

Measurement and Analysis of Agricultural Products Trade Level between China and Ukraine

Abstract. The analysis of intra-industry trade and inter-industry trade in international trade in different regions can fully explain the status of export trade and the advantages and disadvantages of products in different regions. The purpose of this research is to analyze the overall agricultural trade situation between China and Ukraine and the nature of the specific trade. To analyze agricultural import and export trade data between China and Ukraine, the author uses the Grubel-Lloyd index (intra-industry trade index) and the Brulhart index (the marginal inter-industry trade index in a specific period). The Grubel-Lloyd index measures the intra-industry trade of a particular product. The Brulhart index is closely related to that of intra-industry trade, that being the export and import of the same items, but concerns changes in exports and imports between two points in time as opposed to their values at a given point in time. The research is based on data for 2011-2020, which are contained in the UN Comtrade database. The research results show that agricultural trade between China and Ukraine is mutually beneficial. The difference in agricultural resource endowment and agricultural structure directly affects the trade of agricultural products between the two countries. The agricultural products exported from China to Ukraine are mainly unprocessed or primary processed agricultural products. Seafood, meat products, fruits, and vegetables account for a large proportion. The main imports are also primary processed agricultural products such as grains and vegetable oils. The agricultural product trade between the two countries is mainly based on intra-industry trade, and the difference in agricultural technology level is an important factor in determining bilateral agricultural exports.

Keywords: agricultural trade, inter-industry trade, intra-industry trade, export value, import value.

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Оцінка та аналіз рівня торгівлі сільськогосподарською продукцією між Китаєм та Україною

Анотація. Аналіз внутрішньогалузевої та міжгалузевої торгівлі в сфері міжнародної торгівлі дозволяє оцінити стан експортної торгівлі, а також виявити переваги та недоліки продукції в різних регіонах. Метою цього дослідження є аналіз стану торгівлі сільськогосподарською продукцією між Китаєм та Україною та виявлення характерних рис торгівлі між цими країнами. Для аналізу даних про торгівлю (імпорт та експорт) сільськогосподарської продукції між Китаєм та Україною автор використовує Індекс Грубеля-Ллойда (індекс внутрішньогалузевої торгівлі) та Індекс Брюлхарта (граничний міжгалузевий індекс торгівлі за певний період). Індекс Грубеля-Ллойда дозволяє оцінити внутрішньогалузеву торгівлю певним товаром чи послугою. Індекс Брюлхарта характеризує внутрішньогалузеву торгівлю та стосується змін в експорті та імпорті між двома моментами часу на відміну від їх вартості в певний момент часу. Дослідження базується на даних за 2011-2020 рр., які містяться у базі даних UN Comtrade. Результати дослідження свідчать, що сільськогосподарська торгівля між Китаєм та Україною є взаємовигідною. Різниця в забезпеченості сільськогосподарськими ресурсами та структурі сільського господарства безпосередньо впливає на торгівлю сільськогосподарською продукцією між двома країнами. Сільськогосподарська продукція, що експортується з Китаю в Україну, в основному є необробленою або первинною сільськогосподарською продукцією. Велику частку займають

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морепродукти, м'ясні продукти, фрукти та овочі. Основним імпортом є також сільськогосподарські продукти первинної переробки, такі як зерно та рослинні олії. Торгівля сільськогосподарською продукцією між двома країнами в основному базується на внутрішньогалузевій торгівлі, а різниця в рівні агротехніки є важливим фактором у визначенні двостороннього експорту сільськогосподарської продукції.

Ключові слова: сільськогосподарська торгівля, міжгалузева торгівля, внутрішньогалузева торгівля, вартість експорту, вартість імпорту.

1. INTRODUCTION

With the continuous and rapid growth of China's economy and the increasing consumption level of the people in China, the demand for agricultural products has increased. China can no longer fully meet people's demand for agricultural products at a lower cost by relying solely on domestic production. Since 2004, China's agricultural product trade has been in a state of deficit and has a tendency to continue to expand; China has transformed from a net exporter of agricultural products to a net importer of agricultural products, and the demand for agricultural imports will continue to expand in the future. Ukraine is rich in agricultural resources. Its land area ranks second in Europe. Domestic agricultural land accounts for 68.7% of the country's land area. Agricultural exports account for more than 40% of the total export trade. It is called the "European granary". Ukraine has now become the world's largest exporter of sunflower oil. Agricultural products such as corn, wheat, barley, soybeans, and rye are highly competitive in the international agricultural export market.

In recent years, the agricultural trade between China and Ukraine has grown rapidly. In 2019, China has become Ukraine's largest agricultural product trader. However, China's imports of agricultural products from Ukraine are mainly sunflower oil, corn, and food industry waste, and there are not many types of products. In today's situation where trade frictions between China and the United States continue to be complex and changeable, strengthening China's and Ukraine's agricultural trade exchanges is of great significance to promoting the diversification of China's agricultural trading partners and ensuring the stability of China's agricultural product market and food security.

