Research on the Position Measurement of China's Agricultural Global Value Chain

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Abstract: Agriculture is an industry to maintain human survival. Since mankind entered the slave society, agriculture has become an indispensable industry in life, providing necessary nutrients for the continuation of human life and becoming the foundation of human health. Under the background of global economic integration, the international trade in agriculture has gradually developed. In the 21st century, China's economy has been developing continuously, and its position in global trade is increasing day by day. All industries are actively integrated into the global value chain system and play an important role, especially in agriculture. Based on the world input-output table, this paper calculates and evaluates the position and participation of Chinese agriculture in the global value chain, which truly shows the position of Chinese agriculture in the global value chain and provides a powerful theoretical basis for promoting the transformation and upgrading of agriculture-related industries.

1. Introduction

Since the new century, China's total import and export trade of agricultural products has been expanding, especially after China's accession to WTO in 2002. In 2019, the import and export value of China's agricultural products was US$ 228.43 billion, a year-on-year increase of 5.5%, the export value was US$ 78.57 billion, a year-on-year decrease of 0.9%, and the import value was US$ 149.85 billion, a year-on-year increase of 9.3%; In the first half of 2020, the import and export value of China's agricultural products was US$ 115.90 billion, up by 7.5%, the export value was US$ 35.15 billion, down by 3.8% and the import value was US$ 80.75 billion, up by 13.2%, shown in Figure 1.
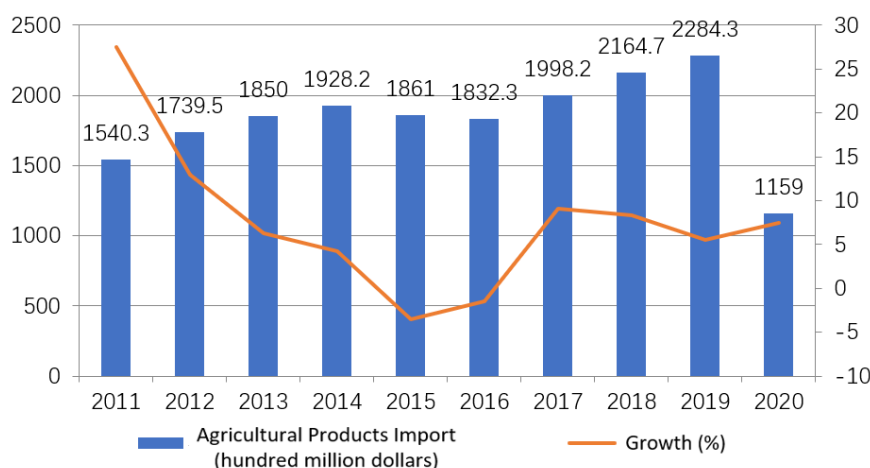

Figure 1 China's total import trade of agricultural products

In recent years, according to the statistics of traditional customs, the export volume of China's agricultural products has increased rapidly. However, China's agricultural products are unbalanced in import and export, and there is a large trade deficit. The ability of agricultural products related industries to sell their products in the international market is not high, and the international competition level is worrying. Compared with the data and information of agricultural products

import and export in a long period, China's agricultural products export is mostly based on low cost, occupying a place in foreign markets, and the added value of goods is low; However, China's imported agricultural products have the advantages of high quality and high scientific and technological content, and quickly occupy China's market with high added value. With the development of society, the cost of manpower increases, the requirement of agricultural production for factor endowment increases, and the appreciation of RMB, the price advantage of China's agricultural products exports gradually declines, and the trade deficit continues to expand.

China is still a big agricultural country, so it is necessary to evaluate Chinese agriculture scientifically and objectively. Especially in the current international environment with frequent trade frictions, a correct understanding of China's status as a big agricultural country in the global value chain of agriculture provides a useful reference for promoting the transformation and upgrading of agriculture and related industries and improving the international competitiveness of Chinese agriculture.

