

# Tariff impact and actual deviation on China's staple grain trade under RCEP: a GTAP model analysis

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**Purpose.** This study aims to evaluate the impact of Regional Comprehensive Economic Partnership (RCEP) tariff commitments on China's staple grain trade by applying the Global Trade Analysis Project (GTAP) model. In addition, it examines the deviations between model-based trade projections and actual trade outcomes to identify the main sources of inconsistency.

**Methodology.** This study applies the GTAP computable general equilibrium model to simulate the impact of tariff adjustments under RCEP. Using CEPII database indicators to update economic conditions to 2022, the study constructs multiple trade scenarios and compares the predicted results with actual trade data from 2022 to 2023 to assess the accuracy and deviations of the predictions.

**Results.** The analysis shows that tariff reductions under RCEP stimulated grain exports, especially rice, but the positive effects diminished over time, while imports of certain products, such as processed rice, declined. Model simulations predicted export growth of 1 to 5% and import decreases of 1.5 to 2%. However, a comparison with actual trade flows indicates that these effects were overstated. External factors – such as fluctuations in international grain prices, domestic production conditions, and agricultural policy adjustments – had a stronger impact, leading to deviations between the predictions and the actual outcomes.

**Originality.** This study focuses on the impact of RCEP on China's staple grain trade, comparing GTAP model predictions with actual post-RCEP trade data. It provides an empirical analysis of prediction deviations and reveals the limitations of tariff-based trade forecasts in volatile agricultural markets.

**Practical value.** The findings provide empirical evidence for policymakers, highlighting that tariffs alone have a constrained impact on actual grain trade outcomes. The results underscore the necessity of a multidimensional approach that accounts for macroeconomic volatility, environmental conditions, and policy shifts. The study advocates for a balanced approach, combining moderate tariff reductions with flexible trade strategies, to strengthen the resilience of staple grain markets.

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**Key words:** *GTAP model, tariff impact, staple grain market, rice, wheat, maize, trade deviation, export, import, liberalisation, agricultural trade.*

**JEL-Classification:** *Q17, Q18, Q19*

## **1. INTRODUCTION**

The Regional Comprehensive Economic Partnership (RCEP), which initially took effect in 2022, represents the largest free trade agreement in the world. It unites fifteen Asia-Pacific economies, collectively accounting for approximately 30% of global GDP and trade volume. Its formation is widely recognised as a milestone in regional integration, with tariff reductions expected to stimulate trade flows across member states. While much of the attention has been on the industrial and services sectors, agriculture remains one of the most sensitive and strategically important areas under RCEP, given its direct implications for food security and rural livelihoods.

Within agriculture, staple grains such as rice, wheat, and maize hold particular significance. These commodities not only sustain fundamental dietary needs but also critically influence trade balances and national strategies for food self-sufficiency. For many RCEP members, tariff adjustments on staple grains directly influence domestic price stability, farmer incomes, and the capacity to ensure reliable food supplies during times of external shocks. Consequently, examining how tariff liberalisation under RCEP reshapes staple grain trade flows offers critical insights into both regional cooperation and national policy trade-offs.

Under the RCEP framework, agricultural trade – especially in major staple crops – has been approached with considerable caution, given its direct impact on food security and domestic market stability. While the agreement broadly commits to tariff liberalisation, concessions on key grain products are often marked by gradual phase-ins, exclusions of sensitive items, and significant divergence across member economies. Some RCEP members had already implemented zero-tariff policies on major grains prior to the agreement's entry into force, whereas others maintain substantial tariff protection on sensitive commodities such as rice and wheat. This differential treatment reflects RCEP's institutional balancing act between market openness and food security imperatives, underscoring that the trade effects of grain tariff liberalisation are likely to vary considerably across countries. Consequently, a systematic analysis of shifts in major grain trade under RCEP – integrating both institutional design and actual trade data – is highly warranted.

China occupies a pivotal position in this context. As both the preeminent grain producer and one of the largest importers within the RCEP bloc, China's trade dynamics fundamentally shape the agreement's overall impact on regional agricultural markets. Tariff adjustments under RCEP are expected to boost China's grain exports, especially rice, while moderating imports of certain processed products. However, due to China's dual role as both a net importer and occasional exporter, its trade outcomes are influenced by the complex interaction between international market dynamics, domestic production capacity, and government policies. This complexity raises the question of whether tariff reductions alone can explain actual trade results.

Methodologically, computable general equilibrium (CGE) frameworks are commonly used to estimate the impact of tariffs on trade. These models provide a structured way to predict how liberalisation may alter trade flows across commodities and regions. However, due to factors such as phased tariff reductions, persistent non-tariff barriers, and global shocks like price volatility or supply disruptions, discrepancies often arise between model predictions and actual outcomes. As a result, researchers are increasingly interested in assessing how well model-based predictions align with actual trade patterns after trade agreements are implemented.

This study aims to assess the long-term impact of the Regional Comprehensive Economic Partnership on China's staple grain imports and exports, using a dynamic recursive model for predictive analysis. By constructing the model, the study forecasts the potential impact of tariff reductions on staple grain trade under the RCEP agreement. These projections are subsequently compared with empirical trade data from 2022 and 2023. By comparing the model's predicted import and export volumes with actual trade data, the study will evaluate the real impact after the implementation of the RCEP agreement and validate the accuracy of the model's predictions.

## **2. LITERATURE REVIEW**

### **2.1. Impact of tariff and NTMs reductions on trade flows**

Theoretically, tariffs, as a significant component of trade costs, have been systematically discussed in the context of customs union theory and the comparative advantage framework regarding their impact on trade flows. Viner (2014) introduced the concepts of trade creation and trade diversion effects, which laid the foundation for analysing the welfare and trade impacts of tariff reductions under regional trade agreements. Subsequently, the product differentiation hypothesis introduced by Armington (1969) became a key theoretical support for subsequent CGE models and the Global Trade Analysis Project (GTAP) framework, providing a standardised analytical tool for depicting the impact of tariff changes on trade flows.

Tariff reductions are widely recognised as a cornerstone of regional trade agreements, serving as the most direct means for facilitating cross-border flows of goods. Theoretically, tariffs increase the landed cost of imported goods, reduce competitiveness, and distort consumption and production decisions. Lowering tariffs reduces these distortions, aligning domestic price signals more closely with global market conditions, thereby encouraging exports and expanding imports where comparative advantage exists.

Model-based assessments further support this theoretical perspective. For example, CGE simulations demonstrate that RCEP tariff reductions could increase exports among member states by 1–5%, while imports are projected to decline slightly as domestic production regains competitiveness. Similarly, studies have shown that tariff liberalisation under RCEP brings dynamic trade and welfare gains across member states (Shan & Yan, 2025). These results confirm that tariff reductions generally stimulate agricultural trade, although the magnitude of impact varies across products and countries.

However, staple grains such as rice, wheat, and maize represent a special case. Unlike other agricultural commodities, staple grains are often classified as sensitive products due to their importance for food security and rural stability. Consequently, many RCEP members, including China, negotiated tariff retention clauses, extended transition periods, or safeguard mechanisms that delay or limit the full liberalisation of staple grain trade (Mockshell & Birner, 2015). This explains why, despite liberalisation in principle, the observed effects on staple grain trade tend to be weaker and slower to materialise compared to other agricultural sectors.

While tariff reductions theoretically lower trade costs and improve market access, the actual effects on staple grain trade depend heavily on broader structural and institutional conditions. Unlike more liberalised agricultural sectors, where tariff cuts quickly translate into expanded trade, staple grains remain subject to constraints such as domestic policy protections, production priorities, and infrastructural limitations. These factors often delay or weaken the translation of tariff concessions into measurable trade gains, suggesting that tariff liberalisation, while necessary, is not sufficient to fully explain observed trade patterns.

Research on grain trade potential among Belt and Road countries highlighted that tariff reductions alone are insufficient to unlock full trade flows (Miao et al., 2024). The findings demonstrate that economic development, transportation infrastructure, and governance capacity critically shape the extent to which countries can capitalise on tariff incentives. This suggests that even when tariffs on staple grains such as wheat, maize, and rice are lowered, supportive domestic factors are necessary to ensure effective trade expansion.

Evidence from RCEP countries further supports this dynamic. Analyses of the spatial trade network of agricultural products found that staple grains constitute the backbone of intra-RCEP exchanges (Pan et al., 2024). Major exporters such as Thailand, Vietnam, and Australia gained central positions in the network, benefiting from tariff preferences. At the same time, the study emphasised that trade efficiency is highly sensitive to non-tariff barriers, including logistics bottlenecks and market connectivity, which limit the full effect of tariff concessions.

