The Impacts of China-US Trade Frictions on Global and China's regional economy

I.Introduction

Since President Donald Trump provoked China-US trade frictions on the grounds of trade deficits in 2018, the US economic frictions with China have escalated, highlighting the expanding range of goods subject to tariffs, the rising tariff level and the spreading frictions. Notably, with global value chains' deepening division of labor and ever-improving allocation of production factors, considering the huge positions of China and the US, the US imposing additional tariffs on China are bound to cause a "Domino effect" across the global production network.

In particular, regions are important in carrying the impacts of US tariffs on China. China and the US are major influencers on the global economy. The tariffs affect a country's economic growth, and change its internal flow of production factors across regions and even its spatial pattern of economic activities. China's regional economies show strong regional disequilibrium in development level and industrial structure, which directly determines the differences in direct foreign economic and trade ties and role in the division of labor on global value chains.

Specifically, total exports vary across provinces in China. In 2017, Guangdong, Jiangsu and Zhejiang were the top three exporters, registering over 60% of the total national exports. Viewed from the structure of value-added in export, each province's export covers not only its own direct value added but the indirect one created by other provinces, 55.01% and 26.92% respectively in 2017. So, given this fact, the US tariffs on China are to produce differentiated impacts on the economic and social development across provinces in China.

In view of this, the simulation of soft connection between the global computable general equilibrium (CGE) model and China multi-regional input output model is applied with a view to exploring impacts of US tariffs on world economies and China's regional

economy while the world is experiencing profound changes unseen in a century. We organize the rest of the report in the following way. Section Ⅱ provides the impact channels . Section Ⅲ introduces the global computable general equilibrium model, scenarios and model connection. Section Ⅳ interprets the simulation results including national-level and regional-level impacts of US tariffs on world economies and China's regional economy, and the research findings in the last part.

II.Impact Channels

Specifically, through what channels will the US tariffs impact China and other economies in the world? From a global perspective, since the world economy is an inseparable circular system, the US tariffs will cause a major impact on the China-US bilateral trade, and other countries or regions, especially economies with close economic ties with the two. To sum up, the impacts brought about by US tariffs on China's macro-economy and regional economy have four paths:

channel 1: Price Channel

The impacts of US tariffs on China's foreign trade are first exerted through the price channel, manifested in that: (1) US tariffs directly work on the prices of Chinese exports to the US, so trade costs rise rapidly, resulting in shrinking Chinese exports to the US; (2) a large part of intermediate inputs in producing Chinese exports (especially high-tech products) to the US is actually from the US, which means the tariffs indirectly impact Chinese imports from the US. The tariffs' actual effects on China's import and export trade respectively depend on the magnitude of their changes, which is closely related to the China-US trade structure and the products on tariff lists.

Channel 2: Global Value Chains

As the division of labor across global production networks grow detailed, commodity production chain activities are cut into countries or regions all over the world. The impacts of US tariffs on production activities along value chains include two parts. (1) As China tends to take on terminal processing activities as to its division of labor on global value chains, the imposition of US tariffs on products from China will have a

joint effect on the raw material end (upstream end) of commodity production. Then China's shrinking exports to the US will lead to decreased Chinese imports of Japanese and South Korean intermediate products. (2) The US domestic production depends on China. The tariffs will directly increase US domestic production costs and further impact its domestic production of goods. Anyway, US tariffs will impact the global economy along value chains.

Channel 3: Trade Transfer Effect

The US tariffs on China will bring about a trade transfer effect on the product market. Specifically, the prices of Chinese goods exported to the US will grow when the latter levies tariffs on products from China, and making Chinese products less competitive in the US market, which will be an opportunity for other developing countries to be part of the global division of labor and take a place in the US market. This will lead to a corresponding increase in US imports from other countries or regions to meet its domestic demand, and this strong trade transfer effect will eventually lead China from direct to indirect participation in the US market.

Channel 4: Global Factor Allocation

The US blamed its manufacturing stagnation and massive unemployment on the huge trade deficits between China and the US; President Donald Trump sought a recovery of manufacturing through trade protection measures. As a matter of fact, the US has no internationally preponderance over its own structure of essential factors and parts of its production chain (such as furniture manufacturing), and imposing tariffs on Chinese exports will not make it back to the US, but simply reallocate some of its associated productivity to other developing countries. Not only that, China-US economic and trade frictions will make domestic investors much less confident in the US market, with capital flows badly impacted.

III.Models, Scenarios and Model Connection

In addition to studying the impact of US tariffs on different countries and regions in the world, this study focuses on the impact of US tariffs on Chinese mainland's 31

provinces and municipalities (hereinafter referred to as “provinces”).. the economic impacts of US tariffs on China’s provinces are explored from the perspective of division of labor on global value chains. In view of the different industrial structures and industries targeted by tariff lists, the economic aggregates and industrial outputs will be impacted to varying degrees across provinces. Global model, scenarios and model connection are explained in this part.

1. Global model

This report simulates the impacts of US tariffs on China’s exports based on the ENVISAGE model developed by the World Bank. The ENVISAGE model is a dynamic recursive global computable general equilibrium model whose core data is based on the GTAP database, etc. and it covers production, income, energy, and trade. A good thing is that the model dimensions are flexibly adjusted. The equilibrium of the model is achieved in both the factor market and the product market.

The ENVISAGE model details the economic ties among producers, consumers and governments in different countries and economies around the world, as well as the economic and trade relations and industrial ties among them, making it a good tool for simulating the effects of US tariffs on different countries and regions.

2. Scenario

Three scenarios of US imposing tariffs to totally different degrees are designed, under which the impacts on the economic aggregates, imports and exports of China, the US and major trading partners are simulated. According to the simulation results, the soft linkage between the global computable general equilibrium model and China’s multi-regional input output model is applied to assess the impacts of US tariffs on China’s regional economy.

Scenario 1: Since July 2018, the United States has imposed additional 25% tariffs on Chinese $50 billion and $200 billion exports to the United States.

Scenario 2: On Sep 1st, 2019, an additional 10% tariff was imposed $300 billion goods exported to the United States.

Scenario 3: An additional 25% tariff will be imposed on the list of $550 billion goods exported to the United States. (Scenario 1+ Scenario 2).

For the purposes of the study, in this report the basic database is aggregated into 19 countries (or economies), including China, the US and their major trading partners, and 24 sectors (see tables 1 and 2). Based on the change range of tariffs in each sector under the setting scenarios, the ENVISAGE model is applied to simulate China's exports of different sectors after being imposed tariffs to compare with exports without tariffs to measure the change range, that is, the impacts on China's exports of different sectors under different scenarios.