2. Literature review

The measurement of the status of global value chain or international division of labor can be traced back to the Vertical Specialization Index proposed by Hummels et al. (2001), which represents the proportion of imported intermediate inputs in exports and refers to the degree to which countries participate in international division of labor. Liu Zunyi et al. (2007) used the non-competitive input-output method and calculated the domestic value-added rate of exports by using VS index. Huang Xianhai and Yang Gaogao (2010) defined the status of international division of labor as the domestic added value contained in export products and its pulling effect on the country's economic growth (domestic full added value), and put forward "weighted added value-productivity" as a measure of the international division of labor status of high-tech industries. Koopman (2010) comprehensively considered the two roles of a country as an intermediate supplier and an intermediate receiver, covering the indirect export of domestic added value and the foreign added value in export, and put forward the global value chain status index. Zhang Haiyan (2013), Zhang Yonghua (2013), Wang Lan (2014), Zhou Shengsheng, etc. (2014) used this method for reference, and analyzed China's international division of labor from the national level and industry level by using the international input-output table data from 1995 to 2009 jointly released by OECD-WTO. They agreed that China is still at the low end of international division of labor, and the international division of labor-intensive manufacturing sector.

According to the data of the world input-output table in the OECD database, this paper selects the world's major agricultural import and export countries (the United States, China, Brazil, Canada, Australia, the Netherlands, ASEAN, etc.), and decomposes the domestic and foreign share of the added value of agricultural trade with reference to Koopman et al. (2010)KPWW decomposition method, and calculates and analyzes the global value chain status of Chinese agriculture with its constructed global value chain status index and global value chain participation index.

3. Calculation method of China's agricultural global value chain status

3.1 Structure of world input-output table and explanation of Koopman's total export decomposition method

The main purpose of GVC analysis is to decompose the total export based on the global value chain, and finally trace the added value of a certain production link back to each specific country. In order to accurately trace the source of added value in each link, we must use the input-output analysis method and transnational input-output table. Input—output analysis method was first proposed by Harvard economist W Leontief(1936). With the development of research on global value chain, economists applied this method to GVC analysis. By using this analysis method, the total export can be decomposed by matrix operation on the transnational input-output table, and finally the domestic and foreign value-added parts of the export can be obtained. If the domestic added value is further

decomposed, the direct and indirect value-added part of a country's export can be obtained, thus obtaining the "real export" of a country's industry. A typical input-output table between countries is shown in Table 1.

Table 1 A typical input-output table between countries

Output \ Input		Demand for intermediate goods				Final product demand				Total output
		Nation 1	Nation 2	······	Nation N	Nation 1	Nation 2	······	Nation N	
		$1,\cdots,M$	$1,\cdots,M$	······	$1,\cdots,M$					
Intermediate input	Nation 1 $\ 1,\cdots,M$	Z^{11}	Z^{12}	······	Z^{1N}	Y^{11}	Y^{12}	······	Y^{1N}	X^1
	Nation 2 $\ 1,\cdots,M$	Z^{21}	Z^{22}	······	Z^{2N}	Y^{21}	Y^{22}	······	Y^{2N}	X^2
	······	······	······	······	······	······	······	······	······	······
	Nation N $\ 1,\cdots,M$	Z^{N1}	Z^{N2}	······	Z^{NN}	Y^{N1}	Y^{N2}	······	Y^{NN}	X^N
Value added		VA^1	VA^2	······	VA^N					
Total input		$(X^1)'$	$(X^2)'$	······	$(X^N)'$					

On the basis of decomposing a country's total exports from the perspective of added value, Koopman's model for measuring GVC status is very suitable to measure the participation status and export added value of an industry in a country, in which GVC status index and GVC participation index can well measure the participation status of an industry in a country's global value chain, and the foreign added value rate of exports can well measure the export added value of an industry in a country.

