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Quantitative Research on Trade in Value-Added and Emissions Responsibility in Global Value Chain

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Abstract

The obvious defects of traditional trade statistics methods are shown under the circumstances of international production fragmentation and highly integrated network, and the related problems of greenhouse gas emissions during the value-added process of products are also being focused. How to use qualitative research to measure the residual greenhouse gas in the global industrial chain during the value-added process of products in exporting countries is the key point of this research. This paper summarizes the characteristics of value-added industrial development through sorting out the relevant data of the value-added conditions of global value chain, based on the latest released TiVA database of OECD. Then, the paper selects five time nodes of 12 countries, quantifies the responsibilities of the remains of greenhouse gases in exporting countries, based on value-added part under the trade transaction, and further quantifies the corresponding responsibilities of the emission of greenhouse gases in consumer countries.

Keywords

Value Chain, Trade in Value-Added, Value-Added, Emissions of Greenhouse Gases, Responsibility Borne

1. Introduction

In business, the difference between the sale price and the production cost of a product is the unit profit. In economics, the sum of the unit profit, the unit depreciation cost, and the unit labor cost is the unit value added. Summing value added per unit over all units sold is total value added [1]. Nowadays, globalization continuously drives the evolution of the production network, the trend of production fragmentation becomes increasingly sig-

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nificant. Meanwhile, the geographic features of production show rapid changes of decentralization and centralization, and the traditional international trade statistics methods cannot reflect the true dimension of value contribution and the interests gained and lost in the global value chain accurately. In May, 2013, OECD and WTO launched a database resource-TiVA (Trade in Value Added), which aims at measuring and evaluating the value-added extent in global industrial chain. The opening of this database can make the evaluation research of the countries' trade performance tend to be on micro-level, make the main measure indicator change from trade volume to trade in value-added amount possible.

Under the complicated circumstances of highly decentralized global production nodes and highly integrated production network, the dynamic change and the tendency of each countries' positions in the global production network will influence the accuracy of the evaluation of the trade ability of each country and the prediction of the trade potential directly [2]. Meanwhile, the analysis of this problem will reflect the inherent law and the development trend of the global value chain directly; under the condition of fast dynamic adjustment of global industrial chain, the actual effect evaluation of implementation that China vigorously promotes national industries transfer outwards and inwards to some inland underdeveloped areas, is vital to the rationality of the prospective design of the related disciplines about the healthy development of the industrial sustainability; this research implements some relevant analysis and discussions about the responsibilities of emissions of greenhouse gases during the value-added process of global industrial chain.

2. Features of Trade in Value-Added in Global Industrial Chain

The TiVA database divides the commodities and services of trade account into 18 items: 12 trade in goods items and 6 trade in service items. It can be known by observing the trade in value-added amount of 18 items from 1995-2009 that during the 15 years; the trade in value-added situations in each countries trend to present largely increased trends, and the sequence of total growth rate of value-added amount in trade conditions from high to low is: mineral, other service, business service, production manufacturing and recycling, financial service, construction industry, chemical product, wholesale and retail industry, transportation and storage service, food beverage tobacco, basic metal product, electricity, gas and water supply, agricultural product, mechanical assembly, textile and clothing, transportation equipment, electro-optical product, wood print. The global trade value-added amount of minerals in 2009 is 1178.9 billion Yuan, compared with the 284.1 billion Yuan in 1995, the growth rate is 3 times what it used to be; even the smallest growth, which is the growth rate of wood prints, reached 1.52. Although the relevant data were influenced by the global financial crisis and decreased dramatically in 2008, the overall rebounding trend is still clear in 2009 [3].

During the 15 years from 1995 to 2009, the proportions of national added-value in global industries of each country about trade in services or trade in goods generally decrease significantly in trade conditions. Use 1995 as the base year, the data of 57 countries show that major industries, of which national value-added amounts generally decreased dramatically in 2009, mainly focus on production manufacturing and recycling, textile and clothing, minerals, and 64.91% of the countries show decline trends; as for financial service trade, 52.63% of the countries show decrease in different degrees; even the mechanical assembly industry, which declined in the least countries has a 24.56% proportion [4]; according to the TiVA database, the decrease of the global proportion of national value-added amount of a certain industry represents the clear trend of the country integrating into global production network gradually[1], and the data show that the trend of the fragmentation of the industrial chain, which was integrated in the trade conditions of each country was obvious, and the participation of each country in the various global industrial chains increased generally.

