

Assessing the Competitiveness and Complementarity of the Agricultural Products Trade between Korea and CPTPP Countries

JKT 27(3)

Received 25 April 2023
Revised 8 June 2023
Accepted 9 June 2023

Meng-wen Chen[†]

Major in International Trade Management, Woosuk University, Korea

Suk-jae Park^{††}

Professor, Department of International Trade, Woosuk University, Korea

Quan-zheng Zhu

Major in Cultural Management, Woosuk University, Korea

Abstract

Purpose – This paper aims to investigate the competitiveness and complementarity of the agricultural products trade between Korea and Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) countries. The study evaluates the opportunities and challenges that Korea's agricultural sector faces after joining the CPTPP, and suggests strategies to deepen cooperation and expand Korea's agricultural products trade.

Design/methodology – To achieve these objectives, we analyze the trade competition and cooperation relationship between Korea and CPTPP countries in the agricultural products trade. This study uses data from Chapters HS1-24 in UN Comtrade from 2012 to 2022, and applies the indices of revealed comparative advantage, export similarity, and trade complementarity to examine the trade dynamics. Furthermore, we use an Autoregressive Integrated Moving Average (ARIMA) model to predict the agricultural products trade complementarity index between Korea and CPTPP countries from 2022 to 2031.

Findings – The findings of our analysis reveal that Korea's agricultural products trade competitiveness is weak compared to that of CPTPP countries, and Korea's agricultural products are at a competitive disadvantage. On the whole, the similarity index of agricultural products trade exports between Korea and CPTPP countries is low, the structure of agricultural products export is quite different, and trade competition is relatively moderate. The trade complementarity index between Korea and CPTPP countries is generally high, with strong complementarity and a large space for cooperation and development. The ARIMA model shows that in the next ten years, although the agricultural products trade complementarity index fluctuates, but is generally high, there will still be a complementarity advantage in the future.

Originality/value – This study is the first attempt to investigate the competitiveness and complementarity of the agricultural products trade between Korea and CPTPP countries. We also introduce an ARIMA model to forecast and analyze the future agricultural products trade complementarity index. Our study provides new perspectives and solutions for the future development of Korea's agricultural products trade after joining the CPTPP.

Keywords: Agricultural Products Trade, ARIMA, Competitiveness, Complementarity, CPTPP

JEL Classifications: F14, O24, O50

[†] First author: chmw1992@163.com

^{††} Corresponding author: sjpark@woosuk.ac.kr

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1. Introduction

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) is a regional free trade agreement that was formed by the signing of free trade agreements by 11 Asia-Pacific countries: Japan, Canada, Australia, Chile, New Zealand, Singapore, Brunei, Malaysia, Vietnam, Mexico, and Peru. The CPTPP represents a cooperative system that aims to liberalize trade without exception in principle, including agriculture, and to eliminate all tariffs on all traded goods, making it a significant step toward higher levels of trade liberalization as compared to the Economic Partnership Agreement (EPA). With a combined gross domestic product that accounts for 13 percent of the global economy, and covering a population of 498 million people, the CPTPP has the potential to significantly strengthen mutually beneficial links among member economies, and promote trade, investment, and economic growth in the Asia-Pacific region. According to analysis, Korea's position in the supply chain in Asia and North America will be enhanced if it joins the CPTPP, potentially gaining about \$86 billion a year, making it one of the largest beneficiaries of the agreement. Joining the CPTPP can deepen cooperative relations between Korea and CPTPP countries, promote the diversification of Korea's commodity market, and create new opportunities in developing Korea's trade. On April 14th, 2022, the Korean government reported that it would conclude its internal decision-making process on applying to join the CPTPP within that week. The Ministry of Strategy and Finance announced that it would hold a written meeting of foreign economic ministers to decide on applying for the agreement. Overall, the CPTPP represents a significant opportunity for regional cooperation and economic growth, and Korea's potential membership will provide significant benefits for both Korea and CPTPP countries.

This paper analyzes the impact of the trade liberalization of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) on Korea's agricultural products trade. Under the CPTPP, contracting parties have agreed to open up agricultural markets by eliminating tariffs and trade barriers, including export taxes, tariff quotas, and export subsidies. This presents both opportunities and challenges for Korea's agricultural sector. On one hand, the elimination of trade barriers could significantly reduce export restrictions for the Korean agricultural products trade and provide favorable conditions for exports. On the other hand, the complete opening of the market could also significantly impact Korea's agricultural products trade. The increased competition may harm relatively disadvantaged products, and surviving in the market may be challenging under significant competitive pressure.