Koopman and others put forward the decomposition method of a country's total export from the perspective of added value, which divides a country's total export into five parts:

$$E_r = DV_r + FV_r = V_r B_{rr} \sum_{s \neq r} Y_{rs} + V_r B_{rr} \sum_{s \neq r} A_{rs} X_{ss} + V_r B_{rr} \sum_{s \neq r} \sum_{t \neq r,s} A_{rs} X_{st} + V_r B_{rr} \sum_{s \neq r} A_{rs} X_{sr} + FV_r$$

(1) Including the domestic added value absorbed by the importing country in the final product;(2) Domestic added value directly consumed by importing countries included in intermediate products;(3) Domestic added value included in intermediate products used by importing countries for production and export to third countries;(4) Including the domestic added value produced by one country and sold back to the exporting country in the export of intermediate products;(5) Value added of exports from other countries. The domestic added value of exports is DV_r.

This decomposition method can better distinguish the domestic value-added and foreign value-added of a country's exports, and reflect the real trade gains. On the other hand, it can decompose the double-calculated part of exports, eliminate the statistical illusion of "big trade explosion" obtained by traditional trade accounting methods, and reduce trade imbalances, thus reducing trade frictions among countries. Refer to Koopman's value-added decomposition method (2010) to calculate domestic value-added exports.

3.2 Correlation index

Based on the decomposition framework of trade added value, Koopman et al. constructed GVC status index, which is used to measure the international division of labor position of a specific industry in a country in the global value chain. The specific calculation formula is as follows:

$$GVC\_Position_{ir} = \ln\left(1 + \frac{IV_{ir}}{E_{ir}}\right) - \ln\left(1 + \frac{FV_{ir}}{E_{ir}}\right)$$

In the formula, i stands for industry, r stands for country, and E_{ir} stands for the total export of department i in r country. IV_{ir} indicates the indirect value-added export of r country's i department, which is used to measure how much r country's domestic value-added is processed by the importing country and then exported to a third country, that is, the domestic value-added of r

country included in other countries' exports. $\frac{IV_{ir}}{E_{ir}}$ actually refers to the proportion of domestic added value of indirect exports of r industry in the total exports of r industry in i country, which is also called "GVC forward participation" by Koopman and others. FV_{ir} refers to the foreign added value included in the total export of r country's i industry. Therefore, $\frac{FV_{ir}}{E_{ir}}$ indicates the proportion of foreign added value in the total export of r country's i industry, which is called "GVC backward participation" by Koopman et al.

GVC_Position$_{ir}$ indicates the position of international division of labor in the global value chain of the i department of r country. Obviously, Koopman's basic idea of constructing GVC status index is that the division of labor status of a specific industry in a country in the global value chain is reflected by its relative importance as an intermediate exporter and an intermediate importer in the industry. Specifically, if a country is in the upstream link of the industry, it will participate in global production mainly by providing raw materials or intermediate products to other countries (regions), and its GVC forward participation ($\frac{IV_{ir}}{E_{ir}}$, which is the proportion of indirect export domestic added value to total export) will be higher than backward participation ($\frac{FV_{ir}}{E_{ir}}$, which is the proportion of export China's external added value), and its GVC status index will be higher. On the contrary, if an industry in a country is in the downstream link of global value chain production, a large number of raw materials or intermediate products will be imported to produce the final products. At this time, the GVC forward participation is lower than the backward participation, and its GVC status index is lower. Therefore, the greater the GVC status index, the higher the position of a country in the global value chain, the closer it is to the upstream, the higher the international division of labor, the stronger the profitability and the higher the relative competitiveness; On the contrary, the smaller the index, the lower the position of a country in the global value chain, the closer it is to the downstream, the lower the international division of labor, the lower the profitability and the lower the relative competitiveness.