Table 1 List of Countries/Regions in this study

Country/Region	Description
CHN	China
USA	United States
EU	Europe Union
JPN	Japan
KOR	Korea
BRA	Brazil
CAN	Canada
IND	India
MEX	Mexico
ASEAN	Association of Southeast Asian Nations
CEE	Central and Eastern Europe
MENA	Middle East and North Africa
OCEA	Oceania
RUS	Russia
XEA	Rest of East Asia
XSA	Rest of South Asia
XA	Rest of Asia
SSA	Sub-Saharan Africa
XAM	Rest of Americas

Table 2 List of Sectors in this Study

1	Agriculture	13	Ferrous metals
2	Coal	14	Metals n.e.s.
3	Oil	15	Metal Products
4	Gas	16	Motor vehicles and parts

5	Minerals	17	Other Transport Equipment
6	Food products	18	Electronic Equipment
7	Textiles	19	Machinery Equipment
8	Wearing apparel	20	Other Manufacture
9	Wood products	21	Electricity
10	Paper products, publishing	22	Water
11	Chemical, rubber, plastic products	23	Construction
12	Construction Materials	24	Service

3. Model connection

In this report, the simulation of soft connection between the global computable general equilibrium model and China multi-region input-output model is applied with a view to assessing the impacts of US tariffs on China's provincial level. The basic logical framework is shown in Figure 1.

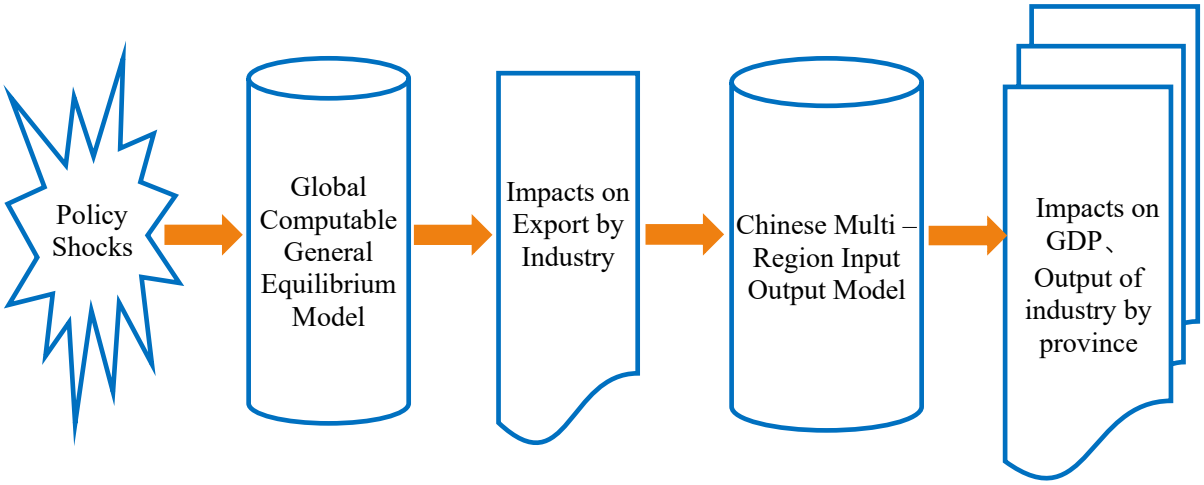

Figure 1 Logical Framework

Based on the logical framework and the national results by sector obtained from the global model simulations, China's multi-region input-output model is soft-connected to estimate the absolute and relative impacts of US tariffs on the value added of each province. The method is as follows:

$$\Delta v = \widehat{fv} \cdot L \cdot \Delta e \qquad (1)$$

$$\Delta e = re \cdot e \qquad (2)$$

$$\Delta v^{s,\cdot} = \theta \cdot \Delta v \qquad (3)$$

Where, Δv means the changes of value-added; $\widehat{fv}$ is diagonal matrix of value added rate;L means Leontief inverse (the total requirements matrix); re means relative impact of China-US trade conflicts on Chinese exports; e means the volume of exports.

The formula is used to calculate the absolute impact of US tariffs on the export value added of each province. With limitation of data availability, this report adopts the value-added rate and Leontief inverse matrix in 2012, which assumes that the value-added rate and intermediate input structure in 2017 are the same as in 2012. The export vector uses the data from 2017. The relative impact on the total economic output of each province is obtained, according to the absolute impact of the US tariffs on the value added in exports of each province:

$$rv^{s,\cdot} = \Delta v^{s,\cdot} / g^{s} \qquad (4)$$

Where g^{s} is GDP of province *s*, $rv^{s,\cdot}$ represents the value added in exports of each province.

IV.Simulation Results

i. National level

1. Characteristics of China in division of labor of Global Value Chains

China is getting much more involved as the division of labor on global value chains grows increasingly refined. China's export destinations in 2010-2018 were concentrated in the US, the EU, Japan and Korea (see Figure 2), hitting 478.4, 408.6, 147.1 and 108.8 billion US dollars (or 19.2%, 16.4%, 5.9% and 4.4% of China's total exports of goods (45.9%)) respectively in total export value in 2018. The figure 2 shows China's close trade relations with these trading partners.

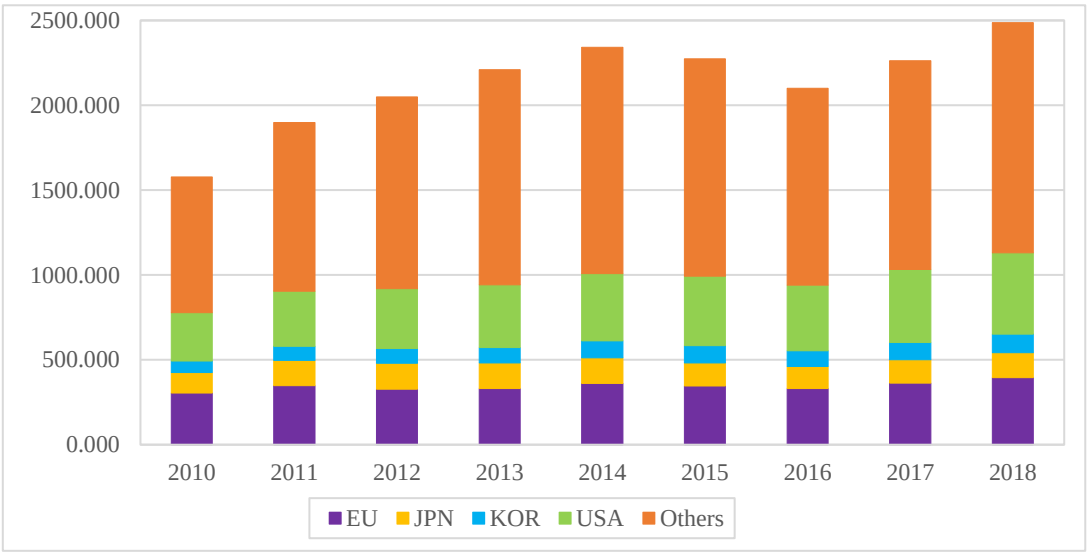

Figure 2 Destinations of Goods Export in 2010-2018（$Billion）

Source: China's General Administration of Customs

The value added in Chinese exports to the US in 2000-2014 is shown in Figure 3. DVA represents the domestic value added in Chinese exports to the US, RDV represents the return value added in Chinese exports to the US, FVA means the foreign value added of Chinese exports to the US, and PDC is the part double-counted of Chinese exports to the US. As is shown in Figure 3, DVA and FVA account for a huge part, about 97-98%. When FVA is further divided, we see that its largest share goes to US, Canada, Mexico, Japan, Korea and Germany (see Figure 4). It means China's export to the US covers a large part of FVA, indicating that China has close trade relations and value chain divisions with other countries or regions. This share refers to the share of the value added of the US, Canada, Mexico, Japan, Korea, and Germany in Chinese exports to the US to the total FVA.