2. LITERATURE REVIEW

As an important global trade field, agricultural trade has long been the subject of research by many scholars. Scholars have studied the role of agricultural trade and the status of agricultural trade between different regions or countries from different perspectives. For the role of agricultural trade, Baylis Kathy, Heckelei Thomas, Hertel Thomas W. (2021) believe that global agricultural production consumes a lot of resources and produces significant pollution. But trade has a substantial impact on the environmental sustainability of the world's food system by moving production to new locations and inducing changes in technology and inputs. This is primarily to the fact that trade can reduce the environmental impact of food production by shifting production to places with more resources and higher production efficiency. In addition, trade can also limit the effectiveness of national environmental policies, because

production can be transferred to countries with less stringent regulations. At present, some consumers are using trade policies to induce exporters to improve environmental sustainability. Although these policies have been promoted in rich countries, these measures will not be able to take effect if the source of the problem is not addressed by decision-makers in the country where the environmental damage occurs its potential.

Eum J, Sheldon I, & Thompson S. R. (2021) constructed an enterprise model to determine the relationship between enterprise productivity and product quality. The model analyzes the impact of trade costs on the trade of food and agricultural products through bilateral trade data of 159 countries from 2010 to 2013. The results show that the ability of an enterprise to produce high-quality products is an important factor restricting the export of agricultural products; in addition, fixed costs and variable costs may have a negative and significant impact on the export of agricultural products. Roux N., Kastner T., Erb K.-H., Haberl H. (2020) believe that more and more agricultural trade between countries will lead to deforestation and transformation of terrestrial ecosystems, which will affect important ecosystem functions.

International trade reduces human pressure on the land ecosystem by optimizing the combination of origins, that is, purchasing agricultural products from countries with more efficient land use. Through the exponential decomposition analysis of the data set of human occupation of net primary production contained in the bilateral trade flows of 392 agricultural products between 167 countries from 1986 to 2011. The results of the study show that global trade in agricultural products has reduced the damage to the origin of agricultural products, but this situation has reversed since 1999. After 2008, on average, countries have increasingly purchased agricultural products from less efficient regions. It has not played a positive role in reducing the impact of humans on the land ecosystem.

Dang L., & Zhao J. (2020) use panel data from China and 28 countries along the Belt and Road from 2006 to 2017 to construct a stochastic frontier gravity model and trade inefficiency model for agricultural exports, and analyze trade efficiency, export potential, and Expand space. The results of the study show that economic scale, population size, and similar cultural customs have a significant positive impact on agricultural exports, while geographic distance has a significant negative impact; while cultural differences between different regions and differences in political system levels hinder the export of agricultural products trade efficiency.

Tuninetti M, Ridolfi L. & Laio F. (2020) argue that the international agricultural trade has triggered

interdependence between distant countries in economic and environmental aspects. Agricultural trade is also believed to cause environmental threats related to biodiversity loss, freshwater resource depletion, and pollution. However, agricultural trade can encourage the most efficient production and minimize the use of natural resources needed for agriculture. Through a national-level assessment of the future international trade of six major crops and three animal products, socio-economic scenarios with different levels of economic development, eating habits, population growth dynamics, and market liberalization levels have been established. The research results show that the demand for agricultural products in the future and the corresponding trade flow will increase significantly compared with the current level, especially in the economic optimistic scenario, the trade volume will increase the most.

The trade of crops for animal feeding will account for the main part of the future agricultural trade, and it is expected that corn will become the most traded crop. The huge changes in global food sources and agricultural trade in the future will endanger the water resources of agricultural production areas, and at the same time increase the pressure on those areas that will continue to provide food in the future.

Jia P. N., Liu A. M., Cheng S. K., Qiang W. L., Liang W. U., & Peng L. I. (2019) studied China's imports of bulk agricultural products. Brazil and the United States are the main importing countries. The main land-intensive agricultural products ensure food supply. In ensuring the supply of agricultural products, China should implement the "going global" strategy, expand foreign agricultural investment, formulate long-term agricultural investment plans, strengthen control over overseas agricultural resources, and reduce production risks.

To improve the supply capacity of foreign agricultural products, China should choose the best overseas investment areas, develop international soybeans, palm oil, and other edible oils, and give priority to fatty raw materials that are imported and highly dependent on foreign countries. Encourage enterprises to participate in the development of foreign agricultural resources and integrate the global agricultural trade system. Yang J., & Dong W. (2019) researched the import and export trade of agricultural products after China acceded to the WTO.

The contradiction between slow production adjustments has intensified. The changes and characteristics of China's agricultural product trade after 2012 show significant differences from the early stage after joining the WTO. The overall growth rate of agricultural product trade has declined, and the structure of imports and exports of agricultural products has undergone significant changes. Imports of labor-intensive agricultural products maintained rapid growth, their share in agricultural imports continued to rise rapidly, and net exports continued to decline. These will harm the development of China's high value-added agricultural industry, agricultural transformation and upgrading, and the increase in the value-added space of the agricultural industry.