Beyond Asia, agricultural trade liberalisation under the Uruguay and Doha rounds in Latin America showed that tariff reductions significantly boosted maize and wheat trade flows, yet the benefits were disproportionately realised by countries with established production capacity and favourable market access (Castellano-Álvarez & Ramírez, 2022). This uneven distribution highlights a global pattern: while tariff cuts can stimulate grain trade, actual outcomes are conditioned by competitiveness and trade infrastructure.

These studies suggest that while tariff reductions under agreements like RCEP provide predictable incentives for trade expansion, actual flows of staple grains are mediated by structural, policy, and institutional factors. For China, this means that tariff concessions may create opportunities for modest export growth and reduced import costs, but the realised effects are likely to deviate from model predictions due to persistent non-tariff barriers and shifts in domestic production.

This phenomenon is highly consistent with the “stability first” principle emphasised in food security theory. Relevant studies suggest that staple grain trade policies often need to strike a balance between improving trade efficiency and ensuring food security (Timmer, 2000; Anderson, 2010).

## **2.2. Empirical study on the impact of RCEP on China’s agricultural trade**

China is the largest agricultural producer and consumer in the world, with a vast agricultural market that spans a wide range of products. As a result, agricultural trade has always attracted significant attention. Other RCEP member countries have increasingly become important sources of agricultural imports for China, and the integration of trade and investment has significantly advanced. This has made China’s agricultural import and export pattern under the framework of RCEP a focal point.

After the implementation of RCEP, China’s agricultural export efficiency to RCEP member countries has generally improved significantly. However, there are still considerable differences in export efficiency across different countries and product categories. Specifically, the trade potential of countries that implemented RCEP later remains underexplored. Although the overall trade efficiency of agricultural products shows positive growth, more than half of the countries still scored below 0.5 in efficiency in 2022, indicating significant efficiency losses and untapped trade potential (Jiao et al., 2025).

The preferential terms of RCEP have provided significant incentives for China’s agricultural exports. Studies using the stochastic frontier gravity model show that tariff structure, government efficiency, and political stability are key factors affecting export performance, while complementary trade potential has gradually declined (Shi et al., 2025). Using the H-K measurement method to conduct a three-dimensional marginal decomposition of China’s agricultural export growth to other RCEP member countries, research has shown that, at the overall level, price-driven intensive margin expansion is the primary path for China’s agricultural export growth to RCEP countries. The export growth of horticultural crops and aquatic products is mainly driven by both price and quantity increases, while the export growth of agricultural by-products, oil crops, and livestock products primarily relies on price-driven factors (Tong et al., 2023).

The dynamic GTAP model has been applied to assess the economic effects in the 5th, 10th, and 20th years after the implementation of RCEP. Results indicate that the import expansion caused by lower agricultural trade costs could effectively ease the supply pressure in China’s important agricultural markets. The demand for imports of meat, dairy products, and fruits is much higher than that for staple grains, which promotes the upgrading of China’s food consumption (Huang & Li, 2024).

Although China is a major agricultural country, there are still gaps between Chinese agricultural products and those from developed countries in terms of quality, processing levels, and added value, resulting in a significant agricultural trade deficit. Empirical evidence based on agricultural trade data between China and the five major developed economies of RCEP from 2007 to 2021 shows that China’s trade deficit mainly stems from imbalances in trade with Australia and New Zealand, particularly in the import of plant products and animal and vegetable oils (Du et al., 2024).

In terms of research methods, scholars primarily use Stochastic Frontier Analysis (SFA) to measure trade potential and the GTAP model to evaluate tariff shocks. The trade potential model is used to assess potential trade flows between countries, while the GTAP model is a multi-regional, multi-sector model used to quantitatively analyse the impact of policy adjustments. The difference between the equilibrium before and after policy adjustments represents the “shock” impact. The GTAP model is widely used in trade measurement. For example, studies have examined the trade welfare impact of the China-Japan-Korea Free Trade Area (Zeng et al., 2024) and the tariff impact of the CPTPP (Jung, 2023).

Based on the above empirical research results, RCEP has had a positive impact on China’s agricultural trade, but the scale of its impact varies across different products. Currently, there is limited research on staple grains, and the detailed analysis of staple grain categories is insufficient, resulting in a lack of adequate attention to the comprehensive understanding and accurate forecasting of staple grain trade.

### **2.3. Actual deviation in trade predictions**

Since the CGE model has been widely used in trade policy assessment, the discrepancy between its predictions and actual outcomes has continued to attract academic attention. Hertel (1996) and Devarajan & Robinson (2005) pointed out that although the CGE model has advantages in depicting the direction of tariff shocks, its predictions often exhibit systematic bias when faced with non-tariff shocks and structural changes.

In simulating the impacts of trade agreements, CGE models and GTAP models are widely used and generally succeed in capturing the direction of trade changes driven by tariff adjustments. However, the predictions of these models often diverge from actual trade flows, exposing the limitations of ex-ante modelling in dynamic and uncertain agricultural markets. Studies indicate that these deviations stem primarily from external shocks, non-tariff barriers, and domestic policy interventions.

For example, studies on the EU – Japan Free Trade Agreement found that while CGE models predicted broad trade growth, the actual outcomes were uneven. The models often underestimated the impact of extensive margin adjustments, such as new products entering trade, leading to deviations between predicted and realised trade flows. This reveals that structural adjustments in trade composition were overlooked in the model forecasts, distorting ex-ante projections (Berndt & Hess, 2024).

Similarly, the GTAP model has been applied to assess the impact of tariff reductions under RCEP on China’s agricultural trade. Although the model projected positive export growth and moderate import declines, real-world deviations were largely due to external factors such as global price volatility and domestic policy changes. This highlights a long-standing issue in CGE-based forecasts: while they can isolate the direct effects of tariffs, they often overstate their magnitude when broader macroeconomic variables are not fully accounted for (Wei et al., 2025).

Other research also showed that the aggregate welfare and trade gains under RCEP were smaller in practice than simulations suggested, particularly for agricultural products. Persistent non-tariff measures and asymmetric liberalisation schedules

limited the translation of tariff cuts into actual trade flows (Estrades et al., 2023). Similar findings were reported in ASEAN, where agricultural liberalisation contributed to productivity growth, but spillover effects on trade were more muted than projected (Trakem et al., 2024).

Taken together, these studies reveal that although GTAP and CGE models can effectively capture the direction of tariff-driven trade changes, actual trade outcomes often diverge from predictions due to non-tariff barriers, market shocks, and domestic policy responses. For China's staple grain trade under RCEP, this implies that while tariff reductions provide a predictable framework for trade shifts, actual trade flows will often diverge from model forecasts in both scale and timing. Given the ubiquity of these deviations, further research into the specific causes of these discrepancies is essential for more accurately assessing the impact of the RCEP agreement.

Although existing studies have widely used CGE models to analyse the tariff effects of regional trade agreements on agricultural trade, there are still several significant gaps in the research.

First, existing studies often rely on model scenario simulations, with relatively limited comparative analysis of actual trade data after the implementation of regional trade agreements. This has resulted in insufficient exploration of the sources of deviation between model predictions and actual trade performance (Hertel, 1996).

Second, the existing literature lacks a systematic review of the tariff commitments among RCEP member countries in key grain sectors. Most studies focus on overall agriculture or non-staple grain products, which limits a deeper understanding of the asymmetry in trade adjustment processes.

Third, although non-tariff factors such as climate shocks, global price fluctuations, and domestic policy interventions have received some attention in the relevant studies and have been measured in certain papers, given the difficulty of precisely quantifying these non-tariff factors within the standard GTAP framework, there is still a lack of systematic verification studies on their role in explaining the deviation between model predictions based solely on tariff changes and the actual trade performance of major grains after RCEP implementation (Hertel, 1996).

Based on the above literature review and analysis of research gaps, this paper focuses on the adjustment mechanisms of China's major grain trade under the RCEP framework and aims to answer the following research questions:

RQ1: What are the differences in tariff reduction commitments among RCEP member countries in the key grain sectors? What different characteristics are observed in the actual changes of China's major grain trade after RCEP implementation?

RQ2: To what extent can the GTAP model scenario simulations, based solely on tariff changes, accurately reflect the actual changes in China's major grain trade after RCEP implementation?