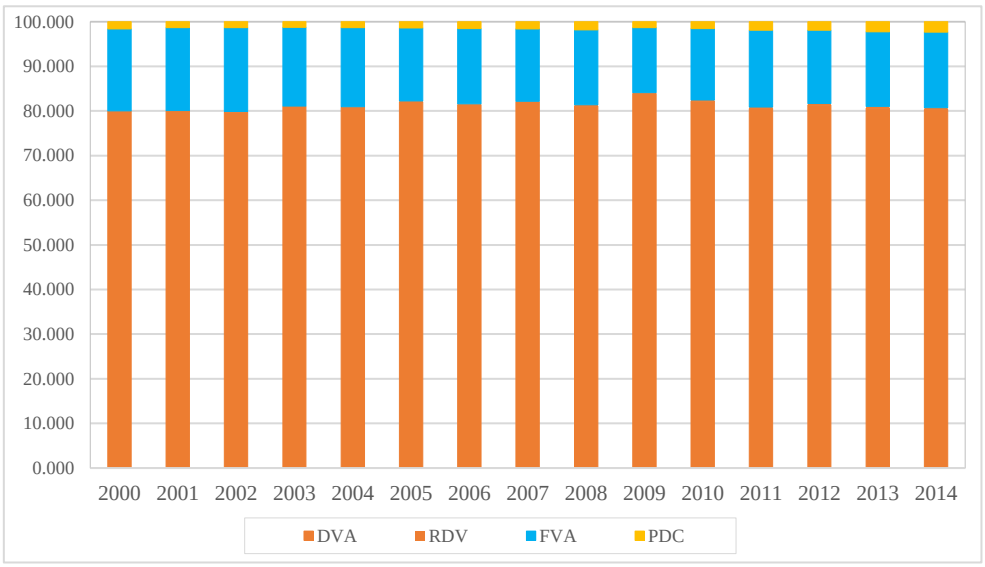

Figure 3　Trade Value-added Decomposition of Export from China to the US（%）

Source: Based on UIBE GVC Indicators

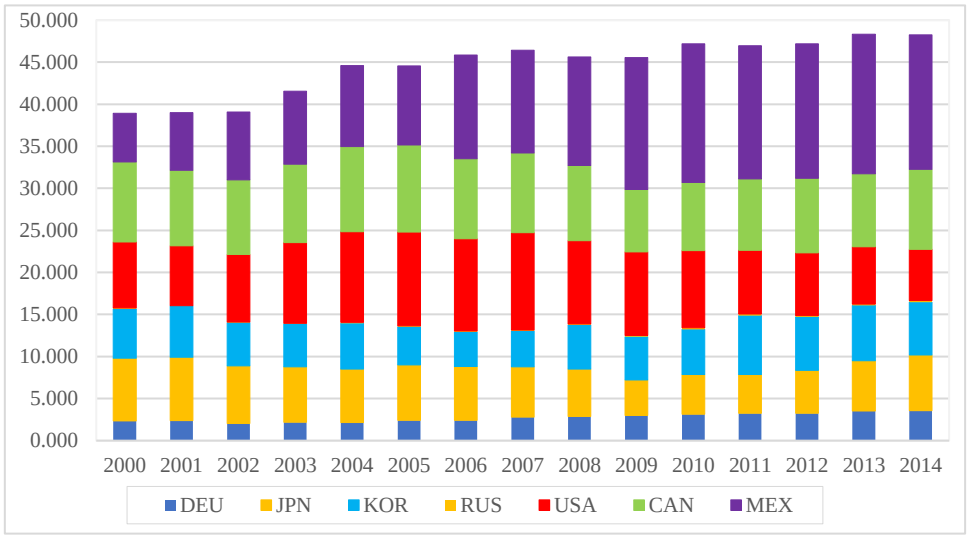

Figure 4　Foreign Value-added Distribution of Export from China to the US（%）

Source: Based on UIBE GVC Indicators

2.　Impacts of US tariffs on global economy

The impacts of US tariffs on GDP and real export of different countries (or regions) are illustrated in this part (see Table 3). The simulation results show that, in the short run, the impacts of the 16 billion, 34 billion and 200 billion tariff lists on China's GDP are relatively limited at only -0.05%, -0.12% and-0.27% respectively; however, the impact

of the 300 billion tariff list reaches -0.61%. A top reason is that electronic products and clothing are the primary products exported by China to the US, relatively few of which are included in the tariffs lists in previous rounds. In scenario 3, for example, the impacts of US tariffs on the GDP and real export of each country are totally different, according to the simulation results. In terms of GDP, US tariffs have a relatively large impact on GDP decline in China, the US, the EU, Japan and Korea. In terms of real exports, US tariffs lead to a decrease of 3.18% and 4.65% in the real exports of China and the US respectively, but other countries see growth in their real exports, indicating a large trade transfer effect after the US imposes tariffs on China.

The US tariffs on China will accelerate the transfer of some industries and parts of production to countries and regions like ASEAN and Mexico, while making Chinese products less competitive in the US market, creating opportunities for other developing countries to join the global division of labor and gain access to the US market. Simulation results show that electronics, furniture and clothing industries are severely impacted by US tariffs, and their outputs would drop by 7%, 6% and 3%, respectively, supposing that US tariff lists were in full implementation. In parallel, other developing countries in strong competition with China will be the beneficiaries of industrial transfer, resulting in large-scale trade transfer effect. The simulation indicates a growth of about 20% in Mexico's electronics output. However, it needs to note that the dependence of these beneficiaries on related sectors in China is also mounting, e.g., Mexico's imports of electronics from China will increase by 30%. It suggests that this industrial transfer is also manifested in China's shift from downstream to upstream in the division of labor on global value chains, and from direct to indirect engagement in the US market. Recent customs statistics also confirm this trend.

Table 3 Impacts on GDP and on Real Export in Different Countries/Regions（S3, %）

Country/Region	GDP	Real Export
CHN	-0.81	-3.18
USA	-0.10	-4.65
EU	-0.03	0.09
JPN	-0.03	0.56
KOR	-0.04	0.38
BRA	0.00	0.41

CAN	0.31	0.90
IND	0.07	0.67
MEX	-0.11	1.37
ASEAN	0.08	0.87
CEE	-0.02	0.05
MENA	0.03	0.21
OCEA	-0.03	0.14
RUS	-0.02	0.23
XEA	-0.04	0.36
XSA	0.09	1.77
XA	-0.06	0.32
SSA	0.00	0.25
XAM	0.08	0.47
World	-0.10	-0.51

Source: Simulation Results

The US tariffs on China will badly impact their major trade partners. The simulation results reveal that the GDPs of major trading partners, including Japan, Korea, the EU, Mexico, will suffer as a result of US tariffs (see Figure 5). China's decreased exports to the US will affect upstream of global value chains as China generally assumes the terminal part in the division of labor on global value chains. Based on the simulation results, we could see that the US tariffs will result in a 7-8% drop in China's imports from Japan, Korea, the EU or other countries and regions, while Canada, Southeast Asia and South Asia will enjoy the benefits. Canada benefits the most, with GDP rising by about 0.3%. As a result, US tariffs on China will produce some ripple effect on the global economy along global value chains.