There is also GVC participation rate index, which can comprehensively measure the overall situation of a country's participation in GVC. The degree of a country's participation in GVC is similar to the international market share. The greater the degree, the more value-added links involved, and the more competitive it is in the international market. The formula is as follows:

$$GVC\_Participation_{ir} = \frac{IV_{ir}}{E_{ir}} + \frac{FV_{ir}}{E_{ir}}$$

The research in this paper is based on OECD database. The database covers 56 industrial sectors in 43 countries (ISTC, Fourth Edition of International Industrial Classification), including data of 28 EU member States and 15 globally important economies, which account for 85% of the global GDP. Compared with other databases, the database provides comprehensive, systematic and consistent time series data on output, added value and trade flow, which come from official statistical data of various countries, ensuring the quality and reliability of the data; Its data base is the product supply and use table of each country, which is the core data of constructing the world input-output table; The database discloses its methodology and basic data, especially the data of social and economic accounts, which greatly expands the application scope of the database; The database decomposes the value of each final product into the contribution share of each country participating in the global value chain and its distribution information, which can be used to analyze the degree of division of labor in the global value chain production process, and can conduct empirical research and comparative analysis on the global value chain of each country and key industries.

4. Calculation results and analysis of China's agricultural global value chain

According to the above calculation method, the status and participation index of agricultural global value chain in major agricultural import and export countries (regions) is shown in Figure 2, which is a comparison chart of the status index of agricultural global value chain in major agricultural import and export countries (regions). The average value is stable between 0.1 and 0.5, and there is no

significant fluctuation. The overall value chain status of agriculture is not very high. At the same time, it can be seen that the United States, Brazil and Australia are higher than the average, their agricultural value chain status is higher, the Netherlands and ASEAN are lower than the average, Argentina and Canada basically float in a small range above and below the average, and China's agricultural product value chain status is steadily rising year by year.
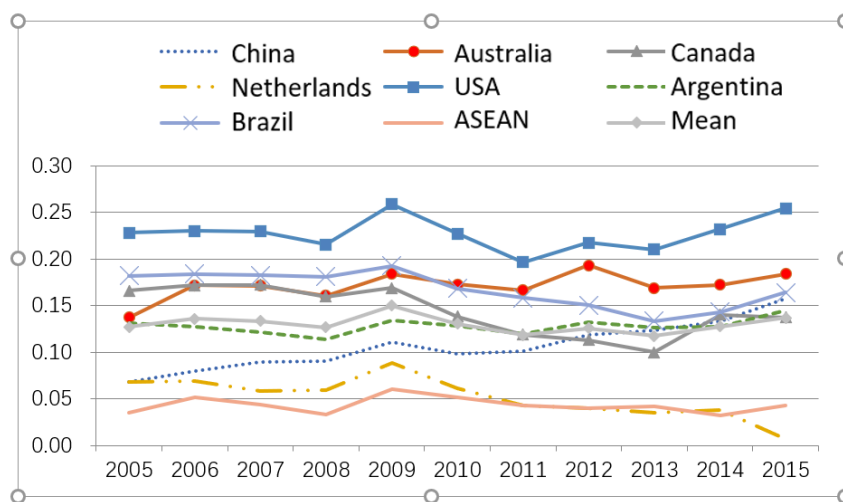

Figure 2 Agricultural global value chain in major agricultural import and export countries/regions