In recent years, domestic and foreign studies on Korea and CPTPP countries mainly focus on intellectual property rights, trade policies, and other aspects. Studies on Korea's agricultural products trade mainly focus on analyzing the impact of FTAs and RCEP, but there is a lack of relevant studies on the agricultural trade between Korea and CPTPP countries. Existing studies largely differ on whether to join the CPTPP, but overall, although it will cause a shock in the short term, from the perspective of long-term development, it is necessary to join. Moon Han-pil et al. (2018) pointed out that South Korea has a significant gap in the number of agricultural imports and exports from CPTPP countries, and proposed enlightenment for the development of CPTPP in the agricultural products trade field. It was pointed out that the Korean government should fully consider the negative impact of the decrease of tariffs and non-tariff barriers on the increase of import volume when joining the

CPTPP. Besides paying attention to the quality and competitiveness of Japanese agricultural and livestock products, Korea should strengthen the construction of animal and plant quarantine systems. Jeffrey (2021) pointed that RCEP supplements and upgrades Korea's existing bilateral and regional FTAs and establishes new bilateral trade commitments, but it is not the most comprehensive. Korea also needs to join the CPTPP. In general, the aforementioned research lacks investigation on the agricultural products trade between Korea and CPTPP countries.

Korea's agricultural production is constrained by its geographical environment, and its agricultural products trade is at a disadvantage. If Korea blindly joins the CPTPP, Korea's agricultural products trade will suffer serious losses. On the contrary, if the issue of joining the CPTPP is avoided, it will also cause Korea to miss an opportunity for agricultural products trade development. Therefore, it is crucial for Korea to understand the competitive and complementary relationship of its agricultural products with those of CPTPP countries. This analysis will enable Korea to identify development opportunities and provide reference opinions and suggestions for existing development programs. In addition, unlike previous studies, this paper, in addition to the quantitative analysis of competitiveness, similarity, and complementarity, also predicts the future complementarity index between Korean agricultural products and CPTPP countries. Through this, the paper will provide a practical basis as to how to promote the overall development of the Korean agricultural products trade, and how to cope with the impact of joining the CPTPP.

2. Literature Review

2.1. Necessity of Joining the CPTPP

In the post-COVID-19 era, countries are actively promoting trade development, and Korea's entry into the CPTPP provides an opportunity for trade and economic development. Many scholars have affirmed Korea's entry into the CPTPP, including Bai Jie and Qing-yi Su (2019), who analyzed the CPTPP from the perspective of rules and openness. They believed that the CPTPP represented the highest standard of a new generation of trade agreements, leading the negotiation and formulation of international economic and trade rules in the 21st century. Furthermore, Yu Jae-har and Lee Chun-su (2021) researched the need for Korea to join the CPTPP. They noted that the CPTPP is the most forward-looking and open regional trade agreement, setting standards for many other contracts. By comparing RCEP and the CPTPP, they pointed out the disadvantages of Korea only joining RCEP, and analyzed the necessity of Korea joining the CPTPP in terms of the tariff reduction rate, cumulative origin clause, and potential expansion of the CPTPP. Korea's participation in the CPTPP is beneficial in promoting trade growth and stabilizing the economy, especially in the face of the global economic downturn. It is worth noting that Korea joined RCEP in 2020. Schott (2021) argued that although Korea has joined RCEP, it still needs to join the CPTPP as RCEP does not address key barriers that restrict Korea's trade with China and Japan. Kang Bok-yung (2019) confirmed the positive impact of Korea's participation in the CPTPP through panel data analysis, which showed that it would help secure a vast internal market and promote sustainable economic growth in Korea. In terms of agricultural trade, joining the CPTPP has already helped the Korean government expand its export market, create a global production network, and foster long-term economic innovation momentum.

2.2. Disadvantages of Joining the CPTPP

Korea's entry into the CPTPP also has some potential adverse effects, which have been studied by scholars in the field of the agricultural products trade and trade practices. In the agricultural products trade sector, joining the CPTPP will require the Korean government to reduce tariff barriers and eliminate non-tariff measures, such as SPS. However, reducing import tariffs on Korean products may lead to an increase in imports of new products. Therefore, Moon Han-pil et al. (2018) pointed out that Korea should be cautious in opening its agricultural products trade market and consider strengthening non-tariff measures, given that Korean agricultural product imports and exports to CPTPP countries are very different, accounting for 25.0 percent (\$7.7 billion) and 32.8 percent (\$2.1 billion), respectively. From the perspective of trade practices, Song Back-hoon (2019) analyzed the macroeconomic effects, industrial production, and export/import effects of the CPTPP using the CGE model. According to results, the implementation of the CPTPP could potentially harm the Korean economy. To avoid potential negative impacts, Korea should join the CPTPP as a secondary member, and encourage China to join the agreement with Korea.