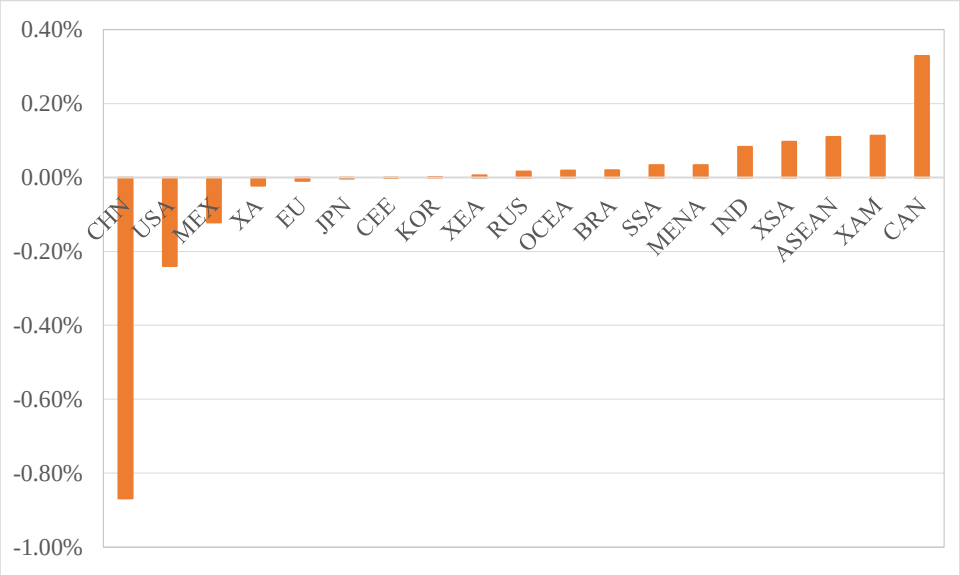

Figure 5　Impacts on GDP in Different Countries/Regions（S3, %）

Source: Simulation Results

ii. Regional level

1. Characteristics of division of labor across domestic value chains in China

The extent to which each province engages in the division of labor on global value chains actually varies significantly (see Figure 6). More or less, the raw materials and parts from other countries or provinces are used as intermediate inputs in producing exporting commodities from different provinces of China, which is why the value added in export of each province is not entirely created by its own. On the provincial average, 55.01% of the value added in export is the value added created by a province its own, 26.92% by other provinces, and 18.07% by foreign value added plus the pure double counting.

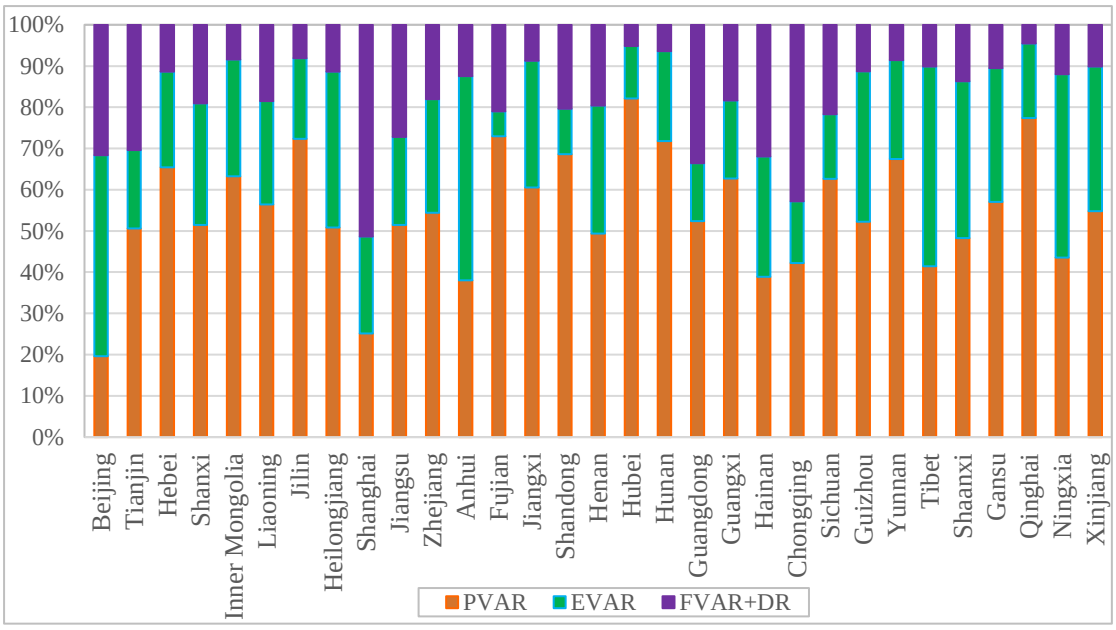

Figure 6 The Composition of Export（ 2017 , %）

Source: Author's Calculation

China's export structure varies from provinces. In the composition of inter-provincial exports, in 2017, for example, with the exception of Beijing, Shanghai, Anhui, Hainan, Tibet, Chongqing and Ningxia, the largest part of the value added in other provinces is created by their own, each above 45%, and as high as 70% in Hubei, Qinghai, Fujian, Jilin and Hunan (see Figure 6). In the inter-provincial export volume, Guangdong, Jiangsu and Zhejiang were the major exporters in China in 2017 at 29.9%, 16.6% and 12.9% of the total national exports respectively, amounting to over 60% of China's total exports in 2017 (see Table 4). In terms of the manufacturing export, we see big differences among the provinces with the largest exports by manufacturing sector, with the export shares of Guangdong, Zhejiang and Jiangsu taking a large part (see Table 5).

Table 5 Provincial Sector with the largest Exports（%）

Sector	Province	PVAR	EVAR	FVAR + DR
Food and Tobacco	Shandong	68.30	17.03	14.67
Textile	Zhejiang	58.43	24.93	16.64
Textiles, clothing, shoes, hats, leather down and other products	Guangdong	61.96	15.88	22.15
Wood processed products and furniture	Guangdong	57.24	20.99	21.77
Papermaking printing and cultural, educational and sporting goods	Guangdong	49.99	17.95	32.06

Petroleum, coking products and nuclear fuel processed products	Liaoning	34.63	17.62	47.76
chemical product	Jiangsu	54.94	22.35	22.71
Non-metallic mineral products	Guangdong	56.49	21.84	21.67
Metal smelting and rolled products	Jiangsu	43.55	33.65	22.80
metal products	Guangdong	48.29	23.41	28.30
General Equipment	Guangdong	45.36	15.58	39.07
Special Equipment	Guangdong	51.96	15.37	32.68
Transportation equipment	Jiangsu	50.26	26.22	23.52
Electrical machinery and equipment	Guangdong	48.17	17.24	34.60
Communication equipment, computers and other electronic equipment	Guangdong	53.08	5.59	41.33
Instrument	Guangdong	51.73	10.24	38.04
Other Manufactural Products	Zhejiang	53.81	31.36	14.83
Scrap and Waste	Guangdong	44.28	12.06	43.66

Source: China's General Administration of Customs

2. Impacts of US tariffs on provincial GDP

In different scenarios, both the impacts and the ways of working of US tariffs on the econom by provinces demonstrate differences. Generally speaking, the negative impact on the export value added of the eastern region is large and direct, while that on the central and western regions is indirect.