RQ3: How do non-tariff factors such as climate shocks, global price fluctuations, and domestic policy interventions help explain the deviation between the tariff scenario simulation results and the actual performance of major grain trade?

Based on these research questions, the paper further proposes the following

hypotheses:

H1: Due to differences in the market openness of RCEP member countries, tariff reduction commitments have a significant heterogeneous impact on China's major grain trade.

H2: Models relying on tariff and non-tariff changes for predictions may have certain discrepancies with actual trade outcomes, potentially either overestimating or underestimating the impact of RCEP on major grain trade.

### **3. METHODOLOGY**

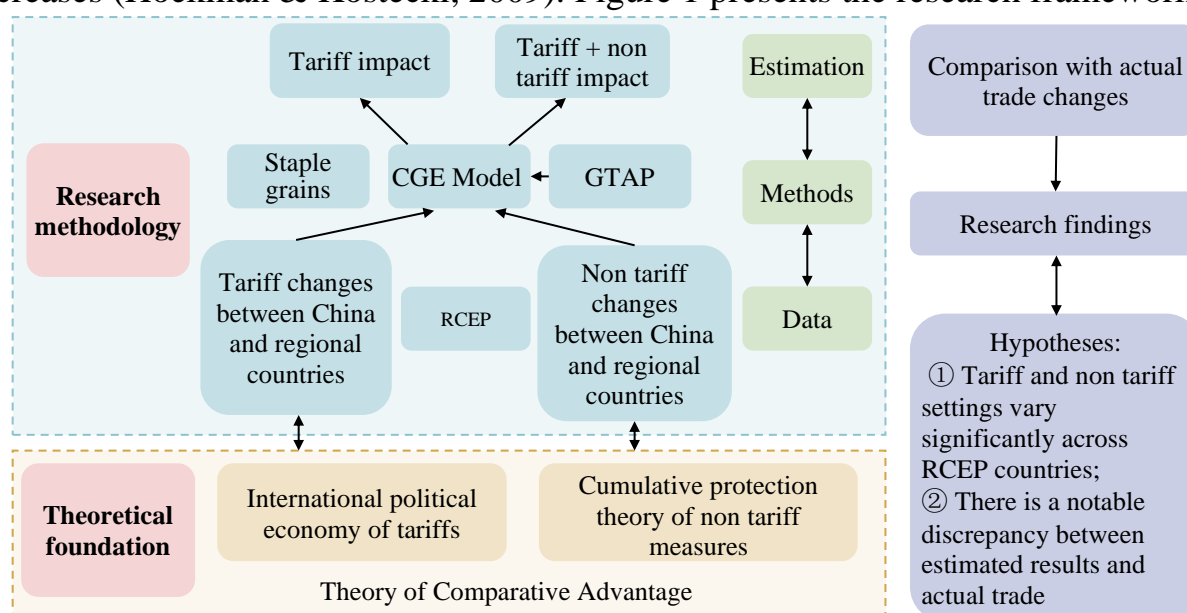
#### **3.1. Theoretical foundations of the analytical framework**

From the perspective of comparative advantage theory, the core purpose of tariff policies is to encourage countries to specialise in producing and exporting goods in which they have a relative efficiency advantage, while importing goods that are more efficiently produced by other countries, thereby achieving the optimal allocation of international resources. In theory, as tariff barriers decrease, trade between countries should become freer, promoting labour division and resource allocation efficiency. However, in practice, even when tariffs are reduced, other domestic interventions may continue to distort price signals and restrict the flow of cross-border resources, hindering the realisation of comparative advantages (Timmer, 2000). Regional trade agreements, by reducing tariff barriers, provide institutional conditions for achieving comparative advantages, making trade among member countries closer to the optimal division of labour as described in theory. Therefore, under the RCEP framework, tariff reductions are not independent of the comparative advantage theory but are an important policy pathway that promotes the realisation of comparative advantages and facilitates resource reallocation, particularly in areas like agricultural products, which are highly sensitive to price signals (Anderson, 2009).

The actual formulation of tariff policies is deeply influenced by the perspective of international political economy. Within this theoretical framework, tariff policies are not solely based on economic rationality, but are often strongly influenced by domestic political forces and interest groups (Besley & Case, 1994). Specifically, agricultural interest groups play a crucial role in pushing the government to implement higher tariff protections on domestic agricultural products (such as rice, wheat, etc.) to safeguard the interests of domestic farmers and market stability. On the other hand, industrial sectors and consumer interest groups tend to advocate for tariff reductions, especially in industrial goods or consumer goods, aiming to lower production costs, enhance production efficiency, and improve consumer welfare (Krugman, 2009). This domestic political competition results in differentiated tariff policies, where countries, in the face of global market pressures, must balance economic benefits with the need for political and social stability (Anderson, 2009).

With the deepening of globalisation, non-tariff barriers (NTBs) have gradually replaced tariff barriers, becoming the main tool for countries to implement trade protectionism. Cumulative protectionism theory suggests that as tariff barriers decrease, countries increasingly turn to non-tariff barriers, such as technical standards,

health and safety regulations, and environmental protection measures, to restrict the entry of external goods (Hoekman & Kostecki, 2009). These non-tariff measures typically provide protection similar to tariffs by increasing compliance costs and exacerbating market uncertainty. Governments, by setting stricter safety standards and environmental requirements, ostensibly aim to protect consumer health and environmental safety, but in practice, these measures often also protect domestic industries, particularly agricultural production, reducing external competition (Howse et al., 2005). In this way, countries can protect specific industries through these hidden barriers without directly raising tariffs, while avoiding international opposition to tariff increases (Hoekman & Kostecki, 2009). Figure 1 presents the research framework.



**Figure 1. Research framework**

Source: authors' elaboration.

### 3.2. Data collection and organisation

To predict the impact of the RCEP agreement on China's grain imports and exports and compare the predicted results with actual data, this study focuses on collecting and organising three key types of data.

The first type of data involves grain import and export statistics, specifically regarding key grain products such as wheat, rice, corn, and soybeans between China and other RCEP member countries. This data are primarily sourced from the UNComtrade database and serve as the basis for comparing the model's predictions with actual trade data.

The second type of data consists of RCEP tariff data. This includes an in-depth analysis of the agreement's key provisions, with particular attention to the annual reduction of tariffs on grains within the RCEP region. Such data is essential for evaluating the potential effects of the RCEP agreement on China's grain trade.

The third category is macroeconomic data, which includes variables such as GDP, capital, population, unskilled labour, and skilled labour. These variables are used as critical inputs in the dynamic recursive model. Updating these variables ensures that the model accurately reflects the long-term economic changes resulting from the

implementation of the RCEP agreement (Aguiar et al., 2019). For example, GDP updates captures the economic growth influenced by the agreement, while changes in capital provide insights into cross-border investment flows. Additionally, population and labour force updates provide an understanding of the labour market's impact on production and consumption. These macroeconomic data are primarily sourced from the CEPII database and provide the necessary foundation for the analysis.

### **3.3. Model construction**

To quantify the theoretical relationships described above, this study employs a CGE model, specifically the GTAP model, to systematically simulate the impact of tariffs and non-tariff barriers. The CGE model, by incorporating comparative advantage, substitution elasticity, and economy-wide linkage effects, can simulate the adjustments in trade flows resulting from tariff changes (Hertel, 1996). This model is an important tool for quantifying the theoretical framework of trade policy and resource allocation, enabling the assessment of the specific impacts of policy changes on the economies and trade flows of different countries.

This study utilises a CGE model to simulate and analyse the impact of global trade, production, consumption, and policy changes. The GTAP database provides the essential data support for this model and is widely used for trade policy analysis, global economic assessment, and the response to changes in various policies, such as tariffs, subsidies, and market access.

In the CGE model, tariffs are treated as a trade barrier parameter to simulate the impact of tariff policies on international trade flows, prices, production, and consumption (Flach et al., 2021). By adjusting tariff levels, the model can analyse how tariff policies affect trade flows between countries. Specifically, the application of tariff predictions in the CGE model involves modifying tariff parameters and observing the changes in economic variables such as import/export volumes, prices, and GDP (Banga et al., 2021).

Within the CGE framework, the mechanisms of trade flows and their response to tariff changes are reflected through adjustments in domestic production and consumption. Trade flows are typically represented by a trade cost function or tariff function, which captures the impact of tariff policies on economic activities, market responses, and trade volumes. This mechanism enables the CGE model to effectively simulate the effects of tariff changes on production, consumption, and price formation in various regions, thus revealing the comprehensive impact on the global economy (Zhu & Huang, 2023).