2.3. Competitiveness and Complementarity

A comprehensive analysis of existing literature reveals that most studies focus on the impact of Korea's accession to the CPTPP, or a comparative analysis of rules between Korea and CPTPP countries in the field of TBT, such as the research conducted by Heo In-ae (2022). However, there are few quantitative studies on the competitiveness and complementarity of the agricultural products trade between Korea and CPTPP countries. If Korea joins the CPTPP, it will bring both new opportunities and challenges, and developing Korea's agricultural products will become an essential and unavoidable issue. Studies on international trade competition and cooperation usually rely on indicators such as the trade competitiveness index, trade similarity index, and trade complementarity index. They typically use the revealed comparative advantage index to analyze the competitiveness of a product or industry in the target country by measuring the relative volume of trade changes (Balassa, 1965). The product export similarity index is utilized to explore the degree of the export similarity of a product between countries in the global export market (Glick et al., 1999). The trade complementarity index measures the degree of complementarity between the exports of a product of one country or region, and the imports of another country or region (Glick et al., 1999). In order to accurately understand the trade structure of agricultural products between Korea and CPTPP countries, this paper adopts relevant data from the UN Comtrade database from 2012 to 2021, and follows the classification of the International Convention on the Harmonization System of Commodity Names and Codes (1992 edition). HS01-24 were selected as agricultural products, and the competitiveness and complementarity of the agricultural products trade between Korea and CPTPP countries were analyzed using the index of revealed comparative advantage, export similarity, and trade complementarity based on the methodology provided by the above research institutes.

3. Methodology

3.1. Revealed Comparative Advantage Index

The revealed comparative advantage index (RCA), proposed by American economist

Balassa (1965), is widely used internationally to measure the comparative advantage of a particular commodity. It refers to the relative value of the share of a country's (region's) industry (product) in its exports to the share of the industry or product in global (regional) trade, and is used to evaluate the comparative advantage of a country's (region's) industry trade in a certain industry. It is an important indicator of a country's (region's) international competitiveness. The specific formula is below.

$$RCA_{xik} = (X_{ik}/X_{it})/(X_{wk}/X_{wt}) \quad (1)$$

The formula for the revealed comparative advantage index (RCA) involves two variables: X_{ik} , the export value of industry (product) k for country (region) i , and X_{wk} , the export value of industry (product) k for the world (region) w . These variables are divided by the total export value of country (region) i and the total export value of the world (region) w , respectively. The resulting value, RCA_{xik} , is used to evaluate the comparative advantage of a country (region) in a particular industry (product). If $RCA_{xik} < 1$, the industry (product) k of country (region) i is at a comparative disadvantage, and lacks international competitiveness. If $1 < RCA_{xik} \leq 1.25$, it has a comparative advantage, and has a certain degree of international competitiveness. If $1.25 < RCA_{xik} \leq 2.5$, it has strong international competitiveness. Finally, if $RCA_{xik} > 2.5$, it has extremely strong international competitiveness.

3.2. Export Similarity Index

The export similarity index (ESI), proposed by Glick and Rose (1999), assesses the level of bilateral competition by measuring the similarity of exported goods between two countries (regions) to a third country (region) or the world market. This index provides insights into the degree of competition between countries, and allows for the identification of potential complementarities in trade. The formula is below.

$$ESI_{ij} = \sum_k \left\{ \left[\frac{(x_{iw}^k/x_{iw}^t) + (x_{jw}^k/x_{jw}^t)}{2} \right] \times \left[1 - \left| \frac{(x_{iw}^k/x_{iw}^t) - (x_{jw}^k/x_{jw}^t)}{(x_{iw}^k/x_{iw}^t) + (x_{jw}^k/x_{jw}^t)} \right| \right] \right\} \times 100 \quad (2)$$

ESI_{ij} represents the revised export similarity index between country i and country j exporting to world market w ; X_{iw}^k and X_{iw}^t represents the export value and total export value of products k from country i to market W ; X_{jw}^k and X_{jw}^t represent the export volume and total export volume of products k from country j to market W . It is generally believed that $ESI_{ij}=0$ indicates that the export structure of the two countries in the world market is entirely different. $ESI_{ij}=100$ indicates that the export structure of the two countries in the world market is completely the same. As time passes, if ESI_{ij} becomes increasingly larger, the competition between the two countries becomes more and more fierce. If the converse occurs, it indicates that competition between the two countries in the world market is gradually easing.

3.3. Trade Complementarity Index

According to the research findings of Feng Cheng-cheng (2021), the trade complementarity index is usually adopted to analyze trade complementarity between two countries. The trade complementarity index is an index to measure the matching degree between the export

of a country's product and the import of another country's product. It reflects the structural matching degree between the export and import of product trade between countries. The formula is below.

$$C_{ijk} = RCA_{xik} \times RCA_{mjk} \quad (3)$$

In the equation, C_{ijk} represents the trade complementarity index between country (region) i 's exports of industry (product) k and country (region) j 's imports of industry (product) k . RCA_{xik} represents the comparative advantage that country (region) i has in industry (product) k , while RCA_{mjk} represents the comparative disadvantage that country j has in industry (product) k . The formula for the revealed comparative disadvantage index in the above equation is below.

$$RCA_{mjk} = (M_{jk}/M_{jt})/(M_{wk}/M_{wt}) \quad (4)$$

Where M_{jk} and M_{wk} respectively represent the import value of industry (product) k in country (region) i and in the world (region) w , and M_{jt} and M_{wt} are the total import amount of country (region) j and the world (region) w . A larger RCA_{mjk} indicates that the country has a comparative disadvantage in producing such industries (products). According to the definition of the formula, as C_{ijk} is the product of the two, and the higher the trade complementarity index C_{ijk} is between two countries, the more similar the main categories of commodities exported by one country and those imported by another country. This indicates higher complementarity; the reverse is minor. Generally speaking, the value of C_{ijk} is bound by 1. When $C_{ijk} > 1$, it indicates trade complementarity between the two countries' industries (products). When $C_{ijk} < 1$, it indicates that there is no trade complementarity between the two.