Martin W. (2018) believes that international trade is likely to become a very important field for agricultural and applied economists in the future. Large-scale international negotiations are no longer the focus of emphasis, and more attention is paid to national reforms and regional agreements. Based on the gravity model and geospatial production data, using new analytical techniques to conduct research, the results show that national reforms and regional agreements have created many opportunities for development and progress in the world's agricultural market driving force, trade policy, food safety, and other fields. Research on the trade relations of agricultural products between different regions, Fenghe Z. (2020) used the UN Comtrade database and adopted HS code categories 1, 2, 3, and 4 as agricultural product trade statistics categories, and conducted a statistical analysis of trade data between China and Ukraine from 2014 to 2019.

The research results show that as Europe Granary Ukraine has abundant agricultural resources. The agricultural products trade between China and Ukraine has developed rapidly. China's imports of agricultural products from Ukraine account for almost half of the total import trade. Agricultural products occupy a very important position in China's imports from Ukraine. Exports only account for less than one-twentieth of China's total export trade. China and Ukraine are highly complementary in agricultural trade. In the future, the two countries should further strengthen agricultural cooperation, give full play to their advantages, and maintain the sound development of agricultural trade. Xia Wenhao, Zhang Yizhuo (2021) constructed a stochastic frontier gravity model to measure the complementarity of trade between China and other member countries of the Regional Comprehensive Economic Partnership (RCEP) from the perspective of China's agricultural exports and study the factors affecting trade potential And its trade expansion space. The results of the study show that the complementarity of agricultural trade between China and other member states is on a downward trend.

The economic scale and language of China and the importing country, as well as the population of the importing country, can significantly promote the export of agricultural products. Geographical distance and the size of China's population hinder the export of agricultural products. The overall export efficiency of China's agricultural products to member countries is showing a downward trend. There is still much room for trade expansion with Japan, South Korea, and Singapore. Zhang Fenghe, Medvid Viktoriia, Lu Xu. (2021) using the United Nations Commodity Trade Database 2009-2018 Sino-Russian bilateral agricultural exports and other trade data, respectively calculate the expansion margin, price margin, and quantity margin, and analyze the type, price, and quantity of exported agricultural products.

To conduct research on the current situation of bilateral agricultural exports between China and Russia. The results show that China's exports to Russia are mainly labor-intensive agricultural products, and Russia's exports to China are mainly land-intensive agricultural products. In terms of promoting the export of agricultural

products, China should expand the types and quantities of agricultural products exported, and Russia should increase the added value of agricultural products and increase the export prices of agricultural products. Hao Tian (2020) constructed a gravity model to study the changes in trade volume between China and 16 Central and Eastern European countries and Poland from two variables that affect international trade: economic scale and the distance between the two countries.

The results show that China and the 16 countries of Central and Eastern Europe have frequent agricultural trade and huge potential for the development of trade space; China and Poland have comparative advantages in agricultural trade categories and do not overlap, and there is strong complementarity in agricultural exports. Liu Chunpeng, Xiao Haifeng (2019) Utilizing UN Comtrade database trade data to calculate the revealed comparative advantage index, trade complementarity index, product export similarity index, and trade intensity index to compare the agricultural trade between China and the Nordic countries from 1995 to 2015.

Complementarity, competitiveness, and development potential are analyzed. The research results show that the types of agricultural products that China and the Nordic countries have comparative advantages are quite different; China's agricultural exports and the Nordic countries' imports of agricultural products are highly complementary, while the Nordic countries' agricultural exports and China's agricultural imports are generally at a relatively low level of complementarity, and The export of agricultural products is not very competitive in the world market.

The overall ties of agricultural trade between China and the Nordic countries are not close enough. Zhao Xin (2021) believes that Ukraine, as a large traditional agricultural country in Europe, is rich in agricultural resources; agriculture plays an important role in Ukraine's national economy, and agricultural products occupy an important position in international trade. However, the research results show that the development of agriculture in Ukraine has not been smooth since its independence. There have been many problems in agricultural production, processing, warehousing, logistics, and other links. Solving these problems depends on the support of government policies and continuous investment and improvement of funds; China is the largest in Ukraine as an importing country of agricultural products, the solution of Ukrainian agricultural issues is conducive to promoting faster development of agricultural cooperation with China.

Kuryn M. (2019) studied the bilateral economic and trade relations between Ukraine and China and found that China is currently Ukraine's largest trading country in Asia, and the total annual trade volume accounts for a large proportion of Ukraine's trade volume. However, the results of the study found that there are many influencing factors in the development of trade between Ukraine and China, including factors such as infrastructure construction, financial operation system, scientific and technological research and development system, and national laws.

China's trade marketization and liberalization increased technical support for Ukrainian agriculture, and the introduction of preferential tariffs for China's trade imports, etc., have continuously improved bilateral trade conditions and promoted the common development of bilateral trade. Zhang Hong (2017) Research believes that Ukraine, as an important country connecting Eurasia, actively responds to China's "One Belt One Road" initiative and conducts comprehensive cooperation with China in the fields of infrastructure, investment, trade, and humanities. However, the research results also found that although China and Ukraine have a good historical basis for cooperation, they also face many difficulties. Regional security, the scale, and direction of cooperation, the instability of the political situation all have a negative impact on the cooperation between the two parties. Overcoming these problems is an important issue facing the two countries.

