect of facilitation on high-sensitivity goods, offering insights for ASEAN-China cooperation. Methodologically, the TFI integrates 26 indicators across four dimensions, and the model controls for GDP, distance, and exchange rates. This empirical approach enhances the understanding of trade facilitation's impact on specialized agricultural value chains.

Keywords: Trade Facilitation; Regional Comprehensive Economic Partnership (RCEP); Agricultural Trade; Gravity Model; Tropical Fruits; ASEAN-China Trade

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1. Introduction

The Regional Comprehensive Economic Partnership (RCEP) represents a significant advancement in regional economic integration, with trade facilitation serving as a core mechanism for reducing trade barriers among member countries [1]. Within this framework, agricultural trade between China and ASEAN has gained particular importance, especially in tropical fruits where ASEAN holds a comparative advantage as a major global producer [2]. China's growing demand for high-quality tropical fruits has created substantial trade opportunities, making this sector strategically important for both regions [3].

The existing literature has extensively examined the general relationship between trade facilitation and aggregate trade flows, particularly in manufacturing and merchandise trade [4]. Studies such as Wilson et al. [5], Tang and Rosland's [6] empirical analysis on China-ASEAN trade, along with Persson [7] on the extensive margin effects, have consistently highlighted the critical role of infrastructure quality, customs efficiency, and regulatory harmonization in reducing trade costs. However, research focusing specifically on agricultural trade remains limited. This gap is significant given the distinct characteristics of agricultural trade, including sensitivity to time, quality degradation, and complex supply chain requirements [8]. The theoretical mechanism linking trade facilitation to trade value often centers on transaction cost reduction, as seen in institutional analyses by Francois and Manchin [9]. Recent digitalization trends, such as those discussed in the context of Industry 4.0, further underscore the need to explore how trade facilitation enhances value retention in high-risk sectors like tropical fruits [10, 11].

Previous empirical work has primarily relied on gravity models to estimate the effects of trade facilitation on trade volumes [12]. For example, research on ASEAN-China trade has demonstrated that improvements in port efficiency and customs procedures positively impact overall trade flows [13]. Yet, these studies often overlook the nuanced mechanisms through which trade facilitation affects product-level trade value [10]. The RCEP, effective from 2022, has intensified regional integration, but its impact on agricultural value chains remains underexplored [14].

2. Theoretical Framework and Stylized Facts

The existing literature has extensively examined the general relationship between trade facilitation and aggregate trade flows, particularly in manufacturing and merchandise trade. Studies such as Wilson et al. and the OECD's trade facilitation indicators have consistently highlighted the role of infrastructure, customs efficiency, and regulatory harmonization in reducing trade costs. However, research focusing specifically on agricultural trade, remains limited. This gap is significant given the distinct characteristics of agricultural trade, including sensitivity to time, quality degradation, and complex supply chain requirements.

Previous empirical work has primarily relied on gravity models to estimate the effects of trade facilitation on trade volumes. For example, research on ASEAN-China trade has demonstrated that improvements in port efficiency and customs procedures positively impact overall trade flows. Yet, these studies often overlook the nuanced mechanisms through which trade facilitation affects product-level trade value.

The theoretical mechanism linking trade facilitation to trade in tropical fruits centers on transaction cost reduction. Trade facilitation measures directly lower the costs associated with cross-border trade, as demonstrated in studies on production networks and logistics performance [15]. For perishable goods, these reductions are especially impactful. Delays in customs clearance or inefficient logistics can lead to spoilage, quality loss, and higher insurance costs, thereby diminishing the value of shipments. Conversely, faster clearance, cold chain infrastructure, and digital tracking systems help maintain product quality and reduce waste, effectively increasing the net value of traded goods. This aligns with findings on digital trade frameworks and value chain dynamics [16].

This leads to the core hypothesis of this study:

H1. *A higher level of trade facilitation in ASEAN countries is associated with a significant increase in the value of China's tropical fruit imports from them.*

To contextualize this hypothesis, it is useful to examine recent trends in the China-ASEAN tropical fruit trade. As shown in **Figure 1**, the value of China's tropical fruit imports from ASEAN has grown substantially over the past decade, rising from USD 1.59 billion in 2014 to USD 9.18 billion in 2024. This growth coincides with the implementation of trade facilitation measures under RCEP [17].