4. Data Source and Analysis

4.1. Data Source

Trade data used in this article is sourced from UN Comtrade, and the analysis is based on agricultural products under HS codes 01-24, using data from 2012 to 2021.

4.2. Data Analysis

4.2.1. Analysis of the Revealed Comparative Advantage Index in the Agricultural Products Trade between Korea and CPTPP Countries

As shown in Table 1, compared with most CPTPP countries, the RCA index of Korean agricultural products trade shows that the overall competitiveness of Korean agricultural products trade at a disadvantage, with only a certain competitive advantage over Brunei and Japan, which also have scarce land and a lack of resources. Looking at the dynamic trend, the competitive disadvantage has shown a slight improvement, but it still remains significantly disadvantaged compared to other CPTPP countries. Among CPTPP countries, the RCA index of New Zealand is the highest, and has remained above 6.0 for ten years from 2012 to

2021. New Zealand is consistently in a leading position, and has strong international competitiveness as compared to other CPTPP countries. Chile ranked second. Its RCA index of agricultural products was slightly lower than 2.5 in 2012 and 2021, stable above 2.5 in other years, and reached above 3 in 2019, indicating that Chile's agricultural products also have strong international competitiveness. The RCA index of Peru's agricultural products remained above 2.5 in 2015, 2019, 2020, and 2021, while the RCA index of other years did not exceed 2.5, but was always higher than 1.25, indicating that Peru's agricultural products have strong international competitiveness. The RCA index of Canadian agricultural products is between 1.25 and 2.5, while the RCA index of Australian agricultural products is also between 1.25 and 2.5 in years except for 2020, which was slightly lower than 1.25, indicating that the agricultural products of Canada and Australia also have strong international competitiveness. The agricultural RCA index of Vietnam and Malaysia started well. However, both showed a downward trend and fluctuated below 1.0, indicating that Vietnam and Malaysia gradually moved into competitive disadvantage, and no longer have international competitiveness. The agricultural RCA index of Singapore and Mexico has increased in recent years, but is still at a competitive disadvantage of below 1.0, and is not internationally competitive. Brunei and Japan had the lowest RCA index for agricultural products, which was at most 0.1 from 2012 to 2014, showing obvious comparative disadvantages without international competitiveness.

Table 1. Revealed Comparative Advantage Index in Agricultural Products Trade between Korea and CPTPP Countries

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|-----|------|------|------|------|------|------|------|------|------|------|
| CAN | 1.31 | 1.30 | 1.28 | 1.36 | 1.35 | 1.34 | 1.36 | 1.30 | 1.51 | 1.48 |
| PER | 2.04 | 2.04 | 2.48 | 2.58 | 2.38 | 2.24 | 2.46 | 2.64 | 2.79 | 2.50 |
| CHL | 2.38 | 2.63 | 2.77 | 2.92 | 2.99 | 2.81 | 2.99 | 3.12 | 2.58 | 2.33 |
| BRN | 0.01 | 0.02 | 0.05 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.04 |
| JPN | 0.08 | 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.12 | 0.12 | 0.13 | 0.14 |
| SGP | 0.27 | 0.29 | 0.31 | 0.33 | 0.32 | 0.30 | 0.39 | 0.40 | 0.36 | 0.35 |
| VNM | 2.24 | 1.87 | 1.85 | 1.58 | 1.48 | 1.42 | 1.31 | 1.12 | 0.96 | 0.96 |
| AUS | 1.52 | 1.56 | 1.62 | 1.91 | 1.66 | 1.62 | 1.44 | 1.29 | 1.22 | 1.27 |
| MYS | 1.50 | 1.30 | 1.27 | 1.20 | 1.23 | 1.13 | 0.99 | 0.99 | 0.98 | 1.10 |
| NZL | 6.94 | 7.13 | 7.16 | 6.86 | 6.62 | 6.97 | 7.29 | 7.36 | 6.97 | 7.23 |
| MEX | 0.76 | 0.78 | 0.77 | 0.81 | 0.86 | 0.89 | 0.91 | 0.92 | 0.97 | 0.99 |
| KOR | 0.16 | 0.15 | 0.15 | 0.16 | 0.17 | 0.16 | 0.16 | 0.18 | 0.18 | 0.18 |

Note: Countries from top to bottom are Canada, Peru, Chile, Brunei, Japan, Singapore, Vietnam, Australia, Malaysia, New Zealand, Mexico, and Korea.