Assume that  $T_{ij}$  represents the trade flow from region  $i$  to region  $j$ , and the tariff rate is  $t_{ij}$ . The trade flow can be expressed by the following formula:

$$T_{ij} = (P_i \cdot X_i \cdot (1 - t_{ij})), \quad (1)$$

where  $P_i$  is the price of goods in region  $i$ ,  $X_i$  is the export volume of region  $i$ ,  $t_{ij}$  is the tariff rate from region  $i$  to region  $j$ .

In this model, the impact of non-tariff measures (NTMs) can be further considered. By introducing the NTM impact coefficient  $\alpha_{ij}$ , the effect of NTMs on

trade flows can be expressed as:

$$T_{ij} = (P_i \cdot X_i \cdot (1 - t_{ij})(1 - \alpha_{ij})), \quad (2)$$

where  $\alpha_{ij}$  is the impact coefficient of non-tariff barriers, reflecting the effect of factors other than tariffs, such as quotas, technical barriers, etc., on trade flows.

To study the trade flows of staple grains in China, this research selects relevant industries from the GTAP database. The GTAP database contains a total of 57 sectors and the categories of staple grains are (1) paddy rice, (2) wheat, (3) cereal grains (nec), and (4) processed rice. Based on the GTAP agricultural product classification, this study observes the correspondence between staple grain categories and the GTAP agricultural product classification (Table 1).

*Table 1*

**Key observations in China's staple grain trade**

Indicator		Sector classification	HS Corresponding encoding	Representative products
Import	1	Paddy rice	1006 paddy and rice	100610 paddy
	2	Wheat	1001 wheat and mixed wheat	1001 wheat and mixed wheat
	3	Cereal grains (nec*)	1002 rye; 1003 barley; 1004 oats; 1005 corn	1005 corn
	4	Processed rice	1006 paddy and rice	100630 processed rice
Export	1	Paddy rice	1006 paddy and rice	100620 brown rice
	2	Wheat	1001 wheat and mixed wheat	not exported
	3	Cereal grains	1002 rye; 1003 barley; 1004 oats	1005 corn
	4	Processed rice	1006 paddy and rice	100630 processed rice

*Note.* \*Here and below, it refers to cereal grains not classified in other specific categories.

*Source:* based on GTAP database and UNComtrade database.

According to the types of staple grains in China, the representative products selected for import and export trade are those with significant proportions. Overall, rice, wheat, and corn are the key products that dominate China's staple grain trade. Since the RCEP agreement was implemented starting in 2021, the forecast begins in 2022, covering the early-stage trade changes after the implementation of the agreement.

**3.4. Dynamic recursion of economic factors**

This study uses the GTAP 10th edition database, which covers data from 141 countries and regions and 65 economic sectors. However, since the database is based on 2014 data, to ensure that the model accurately reflects the economic changes following the implementation of the RCEP agreement, key macroeconomic variables such as GDP, capital, population, and labour are continuously updated using a dynamic recursion method. Through this method, GDP, population, real capital stock, skilled labour, and unskilled labour are updated to 2022, providing a more precise simulation of the long-term effects of the RCEP agreement's implementation (Yang & Kumarasinghe, 2024).

The dynamic recursion process in the model updates each economic variable

through a recursive formula. Specifically, the update of the economic variable for each period is defined as:

$$X_{\{t+1\}} = f(X_t, \theta_t), \quad (3)$$

where  $X_t$  represents the economic variable at time  $t$ ,  $f$  is the function used in the model to predict changes in the variable, and  $\theta_t$  represents parameters reflecting external factors such as tariff changes and market access policies. Through recursive calculations, the model updates these variables at each time step, simulating the long-term impact of policy adjustments on China's staple grain imports and exports.

The average growth rate of each factor indicator is shown in Table 2.

*Table 2*

**Average growth rate of various indicators from 2014 to 2022**

Country	GDP (qgdp), %	Real capital stock (capital), %	Population (pop), %	Unskilled labour (unsklab), %	Skilled labour use (sklab), %
China	53.53	74.62	3.20	5.15	27.49
Vietnam	49.58	54.27	7.04	11.33	11.87
Indonesia	38.80	47.32	8.32	25.04	21.59
Brunei	-5.48	11.87	0.12	-1.50	3.90
Cambodia	51.83	69.20	10.95	42.52	57.08
Thailand	26.23	24.87	2.21	13.86	9.82
Laos	54.43	65.06	11.14	33.75	43.97
The Philippines	50.48	45.94	10.48	16.57	22.21
Malaysia	32.93	36.39	9.74	19.72	38.06
Singapore	19.98	33.24	6.72	11.09	19.67
Myanmar	52.97	71.47	4.83	24.29	27.46
Japan	8.86	7.00	-1.65	4.42	15.76
The Republic of Korea	17.72	30.82	1.38	7.49	20.13
Australia	18.67	21.48	9.29	11.59	18.14
New Zealand	21.08	22.95	6.42	7.03	17.50
Other	17.69	22.27	10.81	16.42	14.84

*Source:* CEPII database (n.d.).

In order to focus on testing the effect of the RCEP, all the countries in the GTAP are divided into 16 groups, specifically classified as China, Japan, the Republic of Korea, Australia, New Zealand, Vietnam, Indonesia, Brunei, Cambodia, Thailand, Laos, the Philippines, Malaysia, Singapore, Myanmar and other countries in the world. The research objects are paddy rice, wheat, cereal grains, and processed rice.

### 3.5. Comparison of model predictions and actual data

This study compares the GTAP model's predicted trade volumes of China's major staple grains for 2022 and 2023 with the annual import and export statistics published by UNComtrade. By comparing the predicted values with the actual data, the study aims to assess the prediction accuracy of the GTAP model and adjust expectations based on actual data, in order to evaluate the model's applicability and reliability in capturing trade changes during the early stages of the RCEP agreement implementation.

## 4. RESULTS

### 4.1. The four characteristics of RCEP's staple grain tariffs

According to the commitment table of RCEP, the key focus is on the first, fifth, tenth, fifteenth, and twentieth years as different scenarios. The annual tariffs on staple grains during these specific years are shown in Table 3.

Table 3

**Scenario settings tariffs on staple grains**

Country	Serial number	Pre-tariff, %	1 Year, %	5 Years, %	10 Years, %	15 Years, %	20 Years, %
1	2	3	4	5	6	7	8
China	Paddy rice	65	65	65	65	65	65
	Wheat	65	65	65	65	65	65
	Cereal grains (nec)	65	65	65	65	65	65
	Processed rice	65	65	65	65	65	65
Japan	Paddy rice	180	180	180	180	180	180
	Wheat	180	180	180	180	180	180
	Cereal grains (nec)	180	180	180	180	180	180
	Processed rice	180	180	180	180	180	180
Australia	Paddy rice	0	0	0	0	0	0
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	0	0	0	0	0	0
	Processed rice	0	0	0	0	0	0
The Republic of Korea	Paddy rice	180	180	180	180	180	180
	Wheat	3	0	0	0	0	0
	Cereal grains (nec)	630	630	630	630	630	630
	Processed rice	180	180	180	180	180	180
New Zealand	Paddy rice	0	0	0	0	0	0
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	0	0	0	0	0	0
	Processed rice	0	0	0	0	0	0
Brunei	Paddy rice	0	0	0	0	0	0
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	0	0	0	0	0	0
	Processed rice	0	0	0	0	0	0
Cambodia	Paddy rice	7	7	6	4	0	0
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	7	7	5	4	0	0
	Processed rice	7	7	6	4	0	0
Indonesia	Paddy rice	7	7	6	4	0	0
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	7	7	6	4	0	0
	Processed rice	7	7	6	4	0	0
Laos	Paddy rice	5	5	5	5	5	5
	Wheat	5	0	0	0	0	0
	Cereal grains (nec)	5	5	5	5	5	0
	Processed rice	5	5	5	5	5	5

*Continuation of the Table 1*

1	2	3	4	5	6	7	8
Malaysia	Paddy rice	40	40	40	40	40	40
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	0	0	0	0	0	0
	Processed rice	40	40	40	40	40	40
Myanmar	Paddy rice	5	5	5	5	5	5
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	0	0	0	0	0	0
	Processed rice	5	5	5	5	5	5
The Philippines	Paddy rice	180	180	180	180	180	180
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	7	0	0	0	0	0
	Processed rice	180	180	180	180	180	180
Singapore	Paddy rice	0	0	0	0	0	0
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	0	0	0	0	0	0
	Processed rice	0	0	0	0	0	0
Thailand	Paddy rice	180	180	180	180	180	180
	Wheat	0	0	0	0	0	0
	Cereal grains (nec)	16	0	0	0	0	0
	Processed rice	180	180	180	180	180	180
Vietnam	Paddy rice	40	40	40	40	40	40
	Wheat	5	0	0	0	0	0
	Cereal grains (nec)	0	0	0	0	0	0
	Processed rice	180	180	180	180	180	180

*Source:* according to the RCEP China tariff commitment table.