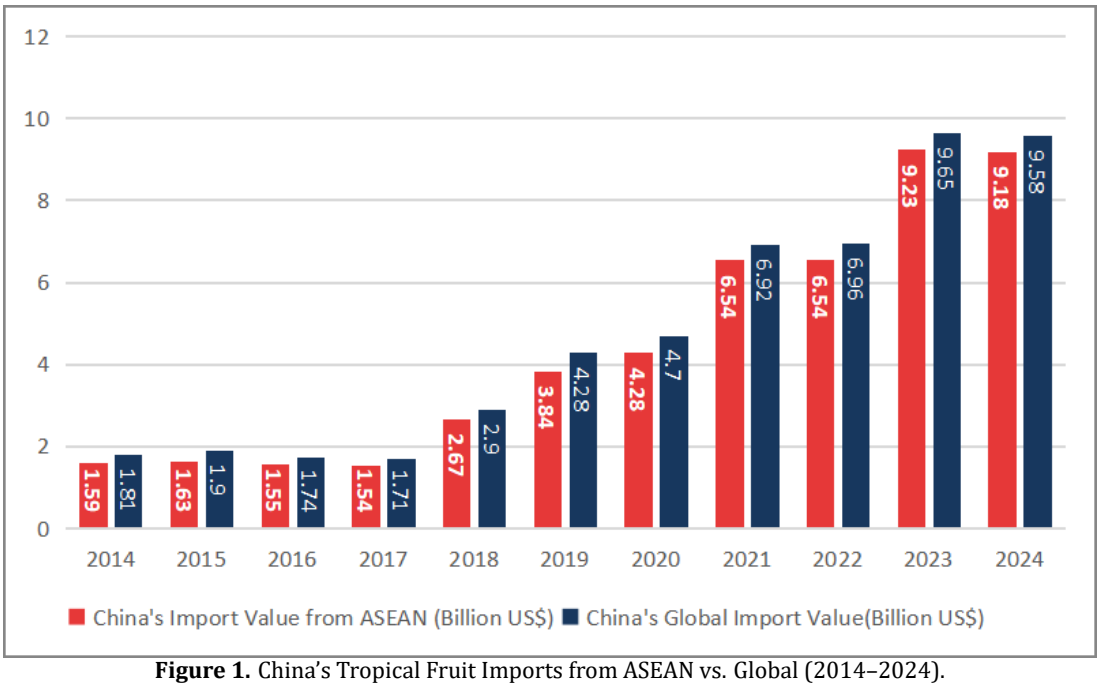

Figure 1. China's Tropical Fruit Imports from ASEAN vs. Global (2014–2024).

Source: UN Comtrade Database.

The RCEP, effective from 2022, has intensified regional integration, but its impact on agricultural value chains remains underexplored, particularly in terms of sustainability metrics [18]. Unlike prior studies focusing on aggregate trade, this research examines tropical fruits, a sector characterized by perishability and supply-chain sensitivity. As shown in **Figure 1**, China's imports from ASEAN grew steadily, underscoring the need for facilitation measures. These stylized facts align with the theoretical expectation that trade facilitation enhances value retention and market responsiveness for time-sensitive goods [19]. The following sections test this mechanism empirically using a refined trade facilitation index and a gravity model framework.

3. Methodology and Data

This section details the empirical strategy, variable construction, and data sources used to analyze the impact of trade facilitation on tropical fruit imports from ASEAN nations to China.

3.1. Measuring Trade Facilitation

This study includes 7 ASEAN countries (excluding Singapore, Myanmar, and Brunei) covering 2014–2024 [20]. We construct a comprehensive Trade Facilitation Index (TFI) to quantify the trade environment of ASEAN exporters, following methodologies used in prior trade facilitation research. The TFI integrates four key dimensions derived from World Bank (WB) and World Development Indicators (WDI) database, with weights assigned via Principal Component Analysis to ensure objectivity, as recommended in studies on indicator robustness [21]. The focus on quantifying trade facilitation is critical, as its improvement is a key mechanism through which regional agreements like the ASEAN + 5 and RCEP are shown to significantly boost agricultural exports, a finding strongly supported by recent research [22]. The PCA procedure was conducted on

the entire panel dataset to ensure consistency across years, similar to approaches in regional trade analyses [23].

The PCA procedure was conducted on the entire panel dataset to ensure consistency across years. We first standardized the 26 sub-indicators, then extracted principal components based on eigenvalues greater than 1, and finally computed the TFI scores using variance-weighted aggregation. To ensure robustness, we also conducted annual PCA checks, which yielded consistent results. This approach enhances transparency and replicability. The Principal Component Analysis methodology was rigorously applied, with both the KMO test score of 0.874 and Bartlett's test result ($p < 0.001$, rejecting the identity correlation matrix) confirming that the selected secondary indicators fully meet the applicable conditions for principal component analysis.

Weights were assigned via Principal Component Analysis, objectively determining indicator importance based on variance contribution. This approach determines indicator weights based on the variation degree in their data; higher variation implies greater informational importance and thus a higher assigned weight. The final TFI score for each ASEAN country-year ranges between 0 (low facilitation) and 1 (high facilitation). The weights have been normalized. Due to rounding, the total is slightly higher than 1 (**Table 1**).