Source: Authors' calculation using UN Comtrade data.

4.2.2. Analysis of the Export Similarity Index in the Agricultural Products Trade between Korea and CPTPP Countries

Table 2 reveals the similarity index of agricultural exports between Korea and Japan is the highest, indicating a relatively high similarity in agricultural products export structures, but

it is still less than 100. Therefore, the agricultural products trade export structures of Korea and Japan are not completely identical, and in recent years, the similarity index between the two has shown a fluctuating downward trend, though it remains relatively high. The agricultural products export similarity index between Korea and Malaysia is the lowest, indicating a significant difference in the agricultural products export structure between the two, and a low level of competition in agricultural products trade, which suggests the possibility of cooperation. Overall, the ESI between Korea and CPTPP countries is much lower than 100, indicating a relatively low similarity in agricultural products export structures, suggesting that the overall agricultural products trade competition between Korea and CPTPP countries is not fierce. Therefore, it can be inferred that the agricultural products trade competition between Korea and CPTPP countries is relatively moderate, especially for product categories with comparative advantages wherein there is a large difference in structure, suggesting the existence of significant opportunities for cooperation.

Table 2. Export Similarity Index in the Agricultural Products Trade between Korea and CPTPP Countries

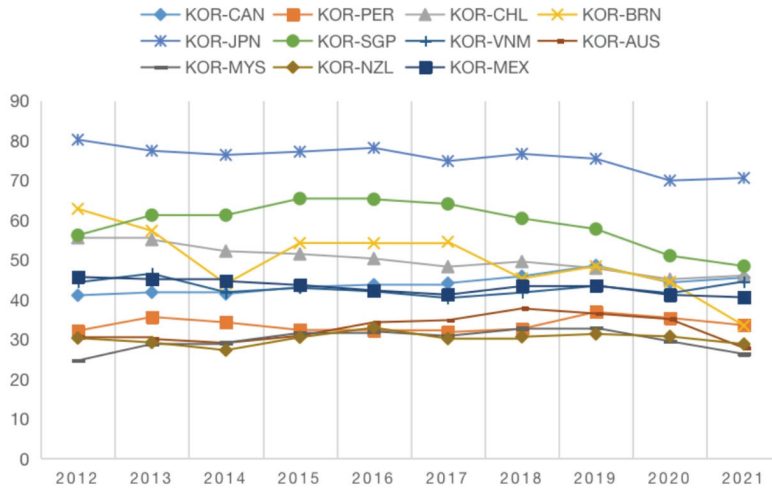
| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| CAN | 41.05 | 41.80 | 41.39 | 43.13 | 43.72 | 44.11 | 45.84 | 48.55 | 44.28 | 45.49 |
| PER | 32.16 | 35.62 | 34.26 | 32.34 | 32.25 | 31.80 | 32.65 | 36.88 | 35.39 | 33.54 |
| CHL | 55.51 | 55.04 | 52.15 | 51.43 | 50.28 | 48.24 | 49.53 | 47.86 | 45.09 | 46.03 |
| BRN | 62.78 | 57.27 | 43.95 | 54.20 | 54.14 | 54.50 | 45.29 | 48.35 | 44.43 | 33.43 |
| JPN | 80.15 | 77.38 | 76.33 | 77.14 | 78.10 | 74.78 | 76.59 | 75.38 | 69.89 | 70.54 |
| SGP | 56.15 | 61.20 | 61.20 | 65.37 | 65.19 | 64.02 | 60.38 | 57.71 | 51.00 | 48.40 |
| VNM | 44.33 | 46.50 | 41.84 | 42.93 | 42.04 | 40.38 | 41.75 | 43.42 | 41.59 | 44.52 |
| AUS | 30.51 | 30.08 | 29.09 | 30.89 | 34.27 | 34.80 | 37.74 | 36.48 | 35.07 | 27.84 |
| MYS | 24.67 | 28.82 | 29.15 | 31.61 | 31.98 | 30.85 | 32.67 | 32.85 | 29.51 | 26.31 |
| NZL | 30.32 | 29.20 | 27.27 | 30.51 | 32.93 | 30.17 | 30.63 | 31.34 | 30.72 | 28.80 |
| MEX | 45.67 | 45.11 | 44.63 | 43.63 | 42.29 | 41.21 | 43.36 | 43.55 | 41.18 | 40.56 |

Note: Countries from top to bottom are Canada, Peru, Chile, Brunei, Japan, Singapore, Vietnam, Australia, Malaysia, New Zealand, and Mexico.

Source: Authors' calculation using UN Comtrade data.