The tariff structure under RCEP demonstrates significant variation across countries and staple grain categories, reflecting differentiated commitments and protection strategies. Countries like China, Japan, the Philippines, Thailand, and the Republic of Korea maintain extremely high tariffs on paddy rice and processed rice – up to 180% – indicating strong domestic protection for these sensitive commodities (Table 4). In contrast, countries such as Australia, New Zealand, Brunei, and Singapore have zero tariffs across all staple grains, signalling open market policies and comparative advantage in production. For wheat and other cereal grains, tariffs vary more widely: the Republic of Korea applies a low or zero tariff for wheat but maintains high rates for “cereal grains (nec),” while countries like Cambodia, Indonesia, and Laos gradually reduce tariffs over 20 years, reflecting phased liberalisation. Malaysia and Vietnam show mixed strategies, maintaining high tariffs on paddy rice and processed rice but liberalising other grains. The changes on tariff of the representative staple grains are showed in Table 4.

The RCEP tariff schedule for staple grains demonstrates a highly complex and differentiated approach among member countries, reflecting their diverse domestic priorities, agricultural capacities, and trade strategies. The agreement’s implementation reveals clear patterns of tariff maintenance, gradual reduction, and selective liberalisation, highlighting the delicate balance that member countries seek between

protecting domestic agriculture and promoting regional trade integration.

*Table 4*

**Changes in tariffs on staple grains**

Category	Country	Indicator	Paddy rice	Wheat	Cereal grains (nec)	Processed rice	
No change in tariffs	China	pre-tariff	65%	65%	65%	65%	
		post-tariff	U	U	U	U	
	Australia	pre-tariff	0	0	0	0	
		post-tariff	0	0	0	0	
	New Zealand	pre-tariff	0	0	0	0	
		post-tariff	0	0	0	0	
	Brunei	pre-tariff	0	0	0	0	
		post-tariff	0	0	0	0	
	Singapore	pre-tariff	0	0	0	0	
		post-tariff	0	0	0	0	
	Tariff changes record small	Japan	pre-tariff	180%	180%	180%	180%
			post-tariff	U	U	U	U
The Republic of Korea		pre-tariff	180%	3%	630%	180%	
		post-tariff	U	0 tax regardless	U	U	
Tariff changes are clear	Malaysia	pre-tariff	40%	0%	0%	40%	
		post-tariff	U	0 tax regardless	0 tax regardless	U	
	Myanmar	pre-tariff		0	0	5%	
		post-tariff	U	0 tax regardless	0 tax regardless	U	
	Laos	pre-tariff	5%	5%	5%	5%	
		post-tariff	U	0 tax regardless	0 tax in 20 years from the 15th year	U	
	Cambodia	pre-tariff	7%	0	7%	7%	
		post-tariff	0 tax in 15 years	0 tax regardless	0 tax in 15 years	0 tax in 15 years	
	Indonesia	pre-tariff	7%	0	7%	7%	
		post-tariff	0 tax in 15 years	0 tax regardless	0 tax in 15 years	0 tax in 15 years	
	Thailand	pre-tariff	180%	0	16%	180%	
		post-tariff	U	0 tax regardless	0 tax regardless	U	
	Vietnam	pre-tariff	40%	5%	0	180%	
		post-tariff	U	0 tax regardless	Zero tariff	U	
	Philippines	pre-tariff	IN	0	7%	180%	
		post-tariff	U	Zero tariff	0 tax regardless	U	

*Source:* according to the RCEP tariff table.

From the perspective of international political economy, the shaping of such tariff policies is influenced not only by economic calculations but also by the power

dynamics and domestic political forces within each member country. The heterogeneity of these policies is rooted in both economic and strategic considerations, as countries aim to safeguard food security, maintain farmer livelihoods, and strengthen their competitive positions in the regional agricultural market.

China, as one of the largest agricultural economies in the region, maintains a relatively high and uniform tariff of 65% on key staple grains, including paddy rice, wheat, and other cereal grains. This reflects a deliberate domestic protection strategy, emphasising food security and the stability of domestic agricultural production. This protectionist stance is closely tied to the political pressures exerted by agricultural interest groups, which seek to maintain domestic production and safeguard the livelihoods of farmers. The stable tariff structure under RCEP commitments indicates China's cautious approach to liberalising trade for its major staples. Nevertheless, China has implemented selective liberalisation measures, reducing tariffs on low-volume grains such as barley and sorghum from 2–3% to zero. This strategic adjustment serves multiple objectives: it diversifies the domestic grain supply, ensures the availability of higher-quality or alternative grain varieties, and meets evolving consumer preferences, all while preserving the domestic market for core staple crops. Such a calibrated strategy demonstrates China's ability to balance protectionism with targeted market liberalisation, reflecting careful consideration of both domestic and international trade dynamics.

Countries such as Australia, New Zealand, Brunei, and Singapore exhibit no change in tariffs for staple grains, as they had already implemented zero tariffs prior to RCEP. This reflects a different set of priorities and economic realities. Australia and New Zealand, leveraging economies of scale and advanced agricultural technology, maintain strong productivity and competitive advantages in the global agricultural market. In these countries, the political will to maintain open markets and support competitive export sectors is influenced by the alignment between domestic industries and global trade interests. By implementing zero-tariff policies, they enhance their competitiveness in international markets. Brunei and Singapore, on the other hand, rely heavily on imports due to limited domestic agricultural capacity. Maintaining zero tariffs facilitates access to reliable international supply chains, reduces procurement costs, and strengthens economic integration within the region. In all these cases, zero-tariff regimes promote smoother supply chains, increase predictability for traders, and contribute to the efficiency of regional agricultural markets.

Japan and the Republic of Korea place a strong emphasis on domestic food security and agricultural self-sufficiency, which is why they maintain high tariffs on sensitive commodities such as rice and processed rice. Japan consistently imposes a 180% tariff on these products, reflecting its long-standing policy of protecting domestic rice farmers and ensuring self-sufficiency in staple foods. This protectionist approach is supported by domestic political forces that prioritise agricultural self-sufficiency over trade liberalisation. The Republic of Korea, on the other hand, maintains high tariffs on rice while implementing selective tariff reductions on wheat, lowering its tariff from 3% to zero. These policies reflect a cautious and phased liberalisation

strategy, allowing limited market access for non-sensitive products while protecting core domestic agricultural sectors. The selective tariff reduction highlights these countries' efforts to promote regional integration and market access, while still taking measures to shield key staple grains from competitive pressures.

In ASEAN countries, there are significant differences in tariff policies. Countries such as Malaysia, Myanmar, Laos, and Cambodia tend to implement moderate tariff reductions or maintain relatively stable tariffs, reflecting their cautious approach in balancing gradual liberalisation with the protection of local farmers and food security objectives. These countries support the gradual opening of markets while considering the interests of farmers and ensuring food security. This reflects a political strategy where governments seek to balance external trade pressures with internal agricultural stability, particularly in the face of international trade agreements. In contrast, countries like Indonesia, Thailand, Vietnam, and the Philippines adopt a more aggressive tariff reduction strategy. The tariffs on several staple grains are scheduled to gradually decrease to zero over a period of 15 to 20 years. These phased reductions encourage a more competitive market environment, attract regional and foreign investment in agricultural production and trade, and promote regional integration in the staple grain markets. These policies also aim to enhance the competitiveness of domestic industries by exposing them to external market pressures, while providing sufficient time for farmers and producers to adapt to changing market conditions.

The RCEP framework demonstrates a complex balance between liberalisation and protectionism. While the agreement encourages open trade and investment flows among member countries, it also allows for targeted protection of sensitive staple commodities. This balance between liberalisation and protectionism is shaped by the political economy of trade, where domestic political and economic priorities influence tariff policies. This dual objective ensures food security, the sustainability of domestic agriculture, and the livelihood of farmers, while also promoting deeper regional trade and economic cooperation. By adopting differentiated and phased tariff reduction strategies, RCEP is able to accommodate the diverse needs and capacities of its members, creating a framework that benefits both highly developed agricultural exporters and import-dependent countries. This tariff system not only promotes regional economic integration and trade liberalisation but also ensures the protection of domestic agricultural priorities, reflecting a complex equilibrium between global market participation and national food security objectives.