1. Infrastructure and Logistics Efficiency
   Measures physical connectivity through 5 indicators.
   Data sourced from Global Competitiveness Report (GCR) and World Bank.

   Logistics Performance Index

2. Customs Performance
   Quantifies clearance efficiency via 4 indicators.
   Combines EFI economic freedom data with GCR border administration metrics.
3. Regulatory Environment
   Assesses institutional quality using 9 indicators.
   Integrates Transparency International corruption perceptions with judicial.

   Independence metrics

4. Finance and E-Commerce
   Merges financial system maturity and digital infrastructure using 8 indicators.
   Includes banking stability (GCR), secure servers (WB), and mobile penetration (WDI).

Table 1. TFI Structure.

Primary Dimension	Secondary Indicators	Range	Source	Weight
I. Infrastructure and Logistics	T_1: Road infrastructure quality	1–7	GCR + WCR	0.0474
	T_2: Railway infrastructure quality	1–7	GCR + WCR	0.0255
	T_3: Port infrastructure quality	1–7	GCR + WCR	0.0484
	T_4: Air transport infrastructure quality	1–7	GCR + WCR	0.0464
	T_5: Logistics performance	1–5	World Bank	0.0368
II. Customs Performance	C_1: Trade freedom	0–100	EFI	0.0482
	C_2: Prevalence of trade barriers	0–100	GCR + WCR	0.0416
	C_3: Burden of customs procedures	0–100	GCR + WCR	0.0128
	C_4: Number of import/export documents	0–100	GCR + WCR	0.0311
III. Regulatory Environment	R_1: Property rights	0–100	EFI	0.053
	R_2: Corruption perceptions index	0–100	Transparency	0.0499
	R_3: Business freedom	0–100	EFI	0.0436
	R_4: Investment freedom	0–100	EFI	0.0479
	R_5: Monetary freedom	0–100	EFI	0.0369
	R_6: Reliability of police services	1–7	GCR + WCR	0.0393
	R_7: Judicial independence	1–7	GCR + WCR	0.0373
	R_8: Intellectual property protection	1–7	GCR + WCR	0.0373
	R_9: Efficiency of legal dispute resolution	1–7	GCR + WCR	0.0403
IV. Finance and E-Commerce	F_1: Financial regulation freedom	0–100	EFI	0.0452
	F_2: Financial services maturity	1–7	GCR + WCR	0.0387

Table 1. *Cont.*

Primary Dimension	Secondary Indicators	Range	Source	Weight
IV. Finance and E-Commerce	F_3: Banking stability	1–7	GCR + WCR	0.0434
	F_4: Quality of electricity supply	1–7	GCR + WCR	0.0352
	E_1: Secure internet servers (per million people)	0–100	World Bank	0.0152
	E_2: Internet users (% population)	0–100	GCR + WCR	0.0469
	E_3: Mobile cellular subscriptions	0–100	GCR + WCR	0.0356
	E_4: Venture capital availability	1–7	GCR + WCR	0.0162

3.2. Empirical Model Specification

3.2.1. Baseline Gravity Model

To address potential endogeneity, we considered alternative specifications like a Difference-in-Differences (DID) model. However, due to the recent implementation of RCEP (2022) and limited post-treatment data, the fixed effects model was deemed more appropriate for capturing time-invariant country characteristics. The baseline gravity model for trade flows is derived from Newton's gravity theory, which posits that bilateral trade volume is proportional to the economic size of the two trading partners and inversely proportional to their geographic distance. For this study, the baseline model is specified as follows:

$$lnImport_{it} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{CNt} + \beta_3 \ln Distance_i + \varepsilon_{it}$$

Where:

$lnImport_{it}$: Value of China's tropical fruit imports from ASEAN country *i* in year *t*.

GDP_{it}: Gross Domestic Product of ASEAN country *i* in year *t*.

GDP_{CNt}: Gross Domestic Product of China in year *t*

$Distance_i$: Geographic distance between the capital city of ASEAN country *i* and Beijing, China (km).

β_0: Constant term.

ε_{it}: Random error term.

3.2.2. Extended Model with Core and Control Variables

To isolate the impact of trade facilitation and control for other confounding factors, the baseline model is extended by adding the Trade Facilitation Index (TFI) and three key control variables. The extended model is specified as:

$$lnImport_{it} = \beta_0 + \beta_1 TFI_{it} + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{CNt} + \beta_4 \ln Distance_i + \beta_5 RCEP_{it} + \beta_6 \ln Exchange_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where:

TFI_{it}: The core explanatory variable. Trade Facilitation Index of ASEAN country *i* in year *t*.