3. RESEARCH AIM

This research aims to analyze the inter-industry or intra-industry trade status of import and export agricultural products in the agricultural trade between China and Ukraine and the development potential of bilateral agricultural trade. The author hopes that the results of this study will be of practical importance and will contribute to the further growth of trade in agricultural products between the two countries.

4. RESEARCH METHODS

This research uses the Grubel-Lloyd index (GL index) and the Brulhart index. The author uses the UN Comtrade Statistics Database 2011-2020 China and Ukraine HS code chapters 1-24 product trade data, excluding China's Hong Kong and China's Macao region data.

5. RESULTS

5.1 The status of agricultural trade between China and Ukraine

Today it is observed the rapid growth in agricultural trade between China and Ukraine. As can be seen from Figure 1, China's imports of agricultural products from Ukraine and the total trade volume of agricultural products between the two countries have achieved substantial growth from 2011 to 2020. Among them, China's imports of agricultural products from Ukraine were US\$866.9 million in 2011 and US\$3.6797 billion in 2020, an increase of 41.344 times during the 10 years.

Although there has been a small number of consecutive declines from 2015 to 2018, there have been substantial continuous declines in 2019 and 2020. Growth; the total trade volume of agricultural products between China and Ukraine was 301.4 million U.S. dollars in 2011, and 3.904 billion U.S. dollars in 2020, an increase of 11.941 times. Similar to China's imports of agricultural products from Ukraine, the total agricultural trade volume between the two countries also appeared continuously from 2015 to 2018. Despite a small decline, continuous substantial growth was observed both in 2019 and in 2020.

This shows that under the premise of rapid economic development in China and rapid improvement in domestic consumption, people's demand for agricultural products is also rapidly increasing. However, in 2018, China trade friction with the United States. China is the main importer of American agricultural products. The trade friction has greatly affected the agricultural product trade between the two countries. China has reduced agricultural product imports from the United States.

At the same time, it is actively strengthening agricultural product trade with other countries and seeking diversified trading partners. As a country rich in agricultural resources, Ukraine has become an inevitable choice for China to expand imports of agricultural products from Ukraine. China's exports of agricultural products to Ukraine were 214.5 million U.S. dollars in

2011 and 220.7 million U.S. dollars in 2020. Except for a few years, such as 149.7 million U.S. dollars in 2014 and a slight decline in 2015 of 84.4 million U.S. dollars, they remained stable during the 10 years.

This shows that the Chinese agricultural product export market and the Ukrainian agricultural product import market are not highly complementary, and Ukraine is not the main market for China's agricultural product exports. In terms of trade balance, from 2011 to 2012, China's exports of agricultural products to Ukraine were greater than imports and were in a surplus. However, since 2013, China's agricultural trade with Ukraine has experienced a deficit, and the overall trend of the deficit is expanding. This is also China. The continuous and substantial increase in the import value of agricultural products is the inevitable result of the low export value.

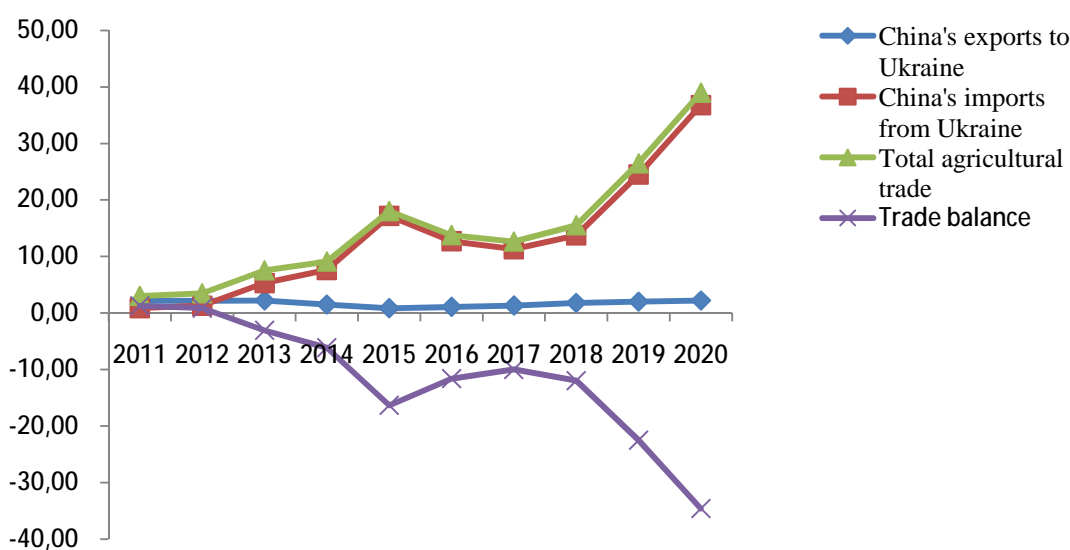


Figure 1. China-Ukraine agricultural trade status (2011-2020)

Note: The ordinate in the figure is the trade balance data. A positive value represents China's trade surplus with Ukraine's agricultural products, and a negative value represents a deficit.