#### **4.2. The China's staple grains import and export NTMs**

Compared to tariff barriers, non-tariff measures affect trade flows through more implicit and complex means, primarily in the form of quotas, licenses, technical barriers to trade, sanitary and phytosanitary measures, etc. These NTMs not only restrict market access but may also increase compliance costs for cross-border transactions, thereby affecting trade flows. According to China's import commitments under the RCEP agreement, the non-tariff measures in different years will exhibit varying characteristics. It is worth noting that for imports into China, the relevant non-tariff measures are defined based on China's commitments in the agreement, while for

China's exports, the commitments of other RCEP member countries will play a decisive role. The non-tariff measures affecting China's import and export of staple grains in different years are presented in Table 5.

*Table 5*

**Restrictive measures facing China's import and export of staple grains**

Category	Country	HS code	Main varieties	Primary restrictive measures	
1	2	3	4	5	
China's exports	Paddy rice / Processed rice	Japan	100640	Broken rice	Establishment registration requirements; Product safety monitoring
		Thailand	100620, 100630, 100640	Rye, Barley, Broken rice	Phytosanitary requirements
	Wheat	Japan	100199	Durum wheat, other than for sowing	Establishment registration requirements; Product safety monitoring
		The Republic of Korea	1001	Wheat and meslin	Phytosanitary procedure requirements
	Cereal grains nec	The Republic of Korea	1003, 1005	Barley, Maize (corn)	Phytosanitary procedure requirements; Quality inspection requirements
		Japan	100290, 100390, 100590	Rye, Barley, Maize (corn), other than for sowing	Product safety monitoring; Establishment registration requirements
China's imports	Paddy rice / Processed rice	Cambodia	100620, 100630, 100640	Husked rice, Milled rice, Broken rice, other than Indica rice	Enterprise registration required; Pre-export fumigation with certificate; Packaging must have Chinese / English labels
		Japan	100630	Milled rice (whether or not polished or glazed), other than Indica rice	Import permitted for Japanese rice meeting protocol requirements
		Laos	100620, 100630, 100640	Husked rice, Milled rice, Broken rice, other than Indica rice	Enterprise registration required; Pre-export fumigation with phytosanitary certificate and declaration
		Myanmar	100620, 100630, 100640	Husked rice, Milled rice, Broken rice, other than Indica rice	Enterprise registration and approval required; Pre-export fumigation; Packaging must be clean with Chinese / English labels
		New Zealand	10	Cereals	Export of genetically modified agricultural products to China requires approval from the Chinese State Council's agricultural department

*Continuation of the Table 5*

1	2	3	4	5	
China's imports	Paddy rice / Processed rice	The Republic of Korea	100620, 100630, 100640	Husked rice, Milled rice, Broken rice, other than Indica rice	Enterprise registration required; Pre-export fumigation with Phytosanitary Certificate; Packaging marked with Chinese information
		Thailand	100620, 100630, 100640	Husked rice, Milled rice, Broken rice, other than Indica rice	Pre-export fumigation required with phytosanitary certificate; Packaging marked with English information
		Vietnam	100620, 100630, 100640	Husked rice, Milled rice, Broken rice, other than Indica rice	Enterprises under registration management; Must originate from specified pest-free areas; Pre-export fumigation treatment required
	Wheat	Australia	1001	Wheat and meslin	Enterprise registration required; Pre-export inspection and quarantine with phytosanitary certificate
		Myanmar	100199	Durum wheat, other than for sowing	Import prohibition on ruminants and their products, and animal feed from Myanmar
		New Zealand	10	Cereals	Export of genetically modified agricultural products to China requires approval from the Chinese State Council's agricultural department
	Cereal grains nec	Australia	1003	Barley	Enterprise registration required; Pre-export inspection and quarantine with phytosanitary certificate
		Laos	1005	Maize (corn)	Enterprise registration required; Pre-export quarantine with phytosanitary certificate
		Myanmar	100290, 100390, 100590	Rye, Barley, Maize (corn), other than for sowing	Import prohibition on ruminants and their products, and animal feed from Myanmar
		New Zealand	10	Cereals	Export of genetically modified agricultural products to China requires approval from the Chinese State Council's agricultural department

Source: World Integrated Trade Solution (n.d.).

China imposes numerous non-tariff barriers on other countries. The non-tariff measures China implements for staple grains are relatively complex, often involving quarantine, fumigation, packaging, and labelling requirements. China enforces strict NTMs on imported grains to ensure food quality and safety, as well as to prevent the

spread of pests or diseases. These measures also protect the domestic market by reducing the risk of invasive species. According to the theory of cumulative protectionism, in the context of globalisation and free trade, countries gradually reduce tariff barriers, but continue to protect domestic industries through non-tariff barriers, especially in sensitive sectors such as agriculture and food. Cumulative protectionism theory suggests that as tariffs decrease, non-tariff barriers gradually replace traditional tariff barriers, becoming a key tool for countries to maintain protectionism, particularly in sectors like food security and agricultural production.

In China's trade of staple grains, key non-tariff measures are implemented by countries such as Cambodia, Laos, Thailand, Japan, and the Republic of Korea. These countries impose strict requirements on China's grain imports and exports. For imports, countries like Cambodia, Laos, and Thailand enforce multiple measures such as fumigation, quarantine, and packaging to ensure the quality and safety of imported grains. Cambodia and Laos require rice exports to be fumigated and accompanied by a phytosanitary certificate; Thailand requires imported rice to be labelled with both Chinese and English information. While these non-tariff measures are ostensibly intended to ensure food safety and quality, they also increase compliance costs and complicate market entry, effectively protecting domestic agriculture and markets. This practice is a typical example of cumulative protectionism theory, in which countries use non-tariff barriers to protect national interests without directly raising tariffs.

For export markets, Japan and the Republic of Korea are key destinations for China's grain exports. These countries impose strict quarantine requirements on China's grain exports to ensure that the grains meet their health and safety standards. While these measures are officially designed to protect consumers and the environment, their actual effect is to shield domestic agriculture from external competition. This approach aligns with cumulative protectionism theory, which explains how countries, despite reducing tariffs, continue to protect specific industries through non-tariff measures, thereby maintaining control over domestic markets and shielding them from foreign competition.

#### **4.3. Analysis of the results of staple grains trade calculations**

Through the quantitative analysis of the GTAP, the trade predicted results of China's staple grains after RCEP was implemented for 1 year, 5 years, 10 years, 15 years and 20 years are as shown in Table 6.

Based on the quantitative analysis under different tariff reduction and non-tariff measure (NTMs) scenarios simulated by GTAP, this study reveals how the implementation of RCEP may reshape China's agricultural trade in the next two decades. The results shown in Table 6 indicate that, under the scenario of combined tariff and non-tariff measure reductions, China's staple grain exports are expected to continue growing, although the growth rates vary across commodities and over time. Rice exports are expected to grow by 10.41% in the first year following RCEP implementation, reaching a peak of 18.16% after ten years, highlighting China's competitive advantage in rice production, particularly for processed and specialty rice varieties that can benefit from expanded market access within RCEP member countries.

Table 6

**Changes under various tariff reduction scenarios, %**

Trade flow	Category	Effective after 1 years	Effective after 5 years	Effective after 10 years	Effective after 15 years	Effective after 20 years
China's exports (only tariff)	Paddy rice	2.94	3.46	4.76	4.65	4.64
	Wheat	0.62	0.4	0.15	0.06	0.05
	Cereal grains (nec)	1.03	1.1	1.31	1.28	1.45
	Processed rice	1.74	1.66	1.58	1.54	1.53
China's exports (tariff and NTMs)	Paddy rice	10.41	14.36	18.16	15.29	15.28
	Wheat	13.15	13.52	13.29	13.25	13.24
	Cereal grains (nec)	1.59	2.47	3.04	2.59	2.71
	Processed rice	2.99	4.66	4.62	4.61	2.99
China's imports (only tariff)	Paddy rice	-0.51	-0.32	-0.11	-0.02	-0.01
	Wheat	-0.31	-0.2	-0.08	-0.04	-0.03
	Cereal grains (nec)	-0.06	-0.04	-0.01	0	0
	Processed rice	-1.98	-1.87	-1.74	-1.71	-1.71
China's imports (tariff and NTMs)	Paddy rice	2.33	1.93	2.14	2.21	2.23
	Wheat	129.66	129.4	129.52	129.53	129.54
	Cereal grains (nec)	-1.6	-1.68	-1.65	-1.65	-1.64
	Processed rice	40.37	37.86	38.00	38.02	38.02

*Note.* All results are compared with the base year prior to the effective year.