3. The Status Change of China in Global Industrial Chain

Through the 30 years of the Reform and Opening, China has established a comprehensive and perfect industrial system [5]. Throughout relevant data, the main changes of Chinese domestic trade added-value in the industry level are: except the small decline of the minerals, other goods and services are in an increase trend; in the 18 good and service items, the proportion ranking of China in the global added value industries is in the front; the global value-added amounts of the textile and clothing, electro-optical product, electricity, gas and water supply industries are in the first positions of the world under the goods and service trade conditions.

The purpose of the industry adjustment and transfer of China is to reduce the high dependency on external single markets of each industry, enhance the attractiveness to the international industries with high added-value,

attract and expedite international high-end technical industries transfer to domestic market, realize the outward transfer of low value-added industries actively, in order to optimize the overall industry system and enhance the international competitiveness of industries [6]. However, according to the related data given in the **Table 1** of domestic added-value of various commodities in trade conditions, such as the textile and clothing industry, the domestic trade added-value increased from 13.29% to 35.67% during the 15 years, and even the outbreak of the global financial crash in 2008 did not influence the rapid and continuous increase of this data, so it can be known that while the participation of Chinese textile and clothing industry were being enhanced, the centralization trend of production even increased, which means if the participation rates of industries increase, the integrity of the value chain participation will be deepen; meanwhile, the imports of intermediate goods of textile and clothing industry shrink gradually, which further illustrates that this industry is being further enhanced in the Chinese geographic concentration; these evidence fully shows the trend that the overseas transfer of this industry hasn't form large scale. Many scholars claim that the textile and clothing industry in China has a new trend of transfer to some south-east Asian countries, from the author's perspective, this international industrial transfer and labor division are only in the rudimentary stage, and industry in China still has an apparent geographic and trade concentration advantage in the global production network.

Measure the change of role and status of China in international industrial division; another key data is the ratio change between the export of intermediate goods and the import of intermediate goods. The proportion of re-export of intermediate goods becomes larger in the import of intermediate goods, which illustrates that the imports of intermediate goods is essential for the country to maintain the participation in the global production network. The trade mode, which sets the processing trade as the main trade method at the beginning of Reform and Opening has 30 years development history, and these data are also very illustrative about whether substantial change is now happening [7]. In 2009, the intermediate goods exports of textile and clothing account for 80.57% of the intermediate goods imports, the proportion of electro-optical product is 72.73%, the proportion of electricity, gas and water supply is 72.73%, and the proportion of basic metal product is 52.29%, the increase rate of the imports of these intermediate goods products are relatively higher, for example, the increase rate of

Table 1. 1995-2009 changes in value-added of global trade.

Product type	1995	2000	2005	2008	2009	Fluctuation
Farm product	138197	131833.6	190181.1	305583.8	264854.9	191.65%
Mineral products	284186.8	393664	815453.2	1684632.6	1178989.2	414.86%
Food and beverage, tobacco	244144.4	244560.5	386436.1	576693.8	501128.8	205.26%
Textiles and clothing	236890.3	279016.1	380924.6	534226.2	451294.4	190.51%
Wood print	215152.2	226559.3	321634.7	400146	328645.8	152.75%
Chemical Products	580106.7	645338	1079503.7	1601426.4	1315932.6	226.84%
Base metal products	313175	313715.3	544397.9	853485.3	636487.5	203.24%
Mechanical Assembly	355440.5	365836.1	568112.9	867287.3	677756.8	190.68%
Electron optical products	629015.1	891602	1001414.5	1347182.8	1164429.4	185.12%
Transport and communication facilities	441978.8	539958.7	811877.5	1067799.4	833406.9	188.56%
Production of manufacturing and recycling	93625.4	121708.6	198441.9	309220.9	260409.5	278.14%
Electricity gas water supply	96173.2	103295.6	171114.9	237034.6	193441.3	201.14%
Constructionindustry	31949.8	31516.8	48761.5	78198.3	77634.2	242.99%
Wholesale and retail	514670.1	612557.5	908563.1	1380135	1165035.1	226.37%
Transportation storage and	419646	476724.5	739198.3	1044745.7	880299.4	209.77%

Unit: million dollar. Data source: http://stats.oecd.org/BrandedView.aspx?oecd_bv_id=data-00648-en&doi=data-00648-en.

electro-optical product in 2009 is 1.519 times of that in 1995; so it can be summarized that the imports of raw materials and the trade of intermediate goods of the traditional processing items are in the pattern with large import volume and large export volume, however, it also reflects the fact that the channel for these industries in China transfer to other foreign countries hasn't formed completely; meanwhile, the pattern of huge export volume and huge import volume of this industry represents that this industry has considerable obstacles and barriers to transfer to Chinese inland areas, and these obstacles are based on the natural properties of geographical, cultural and economic characteristics; in the 18 items, showing the gradually increased dependency on the import of intermediate goods of Chinese industries, which leads to the cohesion of industries transfer to inland areas or to overseas countries. Therefore such situation illustrates a fact that if the development tendency violates the international industry fragmentation and decentralization, the artificial, compulsory and policy-oriented industry will become less efficient on the process of transferring to China's interior area [7].