To better visualize the changes over time in the similarity index of agricultural products export between Korea and CPTPP countries, Table 2 was transformed into Fig. 1. According to Fig. 1, it can be seen that over time, countries with high levels of similarity in agricultural products exports, such as Japan, Singapore, Brunei, and Chile, show a small fluctuating downward trend. This indicates that competition between Korea and these countries in the global market for agricultural products export is gradually easing. Canada shows a small fluctuating upward trend, indicating a slight increase in the degree of similarity in agricultural products exports between Korea and Canada, and slightly intensified competition between the two countries. Overall, the trend in the similarity index of agricultural products exports between Korea and CPTPP countries is relatively flat, meaning that competition in agricultural products exports between Korea and CPTPP countries in the global market is relatively mild.

Fig. 1. Export Similarity Index in the Agricultural Products Trade between Korea and CPTPP Countries from 2012 to 2021



Source: Authors' calculation using UN Comtrade data.

4.2.3. Analysis of the Agricultural Products Trade Complementarity Index between Korea and CPTPP Countries

As can be seen from Table 3, Korea generally has a high complementarity index in the agricultural products trade with CPTPP countries, indicating a high level of bilateral trade complementarity. Canada, Peru, Chile, Vietnam, Australia, Malaysia, and New Zealand show a high complementarity index for the agricultural products trade, with most years exceeding 1.0. This indicates a high level of complementarity in the agricultural products trade between Korea and these countries, with a high degree of trade structure compatibility. Brunei, Japan, Singapore, and Mexico have a low complementarity index for the agricultural products trade, indicating a low level of complementarity in agricultural trade with Korea, and a lower degree of trade structure compatibility. Overall, Korea has a high complementarity index in the agricultural products trade with CPTPP countries, and the index generally shows a fluctuating upward trend. This suggests that if Korea were to join the CPTPP, it could better cooperate with CPTPP countries, have good development prospects, and further develop of the Korean agricultural products trade.

Table 3. Trade Complementarity Index for the Agricultural ProductsT between Korea and CPTPP Countries

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|-----|------|------|------|------|------|------|------|------|------|------|
| CAN | 1.24 | 1.26 | 1.24 | 1.34 | 1.32 | 1.29 | 1.33 | 1.26 | 1.54 | 1.53 |
| PER | 2.67 | 2.59 | 3.23 | 3.50 | 3.22 | 3.21 | 3.49 | 3.61 | 4.28 | 3.68 |
| CHL | 2.29 | 2.60 | 2.91 | 3.23 | 3.34 | 3.28 | 3.55 | 3.72 | 3.50 | 3.04 |
| BRN | 0.01 | 0.04 | 0.09 | 0.02 | 0.04 | 0.04 | 0.04 | 0.02 | 0.02 | 0.03 |
| JPN | 0.09 | 0.09 | 0.09 | 0.12 | 0.13 | 0.12 | 0.14 | 0.14 | 0.15 | 0.16 |

Table 3. (Continued)

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|-----|------|------|------|------|------|------|-------|-------|-------|------|
| SGP | 0.11 | 0.12 | 0.13 | 0.15 | 0.15 | 0.13 | 0.16 | 0.17 | 0.15 | 0.15 |
| VNM | 2.40 | 1.98 | 1.97 | 1.59 | 1.48 | 1.32 | 1.28 | 1.01 | 0.81 | 0.91 |
| AUS | 1.00 | 1.13 | 1.24 | 1.50 | 1.35 | 1.22 | 1.15 | 1.09 | 1.00 | 0.95 |
| MYS | 1.60 | 1.23 | 1.20 | 1.22 | 1.17 | 1.00 | 0.87 | 0.87 | 0.91 | 1.07 |
| NZL | 9.55 | 9.71 | 9.59 | 9.46 | 8.76 | 9.40 | 10.15 | 10.04 | 10.08 | 9.50 |
| MEX | 0.68 | 0.66 | 0.62 | 0.58 | 0.60 | 0.62 | 0.63 | 0.64 | 0.70 | 0.79 |

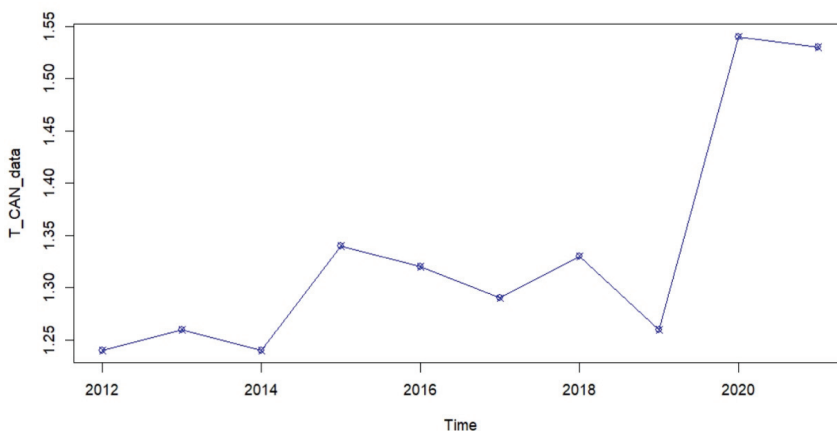
Note: Countries from top to bottom are Canada, Peru, Chile, Brunei, Japan, Singapore, Vietnam, Australia, Malaysia, New Zealand, and Mexico.