$RCEP_{it}$: Dummy variable for RCEP implementation. Capturing policy effects beyond trade facilitation.

$Exchange_{it}$: Real exchange rate of ASEAN country i against the Chinese yuan in year *t*.

μ_i: Country-fixed effects: controlling for time-invariant factors of ASEAN country *i*.

λ_t: Year-fixed effects: controlling for time-varying factors affecting all ASEAN countries.

Table 2 summarizes the definition, measurement, expected sign, and data source of each variable in the extended model, ensuring transparency and reproducibility of the empirical analysis.

3.2.3. Model Estimation Method

Given the panel data structure of 7 ASEAN countries $\times$ 11 years, this study uses panel data regression to estimate the extended model. To address potential endogeneity from time-invariant country-specific factors such as geographic location and time-varying global factors such as COVID-19 impacts, the model incorporates country-fixed effects and year-fixed effects. Before estimation, the Breusch-Pagan test and Hausman test will be conducted to confirm the suitability of fixed effects over random effects. Additionally, robust standard errors will be used to address heteroscedasticity to ensure the reliability of regression results.

Table 2. Definition and Description of Variables in the Empirical Model.

Variable Category	Variable Name	Symbol	Definition	Data Source
Dependent Variable	China's Tropical Fruit Imports	$lnImport_{it}$	Value of China's tropical fruit imports from ASEAN country *i* in year *t*	UN Comtrade Database HS0801, 0803, 080430, 080450, 081060, 200820
Core Explanatory Variable	Trade Facilitation Level	TFI_{it}	Trade Facilitation Index of ASEAN country *i* in year *t*	Based on GCR, EFI, WB data
Control Variables	ASEAN Country GDP	GDP_{it}	GDP of ASEAN country *i* in year *t* constant 2015 prices	WDI
	China's GDP	GDP_{CNt}	China's GDP in year *t*	WDI
	Geographic Distance	$Distance_i$	Distance between the capital of ASEAN country *i* and Beijing (km)	CEPII Database
	RCEP Implementation	$RCEP_{it}$	Dummy variable: 1 = implemented RCEP in year *t*; 0 = otherwise	Based on RCEP official documents
	Real Exchange Rate	$Exchange_{it}$	Real exchange rate of ASEAN country *i* vs. Chinese yuan (2015 = 100)	IFS

4. Empirical Results and Discussion

4.1. Model Suitability Tests

Before estimating the extended gravity model, two key tests were conducted to determine the appropriate panel regression specification: the Breusch-Pagan test and the Hausman test.

The Breusch-Pagan test assesses whether panel data regression is more suitable than pooled ordinary least squares (OLS) regression. The test statistic for the Breusch-Pagan test is 28.74 with a *p*-value of less than 0.001. This result rejects the null hypothesis that pooled OLS is sufficient. It confirms that individual differences exist across ASEAN countries, so panel data regression is necessary to capture these country-specific characteristics.

The Hausman test further distinguishes between fixed effects and random effects for panel regression. The test statistic for the Hausman test is 19.32 with a *p*-value of 0.007. This result rejects the null hypothesis that random effects are consistent. It indicates that time-invariant country-specific factors are correlated with the explanatory variables. Thus, the fixed effects model is adopted for the final regression to address potential endogeneity.

4.2. Baseline and Extended Regression Results

Table 3 presents the results of the baseline gravity model and the extended model. Three specifications are included to show the incremental impact of adding key variables: Model 1 is the baseline gravity model, which includes only core economic and geographic variables. Model 2 adds the core explanatory variable, namely the Trade Facilitation Index (TFI). Model 3 includes all control variables along with country-fixed effects and year-fixed effects, and serves as the final extended model.

Table 3. Regression Results of Baseline and Extended Models.

Variable	Model 1	Model 2	Model 3
Constant	−12.342*** (1.876)	−14.105*** (1.932)	−16.823*** (2.105)
$\ln GDP_{it}$	0.517*** (0.102)	0.489*** (0.098)	0.532*** (0.105)

Table 3. *Cont.*

Variable	Model 1	Model 2	Model 3
$\ln GDP_{CNt}$	0.683*** (0.115)	0.701*** (0.112)	0.725*** (0.118)
$\ln Distance_i$	−0.392** (0.158)	−0.415*** (0.151)	−0.438*** (0.149)
TFI_{it}	—	0.756*** (0.163)	0.823*** (0.171)
$RCEP_{it}$	—	—	0.215** (0.089)
$\ln Exchange_{it}$	—	—	−0.187* (0.096)
Country-fixed effects	No	No	Yes
Year-fixed effects	No	No	Yes
R-squared	0.623	0.687	0.754
Adjusted R-squared	0.601	0.665	0.721

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parentheses.