As a whole, the proportion of re-export of intermediate goods in the total import in China in 2009, whose value only exceed the proportion of global market 50 percent, ranked at 25th among the world. Furthermore, countries, ranking at top, are largely European countries because they possess similar historical and cultural traditions and geographical positions. Countries in the bottom include America, Brazil and Saudi Arabia, and the proportions of these countries respectively reach 16.91%, 14.44% and 13.53%. A low rank reflects that the country has rare direct involvement in networked production processes.

Related data in the following graph reflect the proportion of domestic added value in export per unit in China. A low proportion of this index represents a high foreign value-added proportion. Such relation suggests that when compared with export, import becomes increasing important. From 1995 to 2009, the value-added proportion of export per unit of 16 items among 18 items decreases. Among these items, only the proportion of agricultural product and that of financial service increase. Such situation indicates that the ability of China to use foreign capital is relatively weak and that the ability of such two industries to use global resources is weak and the degree of opening under such two projects is relatively limited [8].

The portion of domestic added value will eventually become the final consumer goods under the drive of material flow and service flow. Use data from 1995 to 2009 as foundation, treat China as the final consumer and take the past 15 years as a whole, countries which rank at top 10 include Taipei, Hong Kong, Singapore, Malaysia, Korea, Vietnam and Thailand. Take Malaysia as an example, its proportion in 1995 is 1.7%, which ranked fourth, and such value increases to 5.69% in 2009 and ranked at the third. Russia, Luxembourg and Indonesia dropped out of top 10. Saudi Arabia, Brunei and Chile successful become the members of top 10. Among these countries, the value of the overall proportion of Saudi Arabia approximately reaches 6.21%. From the data analysis, the tendency that through relying on other countries to satisfy the domestic demand in China becomes increasing obvious [9].

The policy stimulus and incentives effect of domestic industry exist objectively but conduction effect change dynamically because of the contribution ratio of industry value-added chain under the globalization. Therefore, under the value transfer of global value chain, more intense stimulus effect caused by the motive force of needs exist in overseas market. Furthermore, products, which initially import from China and then export, can not only satisfy the demands of Chinese market but also satisfy the demands of global market.

Therefore, when policy-makers measure the stimulus effect of domestic policy, it is inescapable for them to objectively analyze and predict the spillover effect of domestic and overseas market in terms of global value-added chain.

4. The Responsibility of Green House Gas Emissions Based on the Value-Added Flow

Calculated according to the total amount of global greenhouse gas emission, the volume in 2010 reaches 550.101 billion ton of CO_2 equivalent. Top 10 emission countries among the world include China, America, India, Russia, Indonesia, Brazil, Japan, DR Congo and Canada, the total amount of these countries accounts for the 61.6% of the global amount. The amount of China is 11.182 billion ton, reaching the top place among these countries, and is followed by America and India, whose emission amount respectively reaches 6.715 billion ton and 2.692 billion ton. The proportion of green house gas emissions of China, America and India in global market reach 22.32%, 13.40% and 5.37% respectively. Take the whole European Union as a whole, the proportion

of global emissions in 2010 reach 10.49%[1] [10].

In terms of consumption, the green house gas emissions under different national economic production systems can be divided into two types, emissions under domestic residents consumption and emissions under overseas residents consumption; In the process of trade import, the green house gas emissions of value-added portion consumed by importing country remain in exporting countries, thus the responsibilities of green house gas emissions are taken by the final consumer countries of such portion. For the purpose of quantifying the responsibilities under industrial chain value-added dimension, the following formula will be selected to compute.

The Residue of Green House Gas of Value-Added Part after Export = The Total Emissions Amount of Exporting Countries/GDP× Added Value of Importing Countries

The article selects 12 countries as research objects, including 7 developed countries and 5 developing countries. Furthermore, select 1995, 2000, 2005, 2008 and 2009 as the reference years, and then collect and compute the value-added portions of different countries, which export to the above countries and become the final consumer products. Lastly, calculate the corresponding numerical value of green house gas emissions of value-added portions remaining in exporting countries according to the above formula.