Source: United Nations Commodity Trade Statistics Database, 2021.

5.2 The structure of agricultural trade between China and Ukraine

This research uses the World Customs Organization "Harmonized Commodity Description and Coding System" (HS) to divide agricultural products into four categories: the first category is live animals and animal products, and the codes include HS01-HS05; the second category is plant products, and the codes include HS06-HS14; The third category is animal and vegetable oils, fats and their decomposition products, edible fats, animal and vegetable waxes, and the code is HS15; the fourth category is food, beverages, wine and vinegar, and tobacco products, and the codes include HS16-HS24. Use this classification to analyze the trade structure of agricultural products between China and Ukraine.

The product mix of Chinese agricultural products exported to Ukraine. The agricultural products China exports to Ukraine are mainly seafood, meat products, fruits, and vegetables. According to the calculation of the

UN Comtrade database, the agricultural products exported from China to Ukraine from 2011 to 2020 are mainly concentrated in the three categories of HS3, HS16, and HS20. Chapter 03: Fish, crustaceans, mollusks, and other aquatic invertebrates account for 12% of total agricultural exports, and the trend in the export structure is a slight decline. Chapter 16: Meat, fish, crustaceans, mollusks, and other aquatic invertebrate products account for 30% of the total agricultural exports, and they are in a dynamic trend of small fluctuations in the export structure. Chapter 20: Products of vegetables, fruits, nuts, or other parts of plants account for 15% of total agricultural exports, which is in a slight downward trend. In addition to the above three types of products, HS5, HS7, HS8, HS9, HS10, HS13, HS17, HS21, HS23, HS24, and other types of products accounted for 1% to 8% of the total export of agricultural products, as China's exports of Ukrainian agricultural products Small part.

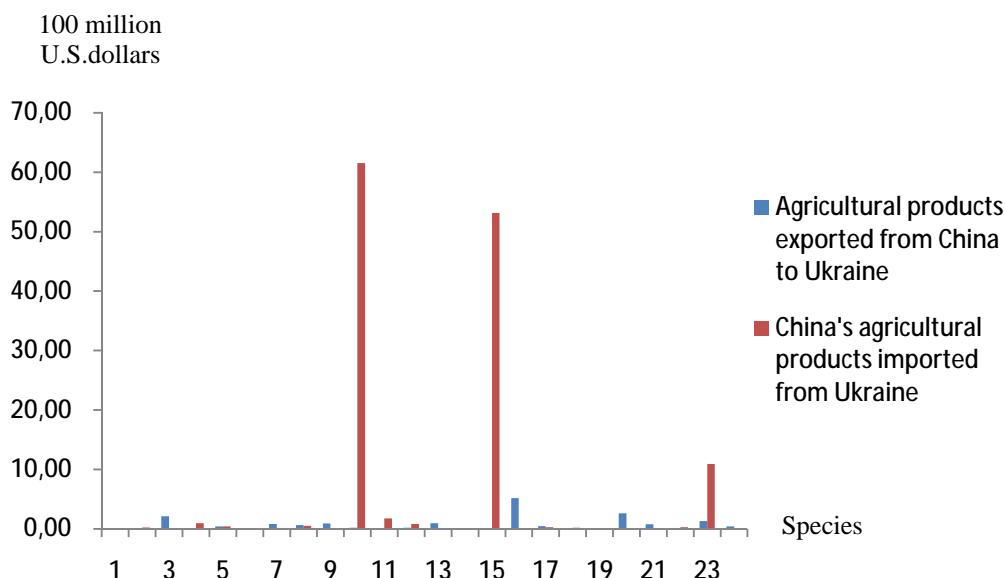


Figure 2. The structure of bilateral agricultural trade between China and Ukraine

Source: United Nations Commodity Trade Statistics Database, 2021.

However, HS1, HS2, HS4, HS6, HS11, HS12, HS14, HS15, HS18, HS19, HS22, and other types of products account for less than 1% of the total agricultural exports, and the trade relationship in China's agricultural exports to Ukraine is not strong. In short, the structure of China's exports of Ukrainian agricultural products is relatively stable. Although the proportion of major agricultural exports fluctuates slightly, the overall trend is stable.

The product structure of China's imports of agricultural products from Ukraine. The agricultural products China imports from Ukraine are mainly grains and vegetable oils. Mainly concentrated on the two types of products HS10 and HS15. Chapter 10: Cereals accounted for 46.86% of the total imported agricultural products, maintaining a growing trend in the import structure. Chapter 15: Animal and vegetable oils, fats, and their decomposition products. Refined edible oils, animal and vegetable waxes accounted for 40.47% of the total imports, showing a continuous growth trend in the import structure. In addition to the above two types of agricultural products, only HS23, that is, food industry residues and waste, animal feed accounted for 8.31% of total imports. The remaining types of agricultural products accounted for less than 1%, and the trade share was very small. This also shows that Ukrainian grains and edible oils are highly complementary in the Chinese market.