As the core focus of this study, the TFI's impact on China's tropical fruit imports is statistically and economically significant. In Model 3, the coefficient of TFI is 0.823, and it is statistically significant at the 1% level. This result directly supports Hypothesis (H1), confirming that higher trade facilitation in ASEAN correlates with greater import value of tropical fruits to China.

From an economic perspective, the coefficient of 0.823 indicates that a 0.1 unit increase in an ASEAN country's TFI corresponds to an approximate 8.23 percent rise in the value of China's tropical fruit imports from that country. This effect holds particular significance for tropical fruits due to their perishable nature. Enhancements in trade facilitation directly mitigate the core challenges associated with tropical fruit trade. Key improvements such as expedited customs procedures, enhanced cold chain infrastructure at ports, and more efficient cross-border logistics collectively reduce spoilage and quality degradation during transit. These advancements lower transaction costs for exporters and importers alike, while ensuring that a greater volume of higher-quality produce reaches consumer markets in China. Consequently, the improved stability and preserved quality underpin the increase in total import value, underscoring the pivotal role of trade facilitation in driving bilateral trade flows for tropical fruits.

Model 3's control variables function primarily to isolate the core impact of the Trade Facilitation Index (TFI) : the logarithm of ASEAN country GDP ($\ln GDP_{it}$) has a coefficient of 0.532 (significant at the 1% level), reflecting how a larger economic scale supports more mature tropical fruit production and export supply chains, thereby stabilizing export volumes to China; the logarithm of China's GDP ($\ln GDP_{it}$) has a coefficient of 0.725 (significant at the 1% level), embodying how domestic economic growth boosts residents' disposable income and drives up demand for high-quality tropical fruits, in turn increasing imports; the logarithm of geographic distance ($\ln Distance_i$) has a coefficient of −0.438 (significant at the 1% level), indicating that longer distances raise transportation time and costs, which amplify spoilage risks for perishable tropical fruits and reduce import value; the RCEP implementation variable ($RCEP_{it}$) has a coefficient of 0.215 (significant at the 5% level), representing the additional trade support from the agreement's tariff reductions and rule unification; and the logarithm of the real exchange rate ($\ln Exchange_{it}$) has a coefficient of −0.187 (significant at the 10% level), showing that an appreciation of ASEAN currencies against the Chinese yuan increases the yuan-denominated cost of tropical fruits and weakens Chinese importers' purchasing willingness. These control variable results confirm the model's rationality, and TFI remains the key driver of growth in China's tropical fruit

imports from ASEAN.

4.3. Robustness Checks

To further verify the reliability of the core conclusion Hypothesis H1, this study adds Hypothesis H2 focusing on the sensitivity of the empirical result to variable measurement and model specification. Hypothesis H2 is defined as follows:

H2. *The positive impact of ASEAN's trade facilitation on China's tropical fruit import value remains significant even when alternative measures of import scale or additional control variables are introduced.*

H2 is designed to address potential concerns about "result dependence on specific variable definitions or model settings". By testing H2, this study ensures that the core relationship between trade facilitation and import value is not accidental or distorted by research design choices.

To test H2 and ensure the core finding is not driven by arbitrary modeling decisions, three distinct robustness checks were conducted. The results of these tests are comprehensively summarized in **Table 4**.

First, the core explanatory variable was replaced to test whether the conclusion relies on the comprehensive Trade Facilitation Index (TFI). Instead of the full TFI, a single-dimensional index (*TFI_Infra*) focusing on infrastructure and logistics efficiency was used as the core variable. Regression results showed that the coefficient of *TFI_Infra* was 0.512, statistically significant at the 1% level. This indicates that even when focusing on a specific dimension of trade facilitation, its positive impact on China's tropical fruit import value remains significant, ruling out the possibility that the core conclusion is driven by the definition of the comprehensive TFI.

Table 4. Results of Robustness Tests.

Robustness Test Type	Core Explanatory Variable	Dependent Variable	TFI Coefficient	Significance Level	Sample Interval
Replace core variable	*TFI_Infra* (Infrastructure)	Import value (USD)	0.512	1%	2014–2024
Adjust sample interval	Comprehensive TFI	Import value (USD)	0.796	1%	2014–2019
Alternative dependent variable	Comprehensive TFI	Import quantity (10,000 tons)	0.689	1%	2014–2024

Second, the sample interval was adjusted to exclude potential interference from external shocks. The original sample (2014–2024) includes the COVID-19 pandemic period, which may have distorted trade flows due to lockdowns and logistics disruptions. To isolate this impact, the sample was restricted to 2014–2019 (pre-pandemic period) for reestimation. The coefficient of the comprehensive TFI in this adjusted sample was 0.796, still statistically significant at the 1% level. This result confirms that the positive relationship between trade facilitation and tropical fruit imports is not a temporary phenomenon caused by pandemic-related factors but a stable economic relationship.