Source: Authors' calculation using UN Comtrade data.

4.2.4. Forecast and Analysis of the Agricultural Products Trade Complementarity Index between Korea and CPTPP Countries

In order to analyze the complementarity index of agricultural trade between Korea and CPTPP countries, this paper uses data from 2012 to 2021 and the ARIMA (p, d, q) model to predict the complementarity index of the agricultural products trade from 2022 to 2032. The specific analysis process is based on the time series data of Canada.

Firstly, the time series plot of the Canadian data is shown in Figure 2. From the time series plot, it can be seen that the data series has a clear upward trend and no significant periodic cyclic features, indicating that the series is non-stationary.

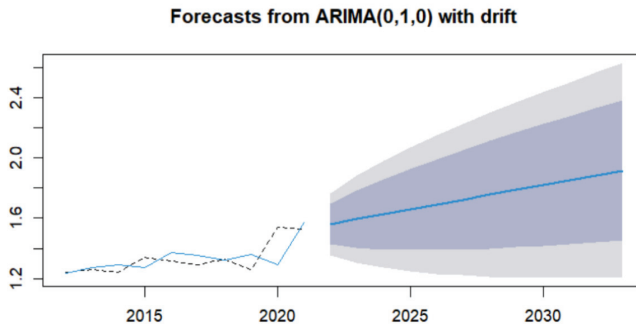
Fig. 2. Time Series Plot of Canadian Data

Since the model is non-stationary, the first-order difference is taken for the CAN time series data sequence. It was found that the sequence fluctuates around the 0 value, and has no obvious trend features. To further determine the stationarity of the differenced sequence, a stationarity test (ADF test) was performed. The test results show that almost all ADF test statistics of the first-order differenced sequence of the CAN time series data have p-values smaller than the significance level ($\alpha=0.05$), indicating that the first-order differenced

sequence of the time series data has achieved stationarity. Therefore, $d=1$ was chosen.

The first-order differenced sequence was subjected to a pure randomness test. The results showed that the P-values of the LB statistics for the 6th and 12th lag of the sequence was less than the significance level ($\alpha=0.05$), indicating that the first-order differenced sequence of the CAN time series data was a stationary white noise sequence. Autocorrelation and partial autocorrelation tests were then conducted, and it was found that both autocorrelation and partial autocorrelation showed truncation at lag 0, indicating that p and q should both be set to 0. Therefore, the ARIMA (0,1,0) model was used to fit the CAN time series data from 2012 to 2021, and the fitted and observed values of the sequence were plotted together, as shown in Fig. 3.

Fig. 3. Comparison of Observed and Fitted Values of the Agricultural Trade Complementarity Index between Korea and Canada from 2022 to 2031



The plot shows that the model had a good fit for the sequence. Using the "tsdiag" function in R language, the significance of the fitted model was tested. The test results showed that the residual sequence was a white noise sequence, which indicated that the model had a good fit for the sequence, and had extracted sufficient information on the sequence correlation. In addition, since all estimated parameter values were greater than twice their standard deviations, all parameters were significant. Finally, predicted values for the Canada time series data from 2022 to 2031 are shown in Table 4.

Table 4. Predicted Canadian of Time Series Data Values

| Year | 2022 | 2023 | 2024 | 2025 | 2026 |
|--------------------------|-------|-------|-------|-------|-------|
| CAN Data Predicted Value | 1.562 | 1.594 | 1.627 | 1.659 | 1.691 |
| Year | 2027 | 2028 | 2029 | 2030 | 2031 |
| CAN Data Predicted Value | 4.017 | 1.756 | 1.788 | 1.820 | 1.852 |

Source: Authors' calculation using UN Comtrade data.

Based on the above method, the predicted results of the agricultural products trade complementarity index between Korea and CPTPP countries are shown in Table 5. According to Table 5, from 2022 to 2031, Korea has relatively high agricultural products trade complementarity index with CPTPP countries. Compared with recent data, there is some fluctuation. Korea's agricultural products trade complementarity index with Peru, Chile, and

New Zealand is significantly higher than that with other countries, while the agricultural products trade complementarity index with Brunei, Japan, Singapore, and Vietnam is relatively low, with Vietnam showing a clear downward trend.