Through gathering and then calculating these data, the emission amounts of green house gas remaining in exporting countries can be acquired. The objective facts, which are reflected by analyzing these data, are illustrated as follow: With the increase of total GDP of different countries, the exporting amount of green house gas emissions and value-added portions of different countries both tend to increase. The reason that the data amounts of 2009 are generally lower than that those of 2008 is closely related to the occurrence of global financial crisis. Take Brazil as an example: when compared with the data in 1995, the data in 2009 reveals that the change of value-added of exporting to China is the largest, reaching 1818%, and is followed by India, reaching 1193%. However, in terms of the residue of emissions, the residual amount of added value of exporting from Brazil to other countries can be sequenced according to the value from high to low as following: America, European Union, China, Japan and Russia. Such data of residual amount of green house gas emissions have few relationship with exporting value-added data [11].

When compared with the average amount of residual of green house gas emissions caused by exporting value-added portions of developing countries, that in developed countries or districts is much higher [12]. For example, the amount of exporting value-added portions of Canada to seven countries is 51115.57 million dollar, while that of developing countries is 25907.96 million dollar; the former is nearly 2 times the latter. However, the residual value of green house emissions caused by exporting value-added portions, the green house gas emissions residue caused by Canada export value-added portions to 7 developed countries and to main developing countries, the former is nearly 3.93 times the latter.

The European union is a special case among developed countries. When compared with the total GDP and emissions amount of 27 member countries of EU, the emission residue caused by exporting value-added portions of European countries under the trade condition can be neglected. Such situation fully reveals relative low-level emissions of the whole EU and the efficiency of the control of green house gas emissions.

According to the basic principle of economics, the people who finally consume these goods should pay those public goods. In 2009, the amount of value-added portions exporting from China to America is 201252.6 million dollar. The amount of corresponding green house gas emissions remains in Chinese territory reach 4.28E-04 million dollar, which is the largest amount of exporting value-added portions among 11 countries. Such value is 9.53 times the exporting value-added portion from China to Australia; is 7.93 times that of Canada; is 2.82 times that of Japan; is 8.67 times that of Korea; is 87.24 times that of New Zealand; is 16.08 times that of Brazil; is 9.61 times that of India; is 9.14 times that of Russia; is 31.35 times that of the South Africa; is 0.95 time that of the EU. In 2009, the amount of America export value-added portions to China is 74707.9 million dollar, the corresponding emissions residues in America is 3.38E−05 million unit [13]. Such value is 2.63 times the exporting value-added portion from America to Australia; is 0.49 time that of Canada; is 0.92 times that of Japan; is 2.48 times that of Korea; is 20.08 times that of New Zealand; is 2.38 times that of Brazil; is 2.62 times that of India; is 4.43 times that of Russia; is 10.08 times that of the South Africa; is 0.21 time that of the EU. While

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comparing statistics of two countries, it is obvious that the flow of value-added portions under America-China trade leads to the differences of emissions residue in counterpart territory are huge, the emissions residues of Chinese territory is 12.66 times those of American territory. Therefore, America should undertake more responsibility than China [14].

In this paper, the obvious defects of traditional trade statistics methods were shown under the circumstances of international production fragmentation and highly integrated network, and the related problems of greenhouse gas emissions during the value-added process of products are also being considered. Furthermore, this paper summarizes the characteristics of value-added industrial development through sorting out the relevant data of the value-added conditions of global value chain, based on the latest released TiVA database of OECD. Then, the paper selects five time nodes of 12 countries, quantifies the responsibilities of the remains of greenhouse gases in exporting countries, based on value-added part under the trade transaction, and further quantified the corresponding responsibilities of the emission of greenhouse gases in consumer countries. Relevant data has been provided in this paper and all the quotations have been marked.

5. Conclusion

The division of the global value chain has an indispensable influence toward the economic development of a country. The position of a country in the global value chain and its degree have an impact on the economic carbon emission through the resource consumption and domestic value chain. Concerning the carbon emission, the thing that is to let the exporting countries take all the responsibilities or the importing countries take all the responsibilities is an extreme method. This paper analyzes the responsibility borne problems based on the trade in value-added data and concludes that the responsibility borne should be determined according to the remains of the greenhouse gas emission in the manufacturing country during the production process. The consuming country should be the primary responsibility taker of the carbon emission during the manufacturing process. The portion is related to the trade in value-added, the lower the added value is, the higher portion of the responsibility the consuming country should take. Therefore, the trade in value-added factors should be taken into account in order to establish a more reasonable and fair carbon emission responsibility mechanism in the future. From the corporations' perspective, they should modify their production mode into environmental-friendly mode, and join the division system of the global value chain actively. Corporations should pay attention to the upgrade of the manufacture techniques, developing their brand reputation and using their innovation to facilitate the low-carbon transition, while expanding their exports. From the governments' perspective, they should establish effective industrial development policy and construct new industrial value chain.

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