Third, an alternative dependent variable was introduced to test the consistency of the conclusion across different import scale indicators. The original dependent variable, "China's tropical fruit import value from ASEAN," was replaced with "China's tropical fruit import quantity from ASEAN" (unit: 10,000 t, data from UN Comtrade Database). Re-estimation showed that the coefficient of the comprehensive TFI was 0.689, significant at the 1% level. This proves that trade facilitation not only increases the value of China's tropical fruit imports but also boosts import quantity, confirming that the core conclusion is not limited to the choice of "import value" as the dependent variable.

All three robustness tests yielded results consistent with the core finding: the positive impact of ASEAN's trade facilitation on China's tropical fruit imports remains statistically significant regardless of variable replacement, sample adjustment, or changes to the dependent variable. This fully supports H2 and ensures the re-

liability of the study's main conclusion.

5. Conclusions and Policy Implications

5.1. Conclusions

This study aims to analyze the impact of trade facilitation measures under the Regional Comprehensive Economic Partnership (RCEP) on China's imports of tropical fruits from ASEAN countries. Using panel data of 7 ASEAN countries from 2014 to 2024, it constructs a comprehensive Trade Facilitation Index (TFI) and adopts an extended gravity model with fixed effects to test the research hypotheses. The key conclusions are as follows:

First, the core hypothesis H1 is fully supported: a higher level of trade facilitation in ASEAN countries significantly promotes the growth of China's tropical fruit import value. From the results of the final extended model, the coefficient of ASEAN's TFI is 0.823 and statistically significant at the 1% level. Economically, every 0.1 increase in ASEAN's TFI leads to an approximately 8.23% increase in China's tropical fruit import value from that country. It is crucial to clarify that the term "value-added effect" in this context specifically denotes the enhancement of trade value through reductions in transaction costs, spoilage, and quality degradation achieved via trade facilitation. This conceptualization focuses on the incremental value retained within the trade flow itself, distinct from national-accounting measures like Gross Value Added (GVA) at the production origin. This finding confirms that improvements in areas such as port infrastructure, customs efficiency, and digital logistics directly address the critical challenges of time-sensitivity and perishability inherent in tropical fruit trade, thereby effectively boosting cross-border trade value.

Second, the robustness hypothesis (H2) is confirmed: the positive effect of trade facilitation remains consistent across varying empirical specifications. Three robustness tests were conducted, including replacing the core explanatory variable with a single-dimensional infrastructure index (*TFI_Infra*), adjusting the sample period to exclude the COVID-19 pandemic by using data from 2014 to 2019, and employing import quantity as an alternative dependent variable. In all cases, the coefficient of the Trade Facilitation Index (TFI) retained statistical significance at the 1% level. This consistency underscores that the identified relationship is not a statistical artifact sensitive to specific measurement choices or external shocks, thereby affirming the high reliability of the core conclusion.

Third, control variables align with basic trade logic and highlight the unique role of trade facilitation. ASEAN's GDP and China's GDP both have positive and significant impacts on import value, reflecting the roles of supply capacity and domestic demand respectively. Geographic distance has a negative impact, as longer distances increase transportation time and spoilage risks for tropical fruits. RCEP implementation provides additional policy support for trade growth, while a stronger ASEAN currency reduces import competitiveness. However, among these factors, the TFI emerges as the most influential driver of import growth. This underscores a key contribution of this study: moving beyond the established effects of traditional gravity variables to quantify the critical role of non-tariff, facilitation-oriented measures specifically for a sensitive agricultural sector.

The study acknowledges a potential limitation related to its sample size. While the use of fixed effects and robust standard errors helps mitigate concerns, and the findings are robust, a broader sample including more countries or a longer time frame could enhance the generalizability of the results in future research. Nonetheless, the findings provide compelling evidence within the ASEAN-RCEP context.

5.2. Policy Implications

Based on the empirical results, this study proposes targeted policy implications for ASEAN countries, China, and bilateral cooperation, to further promote the development of tropical fruit trade under RCEP.

5.2.1. For ASEAN Countries: Prioritize Trade Facilitation in Key Areas

ASEAN countries should prioritize enhancing the specific dimensions of the Trade Facilitation Index that most directly impact tropical fruit trade. First, infrastructure development requires urgent attention. Investments should focus on modernizing port cold chain facilities

and cross-border logistics networks to minimize spoilage during transportation. For instance, major fruit exporting countries such as Thailand, Vietnam, and Indonesia could expand cold storage capacity at key ports. Second, streamlining customs procedures is essential. Implementing digital clearance systems, including online document submission and automated inspection processes, will significantly reduce clearance times. This is particularly critical for maintaining the quality of perishable tropical fruits. Third, strengthening digital and e-commerce capabilities is vital. Expanding secure internet server coverage and promoting mobile payment systems can enhance supply chain visibility and operational efficiency. These improvements will enable exporters to respond more swiftly to dynamic market demands in China.