At the national level by sector, in scenario 1, the sectors with the greatest impact on the value added are the communication equipment, computers and other electronic equipment industries, followed by the chemical products, the wood processing products and furniture, the paper and printing as well as cultural, educational and sporting goods, and the wholesale and retail industry. In scenario 2, the sectors with the greatest impact on the value added are the textiles, clothing, shoes, hats, leather, down and their products, followed by the textile, chemical products, the agriculture, forestry, animal husbandry and fishery products and services, and the wholesale and retail industry. In scenario 3, the sectors with the greatest impact on the value added include the communication equipment, computers and other electronic equipment industries, followed by the electrical machinery and equipment, the textiles, clothing, shoes, hats,

leather, down and their products, the wholesale and retail industry, and chemical products.

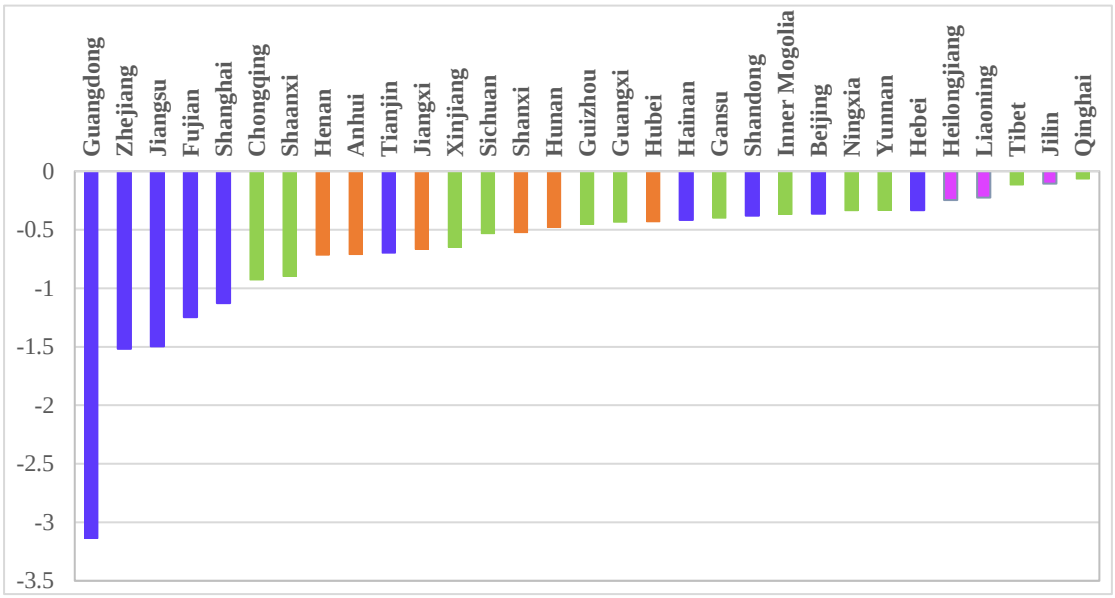

Figure 7　Impacts on Provincial GDP （%, S3）

Source: Simulation Results

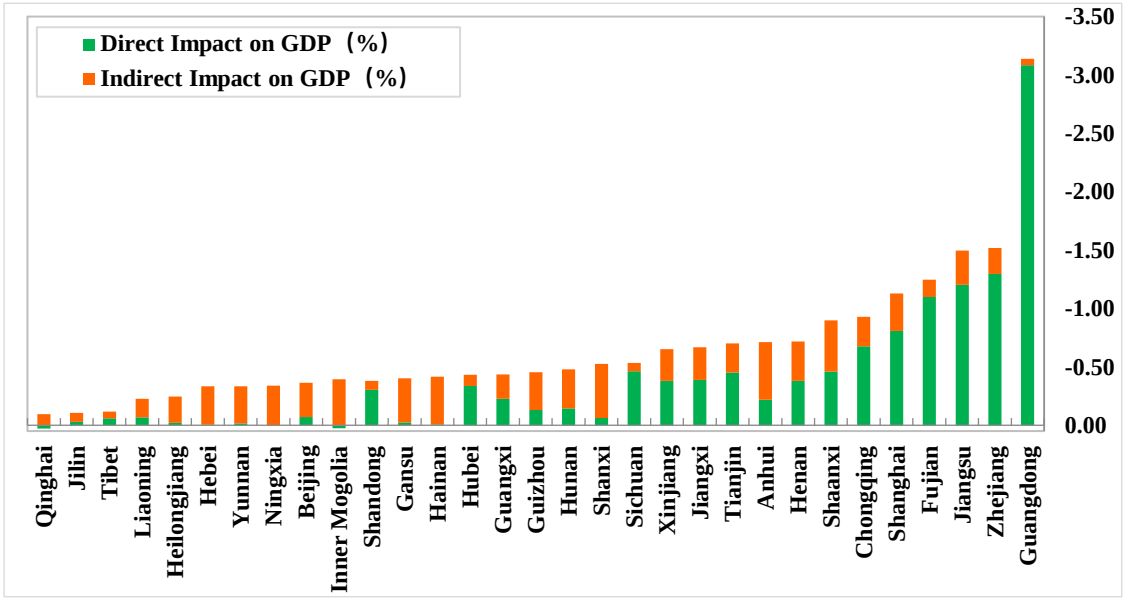

Figure 8　Changes of Provincial GDP — Direct and Indirect Impacts（S3）

Source: Simulation Results

Note: **Direct Impact** means impact caused by change of export from this province to US, **Indirect Impact** represents impact caused by change of export from other provinces to US.

From a provincial perspective, the scenarios affect the change of the value added

through different industries, which has characteristics as follows: (1) in different scenarios, the sectors hardest impacted in the same region are different, e.g., the impact on the value added of the eastern region: under scenario 1, the severely impacted sectors are the communication equipment, computers and other electronic equipment industries, the electrical machinery and equipment, chemical products, the wood processing products and furniture, and the paper printing and cultural and educational sporting goods; in scenario 2, the textiles, clothing, shoes, hats, leather, down and their products, the textile, chemical products, the agriculture, forestry, animal husbandry and fishery products and services, and the wholesale and retail industry; and under scenario 3, the communication equipment, computers and other electronic equipment industries, the electrical machinery and equipment, the textiles, clothing, shoes, hats, leather, down and their products, and the wholesale and retail industry, as well as chemical products. (2) In different scenarios, the sectors hardest impacted vary from provinces, e.g., the hardest-impacted sectors on the value added: under scenario 1, they are the communication equipment, computers and other electronic equipment industries in the eastern region, the metal smelting and rolling processing industry in the central region, the coal mining and selecting industry in the western region, and mainly the agriculture, forestry, animal husbandry and fishery products and services in the northeast region; in scenario 2, they are the textiles, clothing, shoes, hats, leather, down and their products in the eastern, central and northeastern regions, and the agriculture, forestry, animal husbandry and fishery products and services in the western region; and under scenario 3, they are the communication equipment, computers and other electronic equipment industries in the eastern, central and western regions, and the oil and gas exploitation industry in the northeast region.