By analyzing the trade structure of agricultural products between China and Ukraine, it can be known that the agricultural products China exports to Ukraine are mainly unprocessed or initially processed agricultural products, with seafood, meat products, fruits, and vegetables accounting for a large proportion. China's imports from Ukraine are mainly primarily processed agricultural products such as grains and vegetable oils. This shows that the trade of agricultural products between the two countries is mainly concentrated in labor-intensive products. Both China and Ukraine are

traditional agricultural countries and both have abundant agricultural resources.

Moreover, the current agricultural product trade between the two countries is far from being adequately developed. The two countries should strengthen cooperation and increase mutual trust. In the future, there is still broad room for development in the types and quantities of traded products.

5.3 Analysis on the level of intra-industry trade of agricultural products between China and Ukraine

5.3.1 Static analysis of intra-industry trade

Methodology for estimating the GL index. This index was proposed by Grubel and Lloyd in 1975 and is usually used as an important indicator to measure the static level of bilateral intra-industry trade between the two countries. The calculation formula of the GL index is $GL_i = 1 - \frac{|X_i - M_i|}{|X_i + M_i|}$, where X_i and M_i respectively represent the export value and import value of the i -th agricultural product in a certain period. GL is the simple arithmetic average of the intra-industry trade index values of various agricultural products, ranging from 0 to 1. The calculation formula is: $GL = \frac{1}{n} \sum_{i=1}^n GL_i$. When $GL=0$, it means that the trade form between the two countries is all inter-industry trade; when $GL=1$, it means that the trade form between the two countries is all intra-industry trade. When $GL < 0.5$, it means that the agricultural product trade of the two countries is dominated by inter-industry trade; when $GL > 0.5$, it means that the agricultural product trade of the two countries is dominated by intra-industry trade.

The overall analysis of agricultural products GL index. The calculation results in Table 1 show that the average intra-industry trade index of agricultural products between China and Ukraine from 2011 to 2020 is between 0.12 and 0.26. This data indicates that during the statistical period, inter-industry trade played a leading role in the trade between the two countries. The intra-

industry trade index between China and Ukraine is showing an upward trend. Except for the decline to 0.13 in 2015, which is a large decline, it is generally in a state of rising volatility.

GL index analysis of classified agricultural products.

According to the calculation results in Table 1, it can be seen that the main types of agricultural products dominated by intra-industry trade are chapters 05, 08, 12, 17, and 19, of which chapter 05 miscellaneous animal products has the highest level in the industry, reaching the highest value of 0.94 in 2020. In addition, the 19 chapters of cereals, grain flour, starch or dairy products, pastries, and snacks reached 1 in 2015, showing the characteristics of intra-industry trade; chapter 17 sugar and confectionery; chapter 08 fruits and nuts; chapter 12 Oily seeds, nuts and fruits, and medicinal plants also show strong intra-industry trade characteristics.

Chapter 03 Fish and Other Aquatic Animals, Chapter 04 Dairy, Eggs, Natural Honey, Chapter 09 Coffee, Tea and Spices, Chapter 10 Cereals, Chapter 13 Shellac, Gum, Resin and Other Plant Juices, Chapter 14 Plant Materials for Compiling, Other plant products, Chapter 15 animal and vegetable oils, fats and their decomposition products, Chapter 16 meat and other aquatic invertebrate products; the GL value has remained low in the trade of agricultural products between China and Ukraine, showing a strong Characteristics of inter-industry trade. Among them, Chapter 03 and Chapter 16 trade is exported from China to Ukraine, and Ukraine imports from China rarely. Chapters 10 and 15 Trade is mainly China's imports from Ukraine, while China's exports to Ukraine rarely happen.

It shows that the trade of these products is mainly inter-industry trade, and the trade direction is one-way flow, mainly due to the influence of natural endowments and technological differences. Chapter 01, live animals did not have trade exchanges between China and Ukraine in 2011, 2012, 2013, and 2018; in other years, the GL index only maintained a very low amount, showing strong characteristics of inter-industry trade; the trade direction is China exports live animals to Ukraine, but rarely imports live animals from Ukraine. Chapter 02 Meat and edible offal did not have trade exchanges between China and Ukraine in 2015, 2016, and 2018; the GL index remained low from 2011 to 2014, but in 2017, the GL index reached 0.87, showing a better performance. The strong intra-industry trade characteristics indicate that China and Ukraine have frequent trade and import and export of such products, and they are active in the agricultural product market.

Chapter 12, the GL index of oil seeds and fruits, industrial or medicinal plants, straw, straw, and feed showed a downward trend as a whole, and the trade mode changed from intra-industry trade to inter-industry trade; the direction of trade changed from China to Ukraine. Import and export trade has been transformed into China's import trade. GL index for Chapter 17 Sugar and confectionery and Chapter 22 Beverage, wine, and vinegar show an upward trend. The trading mode of these two types of products has changed from inter-industry trade to intra-industry trade. The trade direction is from China's export trade. The master gradually developed into a model of import and export trade between the two countries.