5.2.2. For China: Strengthen Demand Guidance and Supply Chain Cooperation

China should leverage its substantial market demand to optimize bilateral trade with ASEAN countries. First, stabilize domestic demand for tropical fruits by supporting the development of retail channels, particularly fresh food e-commerce platforms, to broaden consumer access to ASEAN tropical fruits. Simultaneously, enhance quality inspection standards to ensure product safety and consumer confidence. Second, strengthen supply chain collaboration through joint efforts with ASEAN countries to establish cross-border logistics corridors, including land-sea intermodal transportation routes. Such initiatives will help reduce intermediate costs and improve overall trade efficiency. Third, provide technical assistance by sharing expertise in cold chain management and digital logistics with ASEAN partners. This support will help enhance their trade facilitation capabilities, with special attention to the needs of less developed member states. China should strengthen demand guidance and supply chain cooperation, considering environmental impacts as highlighted in recent studies on trade-related degradation [24].

5.2.3. For China-ASEAN Bilateral Cooperation: Promote Policy Coordination and Standard Unification

Bilateral cooperation should prioritize the alignment of trade policies and standards to complement existing trade facilitation measures. First, unify tropical fruit quality standards by establishing a joint certification system for key products, particularly durians and mangos, to minimize redundant inspections and lower non-tariff barriers. Second, coordinate the implementation of RCEP with trade facilitation initiatives, leveraging provisions such as mutual recognition of customs procedures to enhance the efficiency of cross-border processes [25]. Third, establish a dedicated monitoring mechanism for tropical fruit trade that enables regular data sharing on import volumes, prices, and logistics performance to promptly address supply chain disruptions.

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Informed Consent Statement

Not applicable.

Data Availability Statement

Data derived from public resources (UN Comtrade, World Bank) is available upon request.

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Conflicts of Interest

The author declares no conflict of interest.

References

[1] Portugal-Perez, A., Wilson, J.S., 2012. Export Performance and Trade Facilitation Reform: Hard

and Soft Infrastructure. World Development. 40(7), 1295–1307. DOI: https://doi.org/10.1016/j.worlddev.2011.12.002

[2] Badarinza, C., Ramadorai, T., Shimizu, C., 2022. Gravity, counterparties, and foreign investment. Journal of Financial Economics. 145(2), 132–152. DOI: https://doi.org/10.1016/j.jfineco.2021.09.011

[3] Beverelli, C., Neumueller, S., Teh, R., 2015. Export Diversification Effects of the WTO Trade Facilitation Agreement. World Development. 76, 293–310. DOI: https://doi.org/10.1016/j.worlddev.2015.07.009

[4] Bernard, D., Blackburne, T., Thornock, J., 2020. Information flows among rivals and corporate investment. Journal of Financial Economics. 136(3), 760–779. DOI: https://doi.org/10.1016/j.jfineco.2019.11.008

[5] Wilson, J.S., Mann, C.L., Otsuki, T., 2003. Trade Facilitation and Economic Development: A New Approach to Quantifying the Impact. The World Bank Economic Review. 17(3), 367–389. DOI: https://doi.org/10.1093/wber/lhg027

[6] Tang, C., Rosland, A., 2025. Impact of logistics performance and trade facilitation on China-ASEAN trade flows. Asian Journal of Economic Modelling. 13(1), 85–96. DOI: https://doi.org/10.55493/5009.v13i1.5363

[7] Persson, M., 2013. Trade Facilitation and the Extensive Margin. The Journal of International Trade & Economic Development. 22(5), 658–693. DOI: https://doi.org/10.1080/09638199.2011.587019

[8] Hoekman, B., Nicita, A., 2011. Trade Policy, Trade Costs, and Developing Country Trade. World Development. 39(12), 2069–2079. DOI: https://doi.org/10.1016/j.worlddev.2011.05.013

[9] Francois, J., Manchin, M., 2013. Institutions, Infrastructure, and Trade. World Development. 46, 165–175. DOI: https://doi.org/10.1016/j.worlddev.2013.02.009

[10] Lee, J.Y., Kim, D., Choi, B., et al., 2023. Early Evidence on How Industry 4.0 Reshapes MNEs' Global Value Chains: The Role of Value Creation Versus Value Capturing by Headquarters and Foreign Subsidiaries. Journal of International Business Studies. 54(4), 599–630. DOI: https://doi.org/10.1057/s41267-022-00596-6