3. Impacts of US tariffs on sectors across provinces

From the simulation results, we see the hardest-impacted sectors in eastern provinces are the communication equipment, computers and other electronic equipment industries, the electrical machinery and equipment, the textiles, clothing, shoes, hats, leather and feather products, while those in central and western provinces are the communication

equipment, computers and other electronic equipment industries, the coal mining and selecting industry, the agriculture, forestry, animal husbandry and fishery products and services.

However, even provinces in the same region have different sectors impacted, such as the significantly different impacts of US tariffs on the sectors in Guangdong, Jiangsu and Zhejiang, three most developed coastal provinces in eastern China. The reason lies mainly in differences in their export structure (see Figure 9-11). In 2017, the largest export share was taken by the communication equipment, computers and other electronic equipment industries, the electrical machinery and equipment, and the textiles, clothing, shoes and hats, leather and down in Guangdong, and the communication equipment, computers and other electronic equipment industries, chemical products, and the electrical machinery and equipment in Jiangsu, and the textiles, clothing, shoes, hats, leather and down, the textile, chemical products, and the electrical machinery and equipment in Zhejiang.

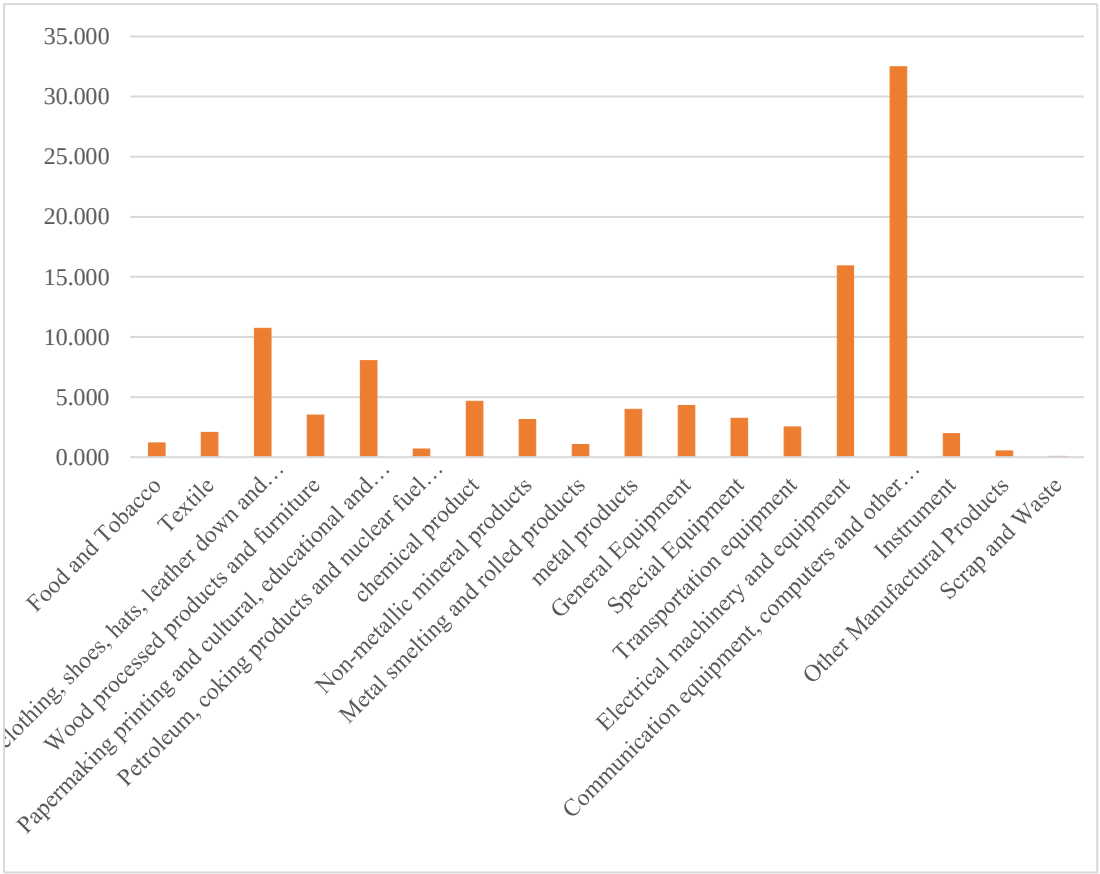

Figure 9 Manufactural Export Structure of Guangdong Province in 2017

Source: China's General Administration of Customs

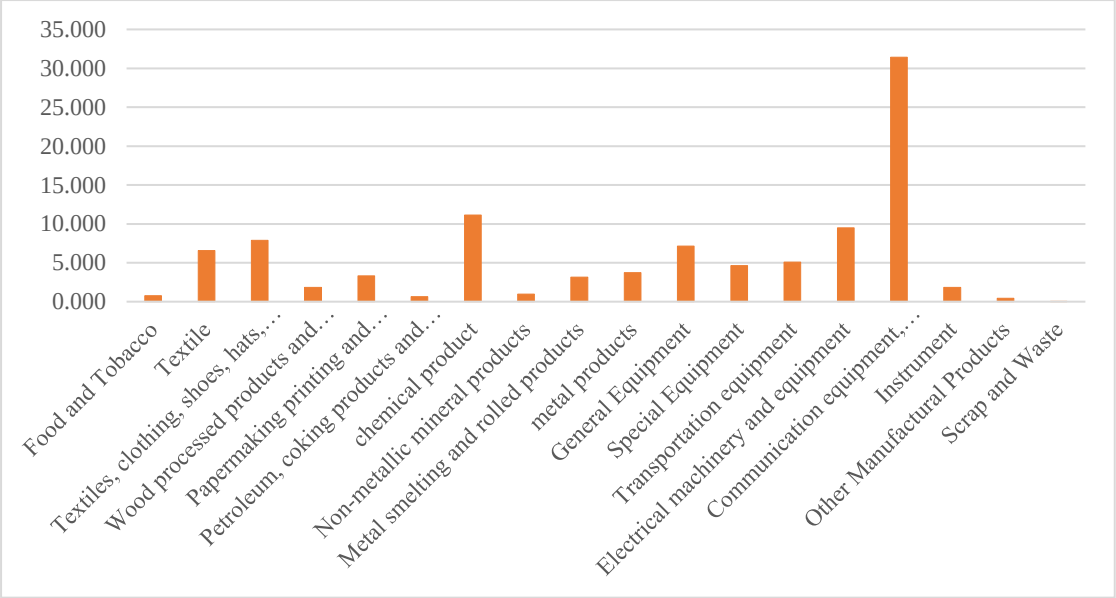

Figure 10 Manufactural Export Structure of Jiangsu Province in 2017

Source: China's General Administration of Customs

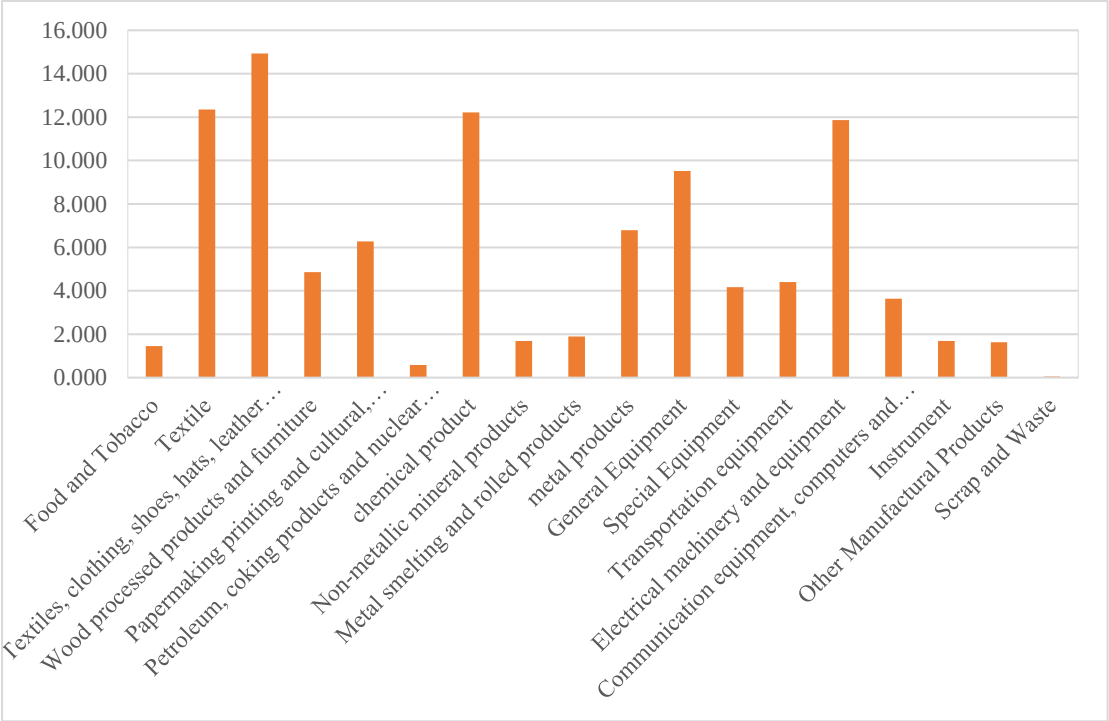

Figure 11 Manufactural Export Structure of Zhejiang Province in 2017

Source: China's General Administration of Customs

In scenario 3, for example, according to simulation results, Guangdong bears the hardest impact on the communication equipment, computers and other electronic equipment industries, with the affected value added at 44.5% of all sectors, followed

by the electrical machinery and equipment industry at 13.2%. The changes of the two in the value added account for 57.7% of all sectors (see Figure 12). In Jiangsu, the communication equipment, computers and other electronic equipment industries is also the hardest-hit sector, with changes in the value added accounting for 30.6% of all, and the electrical machinery and equipment industry and chemical products industry account for 11.2% and 9.3% respectively, with their total changes in the value added accounting for 51.1% of all sectors (see Figure 13). Zhejiang sees small changes in the value added of its major impacted industries. In specific, the textiles, clothing, shoes, hats, leather, down and their products have the largest changes in the value added, or 18.6% of all sectors, followed by the electrical machinery and equipment at 17.3%, and the wholesale and retail industry, the agriculture, forestry, animal husbandry and fishery products and services, the communication equipment, computers and other electronic equipment industries at 9.6%, 9.6%, 9.1% respectively.