Table 1

GL Index of Agricultural Products of China and Ukraine (2011-2020)

Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HS01	--	--	--	0.00	0.00	0.00	0.00	--	0.00	0.00
HS02	0.00	0.00	0.00	0.00	--	--	0.87	--	0.04	0.01
HS03	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.08	0.21
HS04	0.01	0.08	0.02	0.00	0.01	0.01	0.00	0.00	0.00	0.01
HS05	0.23	0.90	0.73	0.99	0.13	0.47	0.83	0.88	0.75	0.94
HS06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.40	0.30
HS07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
HS08	0.62	0.64	0.76	0.56	0.28	0.25	0.53	0.62	0.95	0.72
HS09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HS10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
HS11	0.00	0.58	0.08	0.14	0.23	0.82	0.00	0.00	0.00	0.00
HS12	0.72	0.93	0.92	0.72	0.33	0.37	0.17	0.40	0.15	0.13
HS13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
HS14	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.87	0.00	0.00
HS15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HS16	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.07	0.03
HS17	0.02	0.31	0.42	0.63	0.79	0.93	0.94	0.96	0.86	0.76
HS18	0.93	0.70	0.29	0.07	0.03	0.06	0.05	0.23	0.21	0.80
HS19	0.04	0.74	0.33	0.59	1.00	0.85	0.64	0.58	0.50	0.65
HS20	0.00	0.00	0.00	0.01	0.05	0.02	0.03	0.02	0.04	0.06
HS21	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.08	0.19	0.19
HS22	0.19	0.27	0.24	0.12	0.07	0.02	0.43	0.69	0.91	0.56
HS23	0.02	0.00	0.00	0.00	0.00	0.00	0.21	0.26	0.07	0.06
HS24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.47
average	0.12	0.22	0.16	0.17	0.13	0.17	0.21	0.26	0.25	0.26

Source: United Nations Commodity Trade Statistics Database, 2021.

5.3.2 Dynamic analysis of intra-industry trade

Many scholars believe that there are problems in the use of the GL index: firstly, only a single period can be selected for static analysis; secondly, if there is a large trade imbalance, the calculated results may not match the actual situation. The marginal intra-industry trade proposed by Brulhart and other scholars is a new calculation method given to avoid the above problems, that is, the Brulhart index, which is used to analyze the level of intra-industry trade within a certain period. The specific formula is as follows:

$$A_i = 1 - \frac{|\Delta X_i - \Delta M_i|}{|\Delta X_i| + |\Delta M_i|}$$

A_i represents the marginal intra-industry trade index in a specific period, ΔX_i represents the increase in the export value of a certain product, ΔM_i represents the increase in the import value of a certain product; $A_i < 0.5$ means that the trade parties are mainly inter-industry trade, $A_i > 0.5$ indicates that the two sides of the trade are mainly intra-industry trade.

An overall analysis of the Brulhart index of agricultural products in China and Ukraine. The calculation results in Table 2 show that the Brulhart index of agricultural trade between China and Ukraine is stable from 2011 to 2020, and the values are all greater than 0.5, which shows that bilateral agricultural trade is dominated by intra-industry trade; inter-industry trade only accounts for a small share and has little effect.

Analysis of Brulhart index of classified agricultural products. The classified agricultural product index in Table 2 shows that the changes in the dynamic intra-

industry trade index of different types of agricultural products in the past 10 years are different. Specific analysis of these values can show that: Chapter 01, Chapter 03, Chapter 04, Chapter 06, Chapter 07, Chapter 09, Chapter 10, Chapter 11, Chapter 13, Chapter 15, Chapter 16, Chapter 18, Chapter 20, Chapter 21 are all performance. There is strong intra-industry trade, or there is no inter-industry trade. Chapter 02, Chapter 05, Chapter 08, Chapter 12, Chapter 14, Chapter 17, Chapter 19, Chapter 22, Chapter 23, and Chapter 24 Dynamic Intra-industry Trade Index has shown large fluctuations, and it is greater than 0.5 in some years, or less than 0.5 indicates that China and Ukraine are mainly traded between industries and industries in these types of agricultural products. A dynamic analysis of the level of intra-industry trade in agricultural products between China and Ukraine shows that the agricultural products between the two countries are mainly intra-industry trade, and the level of intra-industry trade in agricultural products will still fluctuate.

Among all the influencing factors of intra-industry trade in agricultural products between the two countries, the most important is the difference in the level of agricultural technology. China has a comparative advantage over Ukraine in agricultural production technology. The agricultural products exported by China to Ukraine are mainly technology-intensive, while the agricultural products exported by Ukraine to China are mainly labor-intensive primary agricultural products.