Figure 3 is the participation index chart. It can be seen that countries really have not changed much. Apart from the sudden rise of Australia in 2006, developed countries such as the Netherlands, Canada, the United States and Australia have higher participation in the global value chain, while developing countries such as Brazil, ASEAN, Argentina and China have lower participation in the global value chain, and China is still rising year by year. This participation is basically in line with the basic national conditions. In global trade, developed countries have economic advantages and have a deeper understanding of the global value chain trading system. After all, they are the main contributors and participants of the current world economic and trade system, while developing countries rely more on basic labor resources and primary production factors, and their own productivity may not meet their own productivity needs, and their participation in the global value chain trading system will not be very high.
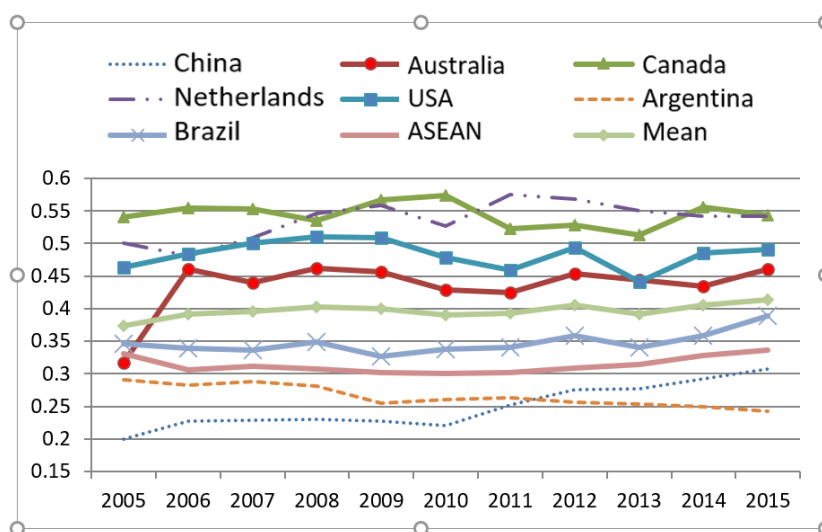

Figure 3 The participation index chart

5. Summary

From the perspective of global value chain, this paper studies Chinese agriculture and finds that Chinese agriculture does not perform well in two indicators, but it is rising steadily year by year.

Unfortunately, both indicators are relatively low. China's agriculture has won the low-end market by relying on products with low added value and high output in global trade. After China's entry into WTO, China actively participated in international trade and agriculture actively participated in the global value chain division system, and the participation index rose steadily. However, the status index and participation index were still low, which echoed the reality that China's agricultural trade deficit was large. It can be seen that the overall international competitiveness level is worrying. China's entry into WTO has deepened the degree of opening to the outside world. Agriculture has won some low-end markets in the international production chain through products with low added value and high output. At the same time, increasing research and development, expanding industry scale and improving infrastructure construction are constantly promoting the rise of China's agricultural value chain status and participation. China's agricultural development is still very long, and the small-scale peasant economy is still deeply rooted. In the long-term development of international trade, it is necessary to break through the low-end locking dilemma, climb from the low-end node to the high-end node of the global value chain, and continuously enhance its participation.

References

[1] Liu Zunyi, Xikang Chen, Yang Cuihong. 2007. Non-competitive Input-Occupation-Output Model and Its Application: Perspective of Sino-US Trade Surplus [J]. Chinese Social Sciences (5): 91-103.

[2] Wang Lan. 2014. The influence of integration into global value chain on the international division of labor of Chinese manufacturing industry [J]. Statistical Research (5): 17-23.

[3] Yang gaogao, Huang xianhai.2013. Internal motivation and the upgrading of the division of labor in the late-developing countries-evidence from China's high-tech industry [J]. Chinese social sciences (2): 25-45.

[4] Zhang Haiyan. 2013. Re-analysis of China's export status based on the value-added trade measurement method [J]. International trade issues (10): 65-76.

[5] Zhang Yonghua. 2013. The position of China's manufacturing industry in the international vertical specialization system: Analysis based on the perspective of added value [D]. Nankai University.

[6] Zhou Shengsheng, Lan Zhenxian, Fu Hua. 2014. Re-examination of the status of China's manufacturing industry in the international division of labor in the global value chain: GVC status index based on Koopman et al. [J]. International Trade Issues (2): 3-12.

[7] Hummels, D., Ishii Jun, Kei-Mu Yi. 2001. The Nature and Growth of Vertical Specialization in World Trade [J]. Journal of International Economics 54(1):75-96.

[8] Koopman, R., W. Powers, Z. Wang, S. J. Wei. 2010. Give Credit to Where Credit is Due: Tracing Value Added in Global Production [J]. NBER Working Paper 16426.