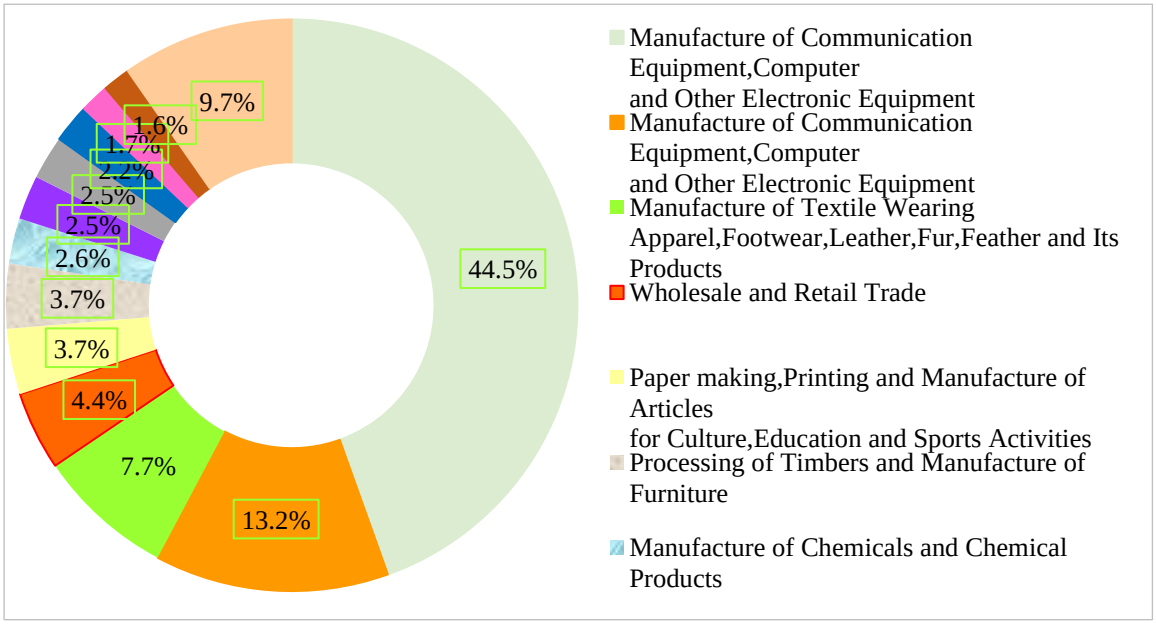

Figure 12　Sectoral Impact in Guangdong Province （S3）

Source: Simulation Results

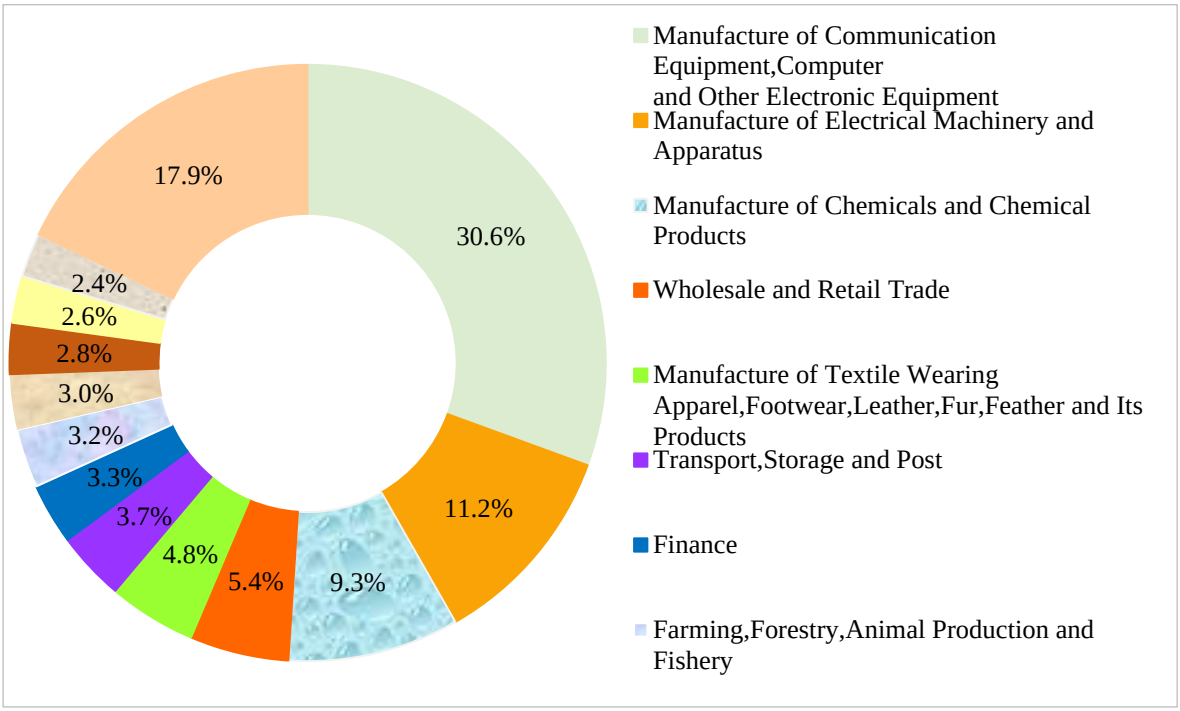

Figure 13　Sectoral Impact in Jiangsu Province　（S3）

Source: Simulation Results

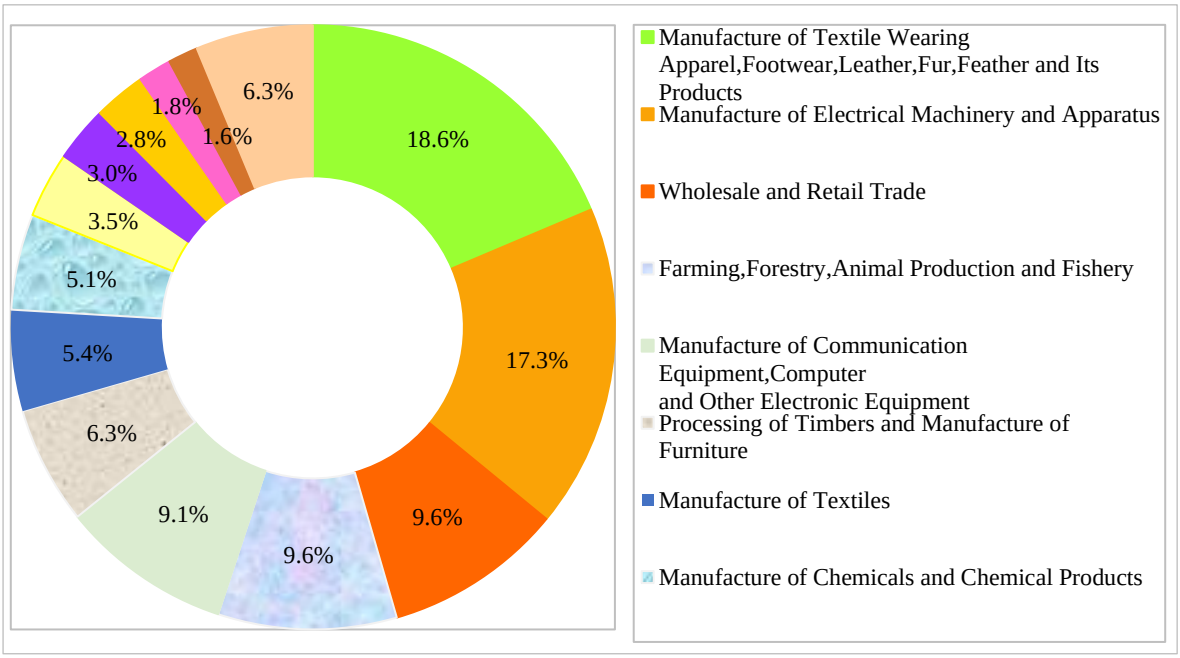

Figure 14　Sectoral Impact in Zhejiang Province　（S3）

Source: Simulation Results

Generally, the impact of US tariffs on the communication equipment, computers and other electronic equipment industries is the most pronounced, while the impacts on

other sectors vary from provinces according to their industrial structures and resource endowments.

V.Conclusion

In this report, the soft connection between the global computable general equilibrium model and China's multi-region input output model is adopted to simulate impacts of US imposing additional tariffs on China's regional economy. The main findings are as follows:

Firstly, the US tariffs on China directly impact the global economic growth. Global economic fluctuations are about to occur under the trade frictions between the US and China, as the economic integration makes all economies depend on each other. Their major trade partners will be terribly impacted. In particular, the GDP of Japan, Korea, the EU and Mexico will suffer under the US tariffs.

Secondly, the impacts of US tariffs on regional economy vary. The direct and total impacts of US tariffs on GDP of eastern coastal provinces including Guangdong, Zhejiang, Jiangsu, Fujian and Shanghai are relatively large. For Anhui, Shanxi, Shaanxi, Inner Mongolia, Gansu and other central and western provinces, the imposition of tariffs indirectly impacts their GDP by affecting the exports of other provinces. Scenario 3 witnesses the hardest impact on provinces' GDP.