Table 2

Burkhardt Index of Agricultural Products of China and Ukraine (2011-2020)

Category	2011- 2012	2012- 2013	2013- 2014	2014- 2015	2015- 2016	2016- 2017	2017- 2018	2018- 2019	2019- 2020
HS01	--	--	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HS02	1.00	1.00	1.00	1.00	--	0.13	0.14	0.96	1.00
HS03	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00
HS04	1.00	1.00	0.97	1.00	0.99	1.00	1.00	1.00	1.00
HS05	1.00	0.62	0.75	1.00	0.27	0.40	0.42	1.00	0.37
HS06	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.77
HS07	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
HS08	0.51	1.00	1.00	0.17	0.94	0.17	0.18	0.20	0.62
HS09	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.96	1.00
HS10	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.98
HS11	0.68	1.00	1.00	0.96	1.00	1.00	1.00	1.00	1.00
HS12	1.00	0.14	1.00	1.00	0.78	0.95	0.93	0.96	0.90
HS13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HS14	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.23	1.00
HS15	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00
HS16	1.00	0.82	1.00	0.99	1.00	1.00	0.95	0.81	0.54
HS17	0.44	0.21	1.00	1.00	1.00	1.00	0.02	1.00	1.00
HS18	0.57	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00
HS19	1.00	1.00	1.00	1.00	0.29	0.52	0.49	0.62	0.33
HS20	1.00	1.00	1.00	1.00	1.00	0.96	0.92	0.84	0.83
HS21	1.00	1.00	1.00	1.00	0.91	1.00	0.88	1.00	0.83
HS22	0.20	0.84	0.96	0.80	1.00	1.00	0.14	1.00	1.00
HS23	1.00	1.00	1.00	1.00	1.00	0.22	0.90	1.00	0.97
HS24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.02
Average	0.89	0.90	0.98	0.96	0.88	0.85	0.77	0.89	0.84

Source: United Nations Commodity Trade Statistics Database, 2021.

6. DISCUSSION

Influencing factors of agricultural products trade between China and Ukraine. The first is the influence of natural resource endowment advantages. According to the theory of comparative advantage, the natural resource endowments of different countries are different, so the types and quantities of agricultural products that can be produced and exported will be different, and the agricultural products with smaller comparative advantages required by each can be obtained through trade imports. China's agricultural advantages over Ukraine are mainly reflected in the abundant land resources, abundant human resources, and relatively advanced agricultural technology.

China can grow and produce a variety of agricultural products, with relatively low labor costs, and in recent years, with economic development The level of improvement, the improvement of people's educational level, the relatively advanced various agricultural technologies, etc.; while the territory of Ukraine is mostly plains and hilly areas, with many natural lakes and abundant water resources. The black land area accounts for more than 27% of the world's total and is known as the "European granary".

In addition to meeting domestic needs, agricultural products are also exported in large quantities to market countries such as the European Union and Asia. China has become the largest market for Ukrainian agricultural exports, and China's trade deficit with Ukrainian agricultural exports has increased year by year. The characteristics of trade between the two industries are obvious; countries with natural resource endowments can use natural conditions to promote the development of agricultural trade.

Economic development level and technological differences. The most direct factor to measure the level of a country's trade development is the country's economic strength and technological development level. A higher level of economic development and stronger economic strength can promote the rapid development and improvement of trade. The important indicator that can reflect the economic level of a country is GDP, and it can also judge the level of international trade. GDP growth can increase the supply capacity of goods and services, and therefore increase the total trade volume of a country in trade exchanges.

Expanding the consumption of agricultural products. Both China and Ukraine are developing countries. In terms of total GDP, Ukraine is far behind China, and China's agricultural production and service supply are much higher than Ukraine. Compared with Ukraine, China has a large population. To maintain the survival of the population, the Chinese government needs to develop Agricultural production, and maintenance of people's food and clothing are the most important things that successive governments have to consider. With the rapid

development of China's economy, investment in agricultural production has continued to increase, and agricultural production technology has also developed rapidly.

Ukraine has a population relative to its land area. The land area is scarce and suitable for crop cultivation. It is far less urgent than China in developing agricultural technology. Therefore, the difference in economic development and agricultural production technology can enable a country to maintain an advantageous export trade position in one or several types of agricultural products.

The influence of political factors. Since the establishment of diplomatic relations between China and Ukraine, relations between the two countries have been in a good state of development. Ukraine actively participates in the construction of the "Belt and Road" proposed by China. In 2015, it signed a cooperation agreement under the framework of the "Belt and Road" with China, which provides important opportunities for the rapid development of cooperation between the two countries in various fields in the future. However, Ukraine is located in Europe. Due to the influence of geographical relations, the trade policies of the United States and the European Union towards China will affect Ukraine's trade policies towards China. To a certain extent, political factors are important factors affecting the development of trade between China and Ukraine.

7. CONCLUSIONS

The research results show that China and Ukraine's agricultural trade is highly complementary, and the agricultural trade between the two countries is mostly intra-industry trade. This research also provides practical evidence for this important result. The difference in agricultural resource endowment and agricultural structure directly affects the trade of agricultural products between the two countries.

At the same time, this research also has certain limitations. First of all, due to the limitations of research conditions, this study only selected trade data over 10 years as the research object. Future studies can select a longer and updated data period for analysis, reflecting that the agricultural trade relationship between the two countries will be more comprehensive. Second, major emergencies can have an important impact on international trade. For example, the global spread of the new coronavirus is not included in this study.

Therefore, such major international events can be considered as factors affecting trade changes in further research. Third, this research is only a demonstration and analysis of selected trade data using mathematical models, but the traditional culture and government policies of the two countries can also have a significant impact on bilateral trade exchanges and promote or hinder trade cooperation.

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