[11] Meyer, K.E., Li, J., Brouthers, K.D., et al., 2023. International Business in the Digital Age: Global Strategies in a World of National Institutions. Journal of International Business Studies. 54(4), 577–598. DOI: https://doi.org/10.1057/s41267-023-00618-x

[12] Ravishankar, G., Stack, M.M., 2014. The Gravity Model and Trade Efficiency: A Stochastic Frontier Analysis of Eastern European Countries' Potential Trade. The World Economy. 37(5), 690–704. DOI: https://doi.org/10.1111/twec.12144

[13] Cui, R., Dao, V.D., Do, K.O., 2019. Research on the Impact of Trade Facilitation on Trade Between Vietnam and Europe Empirical Analysis Based on Commercial Gravity Model. In Proceedings of the 2nd International Conference on Economy, Management and Entrepreneurship (ICOEME 2019), Voronezh, Russia, 14–15 May 2019. DOI: https://doi.org/10.2991/icoeme-19.2019.36

[14] Xiao, Y., Abula, B., 2023. Examining the Impact of Digital Economy on Agricultural Trade Efficiency in RCEP Region: A Perspective Based on Spatial Spillover Effects. Journal of the Knowledge Economy. 15(3), 9907–9934. DOI: https://doi.org/10.1007/s13132-023-01484-6

[15] Saslavsky, D., Shepherd, B., 2014. Facilitating International Production Networks: The Role of Trade Logistics. The Journal of International Trade & Economic Development. 23(7), 979–999. DOI: https://doi.org/10.1080/09638199.2013.811534

[16] Visetnoi, S., Sirisoponsilp, S., 2022. Benefit Imbalance and Market Domination in Cross-Border Fruit Value Chain: The Case of Thai Longans. In China's Belt and Road Initiative in ASEAN. World Scientific: Singapore. pp. 381–398. DOI: https://doi.org/10.1142/9789811241314_0016

[17] Ramasamy, B., Yeung, M.C.H., 2019. China's one belt one road initiative: The impact of trade facilitation versus physical infrastructure on exports. The World Economy. 42(6), 1673–1694. DOI: https://doi.org/10.1111/twec.12808

[18] Zaman, K.A.U., 2022. SDGs' Indicators for Trade Facilitation and the Regional Comprehensive Economic Partnership (RCEP) in ASEAN. In: Anbumozhi, V., Kalirajan, K., Kimura, F. (Eds.). Sustainable Development Goals and Pandemic Planning. Springer Nature: Singapore. pp. 505–541. DOI: https://doi.org/10.1007/978-981-16-6734-3_12

[19] Toševska-Trpčevska, K., Tevdovski, D., 2016. Trade Facilitation Indicators and their Potential Impact on Trade Between the Countries of South-Eastern Europe. Scientific Annals of Economics and Business. 63(3), 347–362. DOI: https://doi.org/10.1515/saeb-2016-0127

[20] Calvo Pardo, H.F., Freund, C.L., Ornelas, E., 2009. The ASEAN Free Trade Agreement: Impact on Trade Flows and External Trade Barriers. SSRN Electronic Journal. DOI: https://doi.org/10.2139/ssrn.2483814

[21] Felipe, J., Kumar, U., 2012. The Role of Trade Facilitation in Central Asia: A Gravity Model. Eastern European Economics. 50(4), 5–20. DOI: https://doi.org/10.2753/EEE0012-8775500401

[22] Akhmadi, H., Lee, J.Y., 2024. The Role of ASEAN+5

Trade Agreement in Boosting Agricultural Exports: Insights and Implications for the RCEP Agreement. Research on World Agricultural Economy. 52–70. DOI: https://doi.org/10.36956/rwae.v6i1.1371

[23] Yu, Z., Luu, B., 2022. The effects of trade facilitation on Vietnam's trade relationship with ASEAN countries. Journal of Management, Economics, and Industrial Organization. 1–15. DOI: https://doi.org/10.31039/jomeino.2022.6.3.1

[24] Huang, D., Loganathan, N., Subramaniam, Y., et al., 2025. The Impact of Trade Cooperation with China, Financial Development, FDI Flows, and Economic Growth on Environmental Degradation in ASEAN-5 Economies. International Journal of Energy Economics and Policy. 15(3), 164–175. DOI: https://doi.org/10.32479/ijeep.18671

[25] Fang, T., 2021. Analysis on Promoting the Belt and Road International Road Transport for Economic Cooperation and Trade Facilitation in China-ASEAN Area. In Proceedings of the 2021 International Conference on Public Management and Intelligent Society (PMIS), Shanghai, China, 26–28 February 2021; pp. 17–21. DOI: https://doi.org/10.1109/PMIS52742.2021.00011