*Source:* calculated based on GTAP database.

After reaching the peak, the growth rate slightly declines to 15.28% by the twentieth year, indicating a stabilisation effect as markets gradually saturate and the initial export advantages brought by tariffs and non-tariff barriers level off, resulting in stable long-term growth. The growth of rice and wheat exports is mainly driven by the reduction of non-tariff barriers. In contrast, wheat exports will remain stable after a sharp increase, with a 13.15% increase in the first year under the combined tariff and non-tariff measure reduction scenario. The export of cereal grains (nec) and processed rice shows a moderate increase, with cereal grains rising from 1.59% to 2.71%, and processed rice increasing from 2.99% to 4.66% after five years, before showing a declining trend. The export data suggest that the initial reduction of tariffs and non-tariff barriers provides a strong stimulus to China's staple grain exports, but this stimulus gradually weakens, reflecting market absorption limits and competitive responses from other exporting countries.

Regarding China's staple grain imports, the results show that with only tariff reductions, imports of all staple grains show a clear downward trend, indicating that RCEP implementation will gradually reduce China's reliance on imported staple grains. However, in the combined tariff and non-tariff barrier scenario, China's imports of rice, wheat, and processed rice increase, particularly with wheat imports projected to grow by about 130% and processed rice by about 40%, showing significant concessions on

non-tariff barriers within the RCEP framework. This suggests that China plays a crucial role in the regional market under RCEP. This analysis confirms that the Chinese market continues to play a vital role in the RCEP framework.

#### 4.4. Comparison analysis of model predictions and actual data

The RCEP agreement was signed in 2020, and most countries began to implement it in 2022. The actual impact of the agreement has begun to emerge, so the forecast of China's staple grains and the actual trade volume are compared, as shown in Table 7.

*Table 7*

**Deviation between trade forecast and actual trade data, thsd t**

Indicators	Category	Import			Export		
		2020	2022	2023	2020	2022	2023
Tariff only model prediction	Paddy / processed rice	2911	2896	2897	2304	2372	2375
	Wheat	8151	8126	8128	0	0	0
	Cereal grains	11241	11234	11234	3	3	3
Tariff & NTMs model prediction	Paddy / processed rice	2911	2979	2976	2304	2544	2567
	Wheat	8151	18720	18715	0	0	0
	Cereal grains	11241	11061	11058	3	3	3
Actual trade	Paddy / processed rice	2911	6158	2597	2304	2215	1626
	Wheat	8151	9873	11878	0	6	17
	Cereal grains	11241	20618	26228	3	1	9
Relative percentage error (only tariff)	Paddy / processed rice	-	-52.97%	11.55%	-	7.09%	46.06%
	Wheat	-	-17.69%	-31.57%	-	-	-
	Cereal grains	-	-45.51%	-57.17%	-	200.00%	-66.67%
Relative percentage error (tariff and NTMs)	Paddy / processed rice	-	-51.62%	14.59%	-	14.85%	57.87%
	Wheat	-	89.61%	57.56%	-	-	-
	Cereal grains	-	-46.35%	-57.84%	-	-	-

*Source:* actual import and export data source is UNComtrade, query date is August 15, 2023.

RCEP was signed in 2020 and largely implemented in 2022, aiming to promote trade liberalisation through tariff reductions among member countries. The GTAP model simulated the impact of these tariff and NTMs reductions on China's imports and exports of paddy rice, processed rice, wheat, and cereal grains, forecasting moderate export growth and a slight reduction in imports. These predictions were based on the assumption that domestic production and market conditions would remain stable, with most trade changes attributed to tariff liberalisation among RCEP member countries. By comparing the GTAP model's predicted import and export volumes with the actual trade data for 2022 and 2023, the actual impact of RCEP implementation can be assessed and the model's predictive accuracy validated. This comparison provides valuable insights into the changes in China's staple grain trade post-RCEP and reveals the real factors influencing trade.

In the context of simultaneous reductions in tariff and non-tariff trade barriers,

there are significant discrepancies in the predictions of staple grain import trade volumes, indicating the complex interactions between global market conditions, domestic production adjustments, and international policy developments. In 2022, the supply chain disruptions and transportation difficulties in the post-pandemic period led to China's actual imports of rice and processed rice being significantly lower than predicted (51.62% below the forecast). In 2023, India's comprehensive tightening of rice export policies led to a decrease in global supply expectations and price fluctuations, further causing the prediction to fall short (14.59% lower than expected). Similarly, wheat imports also deviated from the model predictions, with actual imports in 2022 and 2023 both falling below expectations. Since the outbreak of the Russia-Ukraine war in 2022, the war has had a significant impact on the global wheat supply chain. As a major wheat producer and exporter, Ukraine's wheat exports were severely restricted, and Russia's supplies were also affected by sanctions, resulting in a decline in wheat imports and increased uncertainty. In contrast, the import volume of grains, primarily corn, significantly exceeded predictions in 2022 and 2023. Since May 2022, when China signed an agreement with Brazil to import corn, Brazil quickly became China's largest source of corn, significantly expanding China's corn import sources.

In terms of exports, China's actual exports of rice and processed rice were lower than predicted, with 2023 exports being 57.87% lower than forecasted. The main reason for this is domestic factors, as the rice planting area in 2023 decreased by 1.7% and production fell by 0.9%, limiting the quantity available for export. These findings highlight the importance of considering domestic agricultural policies and production fluctuations when developing predictive models, especially for products like rice, which are highly sensitive to production conditions.

The actual trade volumes exhibited greater fluctuations than predicted, reflecting the complex influence of global market dynamics and domestic production adjustments. While tariff reductions provide predictable incentives for trade expansion or contraction, external market factors such as international price volatility, export bans in other countries, and global supply shocks can result in outcomes that diverge significantly from the model's predictions. At the same time, domestic agricultural policies, including adjustments in planting areas, crop rotation, and yield improvements, played a key role in determining actual trade volumes. Furthermore, the timing and phased nature of RCEP implementation means that short-term impacts may differ from medium- and long-term trends, especially for sensitive staples like rice and wheat.

## **5. DISCUSSION**

This study provides a detailed analysis of the impact of RCEP implementation on China's staple grain trade, with a particular focus on the discrepancies between the predictions of the GTAP model and the actual trade outcomes. The proposed solutions have the following characteristics:

1. Refined analytical method: this study fills the gap in previous research that typically treats staple grain trade as a whole by individually analysing different grains.

Unlike traditional research methods, this study not only focuses on overall trade volumes of staple grains but also delves into the varying responses of different grains, especially after the implementation of RCEP, considering the effects of tariff reductions and non-tariff barriers. This analytical method provides more precise trade trend predictions and empirical analysis, with the advantage of revealing the differing market environments and trade responses that various grain categories face under the same trade agreement.

2. Real-world market fluctuations: this study not only focuses on long-term policy changes but also considers the short-term impact of global market fluctuations and domestic production adjustments on trade flows. By comparing the actual trade data from 2022 and 2023 with GTAP model predictions, it was found that significant market fluctuations, particularly due to the Russia-Ukraine war and other supply chain disruptions, caused actual trade volumes to deviate significantly from the predicted levels. This analysis of short-term market fluctuations complements the limitations of existing models, emphasising the profound impact of price volatility and supply shocks on trade flows.

A comparison with existing literature shows that the findings of this study align with those of Estrades et al. (2023) and Trakem et al. (2024), who also argue that the GTAP model effectively captures the overall trade trends and the relative impact of tariff changes. However, as these studies point out, the predictive accuracy of GTAP is limited when sudden global market changes or domestic production fluctuations occur. While tariff reductions have a positive long-term effect on trade, short-term price volatility and supply shocks significantly impact trade flows, factors that the GTAP model fails to fully account for.