Table 5. Forecast of the Agricultural Products Trade Complementarity Index between Korea and CPTPP Countries

| | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|-----|------|------|------|------|------|-------|-------|-------|-------|-------|
| CAN | 1.56 | 1.59 | 1.63 | 1.66 | 1.69 | 1.72 | 1.76 | 1.79 | 1.82 | 1.85 |
| PER | 3.79 | 3.90 | 4.02 | 4.13 | 4.24 | 4.35 | 4.47 | 4.58 | 4.69 | 4.80 |
| CHL | 3.12 | 3.21 | 3.29 | 3.37 | 3.46 | 3.54 | 3.62 | 3.71 | 3.79 | 3.87 |
| BRN | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 |
| JPN | 0.17 | 0.18 | 0.18 | 0.19 | 0.20 | 0.21 | 0.21 | 0.22 | 0.23 | 0.24 |
| SGP | 0.15 | 0.16 | 0.16 | 0.17 | 0.17 | 0.18 | 0.18 | 0.19 | 0.19 | 0.19 |
| VNM | 0.74 | 0.58 | 0.41 | 0.25 | 0.08 | -0.08 | -0.25 | -0.41 | -0.58 | -0.75 |
| AUS | 0.94 | 0.94 | 0.93 | 0.93 | 0.92 | 0.92 | 0.91 | 0.91 | 0.90 | 0.89 |
| MYS | 1.01 | 0.95 | 0.89 | 0.83 | 0.78 | 0.72 | 0.66 | 0.60 | 0.54 | 0.48 |
| NZL | 9.49 | 9.49 | 9.48 | 9.48 | 9.47 | 9.47 | 9.46 | 9.46 | 9.45 | 9.44 |
| MEX | 0.80 | 0.81 | 0.83 | 0.84 | 0.85 | 0.86 | 0.88 | 0.89 | 0.90 | 0.91 |

Note: Countries from top to bottom are Canada, Peru, Chile, Brunei, Japan, Singapore, Vietnam, Australia, Malaysia, New Zealand, and Mexico.

Source: Authors' calculation using UN Comtrade data.

5. Conclusion and Prospects

To investigate the competitiveness and complementarity of agricultural trade between Korea and CPTPP countries, this study analyzed the Revealed Comparative Advantage index, export similarity index, and trade complementarity index based on agricultural products data from 2012 to 2021. Additionally, an ARIMA model was used to project the complementarity index for the period of 2022 to 2032, predicting future trends. The conclusions of this research are as follows. First, Korea has a low RCA index for the agricultural products trade, indicating a disadvantageous position, with only slightly higher values than Brunei and Japan, but significantly lower than other CPTPP countries such as New Zealand, Chile, Peru, and Canada. This suggests that Korea's agricultural products trade competitiveness is weak and lacks a competitive advantage. Secondly, Korea has the highest export similarity index with Japan, indicating a high level of similarity in export structures, but it is not identical. Overall, the export similarity index between Korea and other CPTPP countries is generally low, indicating significant differentiation in agricultural products exports, a reduced level of competition, and the potential for cooperation. Thirdly, the overall trade complementarity index of Korea with CPTPP countries is relatively high. Korea has a high level of complementarity in agricultural products trade with Canada, Peru, Chile, Vietnam, Australia, Malaysia, and New Zealand. If Korea joins the CPTPP, it can further cooperate with other member countries with enormous development potential. The results of the ARIMA model forecast indicate that, although there will be fluctuations in the agricultural products trade complementarity index from 2022 to 2031, the overall level is high, indicating that there is good complementarity in the agricultural product trade between Korea and CPTPP countries, and there is significant potential for future cooperation and development. In general, Korean

agricultural products lack competitiveness as compared with CPTPP countries, but the similarity of export structure is not high, and the complementarity is good. The forecast results show that there is also some complementarity between Korea and CPTPP countries in the future, so there is some room for the development of cooperation in the agricultural products trade between Korea and CPTPP countries.

Since this paper adopts the HS two-digit code for classifying agricultural products, the data are too comprehensive and may obscure the actual competitive relationship in the process of data summation. In subsequent research, more detailed and accurate research can be conducted for segmented agricultural products.

As for the shortcomings of Korea's trade in agricultural products, Korea needs to consider the weak competitiveness of agricultural products and take advantage of the differences and complementarities in the structure of agricultural products with CPTPP countries to promote the development of Korea's agricultural trade in the face of the opportunities and challenges that will be brought by joining the CPTPP. Based on the research results, and in combination with the CPTPP agreement, the following recommendations are proposed. First, Korea should open up the agricultural product market moderately, actively use trade barriers and other measures to protect agricultural products, avoid excessive liberalization, and effectively guarantee food security. Second, it must optimize the agricultural industry structure and improve the quality of agricultural products. In order to avoid an impact on the agricultural products trade after joining the CPTPP, while using trade barriers and other methods for protection, it should also actively promote the optimization of the agricultural products industry structure, improve quality, add value to agricultural products, and comprehensively enhance the international competitiveness of the Korean agricultural products trade. Third, Korea needs to deepen cooperation with CPTPP countries, give full play to the advantages of agricultural product complementarity, expand agricultural product export channels, and effectively promote agricultural product exports. In view of the weak competitiveness of Korean agricultural products, measures must be taken as soon as possible to enhance competitiveness. By increasing the added value of agricultural products, developing characteristic agriculture, and accelerating the development of agricultural technology, the disadvantageous situation can be reversed, and the positive role of joining the CPTPP can be better utilized to promote the growth of agricultural product exports.

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