Finally, the impacts of US tariffs on sectors across provinces vary significantly. Under different scenarios, we find different major sectors impacted in the same region and different sectors impacted across regions. Under the same scenario, we find different sectors with the greatest impacts on value added and employment demand in the same region. The worst impacted sectors in eastern coastal provinces include the communication equipment, computers and other electronic equipment industries, the electrical machinery and equipment industry, the textiles, clothing, shoes, hats, leather, down and their products, the wholesale and retail industry, chemical products, the agriculture, forestry, animal husbandry and fishery products and services, while those in central and western provinces are the agriculture, forestry, animal husbandry and fishery products and services, the communication equipment, computers and other

electronic equipment industries, the wholesale and retail industry, the coal mining and selecting industry, the metal smelting and rolling processing industry, etc.

In general, China is still at the middle and low ends as to the division of labor on global value chain, with a low profitability and a lack of irreplaceability, so it has insufficient bargaining power after being imposed tariffs by the US. China's current engagement in the global industrial division of labor is relatively limited, as its central and western provinces engage in the division of labor system by providing energy, raw materials and primary products, and have not yet been freed from their dependence on resources, while the eastern coastal provinces have to import a large number of intermediate products. It thus needs to extend and deepen the domestic part of global value chain division of labor so the central and western provinces play a larger role in the global division of labor system.