Although much of the existing literature focuses on predicting the impact of RCEP on agricultural trade, agricultural products are diverse, including grains, fruits and vegetables, fisheries, and livestock. In contrast, research specifically targeting staple grains is relatively scarce. Cai et al. (2025) studied the impact mechanism of RCEP on agricultural trade among member states, noting that in the short term, China's grain imports increased by 0.72%, primarily driven by tariff reductions, with grains benefiting significantly due to their high substitution elasticity; exports increased by 1.30%, benefiting from improved price competitiveness. This conclusion differs from our study, mainly because Cai et al. (2025) did not differentiate between different categories of grains, and the impact of China's major imports of oilseeds may have influenced the results. In contrast, our study focuses on staple grains, excluding the impact of oilseeds, thus leading to different conclusions. Granular category analysis helps more precisely reveal the trade responses of different grains under the RCEP framework.

In addition, this study compares the predicted outcomes for staple grains under RCEP with actual trade data, using the same research methodology as Estrades et al. (2023). Their study found that using the GTAP model to analyse the entire supply chain under RCEP showed that the benefits of tariff liberalisation alone were minimal, with actual income projected to increase by only 0.21% by 2035. They compared the GTAP

predictions with actual data, using Germany as an example, and found that fish exports were predicted to be 1.3 and 1.4 million USD, respectively, which were 674 and 726% higher than the actual export of 0.2 million USD.

This study compares the GTAP model predictions for China's staple grain trade with actual trade data and finds that the fluctuations in actual trade volumes exceeded the predictions, highlighting the complex effects of global market dynamics and domestic production adjustments. Several factors can explain the discrepancies between the model predictions and actual outcomes:

After analysing the impact of RCEP on China's staple grain trade and comparing the discrepancies between GTAP model predictions and actual trade outcomes, this study finds that short-term market fluctuations and supply disruptions have a significant impact on trade flows, beyond the model's ability to capture these time-varying factors. Between 2022 and 2023, disruptions such as the Russia-Ukraine war and global supply chain issues caused substantial deviations from the model's predictions. In particular, fluctuations in global wheat supply and the expansion of China's corn import sources from Brazil affected trade volumes, with domestic production factors like reduced rice planting area further influencing net trade demand. These findings underline the need to consider both external shocks and domestic production changes in trade forecasting.

Based on these insights, the study proposes policy recommendations: to strengthen regional market connectivity and enhance trade liberalisation, countries should continue reducing tariff and non-tariff barriers in the staple grain sector, considering global market changes and domestic demands. China, in particular, should gradually relax tariffs and optimise non-tariff measures while ensuring that market opening progresses without compromising food security. Furthermore, in light of increasing global uncertainties, especially regarding supply chain disruptions and price fluctuations, it is recommended that countries develop flexible emergency policies to safeguard food supply stability and address unforeseen events, ensuring that the food supply chain can be quickly adjusted and maintained during geopolitical risks or other global challenges.

## **6. CONCLUSIONS**

This paper provides a comprehensive analysis of China's tariff commitments on staple grains under the RCEP framework. Drawing on the commitment schedules of member states, it examines the extent and variation of tariff and NTMs adjustments across different trading partners. To evaluate the likely impacts of these changes, the study employs the GTAP model to simulate staple grain trade flows under multiple scenarios following the implementation of RCEP. Beyond model-based predictions, the paper also compares projected outcomes with actual trade data from the initial years of RCEP enforcement. This dual approach allows for the identification of discrepancies between expected and realised trade patterns and provides insight into the underlying factors responsible for prediction deviations. The main conclusions of the paper are as follows:

First, China faces different levels of tariff reductions on staple grains among RCEP member countries, reflecting the diversity of trade commitments across the region. For Australia, New Zealand, Brunei, and Singapore, zero tariffs on staple grains were already in place prior to RCEP's implementation, meaning that RCEP had little to no additional effect on tariff levels. In Japan and the Republic of Korea, tariff protections on staple grains remain largely intact. Japan has preserved tariffs on sensitive products such as rice, wheat, and other cereal grains, while the Republic of Korea has made only minimal reductions on wheat imports. In contrast, a number of ASEAN countries – particularly Indonesia, Thailand, Vietnam, and the Philippines – have enacted substantial tariff reductions on staple grains under RCEP. These differences illustrate the asymmetry of tariff concessions within the agreement, suggesting that China's trade patterns with individual members will adjust in uneven ways depending on the degree of market openness.

Second, China employs a range of NTBs on staple grain trade, such as quarantine, fumigation, packaging, and labelling requirements. These measures aim to ensure food quality and safety, prevent the spread of pests, and protect the domestic market by reducing the risk of invasive species. According to the theory of cumulative protectionism, as tariffs decrease, NTBs become more prominent, continuing to protect domestic industries, especially in sensitive sectors like agriculture and food security. Countries like Cambodia, Laos, Thailand, Japan, and the Republic of Korea implement similar non-tariff measures on China's grain imports and exports, complicating market entry and increasing compliance costs, ultimately serving as a form of protectionism without raising tariffs.

Third, based on the quantitative analysis using the GTAP model, this study reveals the impact of RCEP implementation on China's agricultural trade over the next two decades. Under the scenario of combined tariff and non-tariff measure reductions, China's staple grain exports are expected to continue growing, especially rice exports, which are projected to increase by 10.41% in the first year and reach a peak of 18.16% after ten years, before slightly declining. Wheat exports are forecasted to remain steady. Regarding imports, tariff reductions lead to a clear decline in imports of all staple grains, but in the combined scenario of tariff and non-tariff measure reductions, imports of wheat and processed rice are projected to increase significantly, with wheat imports expected to rise by 130%. Overall, the analysis confirms that China continues to play a crucial role in the regional market under the RCEP framework.

Fourth, under the RCEP framework, the simultaneous reduction of tariff and non-tariff barriers has led to significant discrepancies between predicted and actual staple grain import volumes. In 2022, supply chain disruptions resulted in China's rice and processed rice imports being 51.62% lower than predicted. In 2023, India's tightening of rice export policies further decreased global supply expectations, causing wheat imports to fall short. Conversely, corn imports exceeded predictions, with Brazil becoming China's largest supplier. Export volumes of rice and processed rice also declined, primarily due to reduced domestic production. These deviations highlight the greater influence of global market fluctuations and domestic production changes over

tariff reductions.

In general, China's experience under RCEP demonstrates that tariff concessions, while important, are only one of several forces shaping staple grain trade. China's protection levels for staple grains remain higher than those of several RCEP partners, and its domestic production capacity continues to play a decisive role in determining import demand and export supply. The evidence shows that the impact of tariff reductions on staple grain trade has been smaller than predicted, with broader agricultural and macroeconomic factors exerting stronger influence. For policymakers, these findings carry two key implications. First, trade liberalisation efforts should be complemented by strategies that address supply-side constraints, such as agricultural productivity and climate resilience. Second, for countries that still maintain high levels of tariff protection, moderate and carefully sequenced tariff reductions may help balance domestic food security concerns with regional integration goals.

## **7. LIMITATIONS AND FUTURE RESEARCH**

This study provides an in-depth empirical analysis of the impact of RCEP implementation on China's staple grain trade, but there are several limitations that can be addressed in future research.

Firstly, regarding the methodology, this study relies on the GTAP model, which is based on a 2014 database. Although it was dynamically updated using CEPII indicators to approximate the 2022 data, recent global developments, such as the COVID-19 pandemic and the Russia-Ukraine war, were not fully captured by the model. Therefore, future research could consider integrating more real-time models and data to enhance the model's responsiveness to such uncertainties and improve prediction accuracy.

Secondly, the geographical scope of this study is focused on China's staple grain trade within the RCEP framework, which may limit the broader applicability of the findings. Given the varying agricultural policies and trade patterns across different regions, future research should expand to include other regional or multilateral trade agreements. Comparing the impact of these agreements on staple grain trade would provide more generalised conclusions and a broader perspective on the effects of regional trade agreements.

Additionally, while this study considers the impact of global market fluctuations, it has limited analysis of domestic production factors, such as climate change and policy adjustments. Changes in domestic production, such as agricultural policy shifts and the impacts of climate change, can significantly influence trade flows. Future research could explore these factors in greater detail and analyse their differential effects across countries or regions, especially in the context of global warming and extreme climate phenomena.

To address these limitations, future research could integrate the GTAP model with other economic models, extend the geographical scope, and conduct a more detailed analysis of domestic production adjustments. Furthermore, considering the increasing uncertainty in the global market, future studies could investigate how to construct more

flexible and dynamic forecasting models that better adapt to global political and economic fluctuations and unforeseen events, thereby improving the practical applicability and accuracy of predictions.

### **AUTHOR CONTRIBUTIONS**

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