A Review on the Shock of Sino-US Trade Friction on Semiconductor Industry in China based on the Perspective of Global Value Chain

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Abstract. With the formation of a new international division of labor which takes global value chain as its core, the high-tech industry represented by the semiconductor has gradually become the key point for countries to occupy the top of the value chain and maintain their comparative advantages. However, currently, Sino-US trade friction continues to escalate and the United States has repeatedly lauched trade sanctions in the field of high-tech product trade, posing a great threat to the development of the semiconductor industry in China. By combining relevant literature, this paper finds that the narrowing of technology gap is the fundamental cause of Sino-US trade friction hidden under the surface factor of trade imbalance; The Sino-US trade conflict has a negative impact on global economic welfare of both countries. A number of regulatory measures imposed by the United States on China have curdled the participation and position of the Chinese semiconductor industry in the global value chain.

Keywords: Sino-US trade friction; Global value chain; Semiconductor

1 Introduction

The semiconductor industry is an important strategic industry for national economy, and all relevant countries attach great importance to the security, stability, autonomy

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and controllability of all links of the semiconductor value chain, trying to dominate the global semiconductor industry. Due to the numerous links and complex technology in the semiconductor value chain, local enterprises participate in it to varying degrees whose market segment positions significantly differ. In general, a modern,autonomous and controllable supply chain has not yet been formed in China.

In early 2017, the United States launched trade sanctions against China on the grounds of a huge trade deficit.Since then, the trade friction between the two countries has continued to expand, and the trade of high-tech product represented by the semiconductor industry has become the most fiercely contested area between the two countries. For the purpose of maintaining the international competitiveness, the United States has launched a continuous “market war” and “technology war” against China’s high-tech industries in recent years, trying to use means like technology blockade, export control to hinder the development of these industries especially the semiconductor industry, resulting in the semiconductor industry in China into a “Stranglehold” dilemma.

As the deepening of the international division of labor, it is of great significance to constantly improve the position of the global value chain and the self-sufficiency rate to ensure the country’s irreplaceability. Therefore, enhancing the participation and position of China’s semiconductor in the global value chain is of great significance for the security of the modern information industry and sustainable economic growth in China. Starting from the main background of Sino-US trade friction, this paper studies the specific shock of US scientific and technology policy on semiconductor industry in China from the perspective of global value chain by systematically combining relevant literatures,which has both theoretical and praictical significance for the research on Sino-US semiconductor trade.

2 Sino-Us Trade Friction

2.1 Causes of Sino-US Trade Frictions

Scholars at home and abroad have different views on the causes of Sino-US trade frictions, which are basically discussed in three aspects: trade imbalance theory, political interest theory and scientific and technological "threat" theory.

The article “The origin of the US-China trade war” points out that the Sino-US trade war originates from the deficit issue that has been concerned by US economists

from the beginning of this century. Since the Trump administration took office, the US has repeatedly used its huge trade deficit with China as an excuse to adjust its domestic industrial structure, impose high tariffs and undermine the multilateral trading system for many times. Lin et al. pointed out that the long-term trade imbalance caused by the difference in industrial structure between China and the United States is the root cause of Sino-US trade friction [1]. However, most Chinese scholars believe that the reasonable trade balance between China and the United States is the inevitable result of global resource allocation under the spontaneous operation of the market. The trade friction provoked by the United States is not only an economic issue, but also has more political purposes [2], such as reshoring the manufacturing industry to win key votes [3] and maintain their right of speech in the field of international trade [4]. The science and technology "threat" theory is considered to be the more fundamental cause of the Sino-US trade war, mainly manifested in China's relative improvement of its position in the global value chain [5] and the narrowing of the technology gap between China and the US [6].

Given the rapid development of the scientific and technological innovation, the United States is apparently aimed at the issue of trade imbalance, but in fact it will point to the development goal of "Made in China 2025". It is the conflict between the strong upgrading of China's manufacturing industry and the weak return of the United States manufacturing industry intensified the trade conflict between the two countries and thus the trade friction gradually escalated.

2.2 The Impact of Sino-US Trade Frictions

As for the impact of Sino-US trade frictions, scholars mainly study from two aspects: national economic welfare and global value chain.

Current researches on the impact of Sino-US trade friction on the welfare level of the two countries generally believe that it is not conductive to global economic growth and will lead to the deterioration of the trade environment of the two countries, among which the deterioration of the welfare level of China’s national economy is more significant. However, scholars have mixed findings on the impact of the trade war on US national welfare. Cui et al. and Guo et al. used the General computable equilibrium model (CGG) to presuppose multiple scenarios under China-US trade frictions, and found that Sino-US trade frictions had negative impacts on GDP growth and residents' welfare in both China and the United States[7][8].

Even if some countries benefited from the frictions, they did more harm than good to the world economy. Zhang et al. analyzed the entity list announced by the two countries and the characteristics of the tariff increase[9]. They found that the trade friction directly reduced the bilateral trade volume and produced a trade diversion effect, which caused a negative demonstration effect while worsening the welfare level of residents of the two countries.

In terms of global value chain, from the industry level and time level, the trade control measures of the United States in this trade friction have the most significant negative impact on China's technology-intensive industry [10]. In the short term, trade friction has an obvious hindering effect on the comparative advantage of the manufacturing industry in China, but the effect is weak in the long run [11]. From the spatial level, Lv et al. believe that Sino-US trade frictions will promote the "passive restructuring" of global value chain, that is, the transformation from the"North-South" mode to the "North-North" mode and "South-South" mode[12].

3 Global Value Chain

Sino-US trade frictions have added uncertainty in global value chains to a large extent [13]. Given the further deepening of the international division of labor, the impact of trade policy changes embedded in the global value chain system through tariff cost effect [14] and trade transfer effect [15] is more complex than its impact on bilateral relations. As one of the two most important economies in the world, the trade frictions between China and the United States are closely related to global economic stability and prosperity. But judging from the list of U.S. tariffs on Chinese imports, the United States mainly targets products in high-tech field of China, especially intermediate products in the field of science and technology developed by the "Made in China 2025" plan, which undoubtedly exerts a great negative impact on the export of China's high-tech products, and then has an impact on the GVC position and participation of China's high-tech industry.

3.1 The Global Value Chain Theory and Calculating Methods

The global value chain theory was born in the 1980s, gradually formed in the 1990s, and has been iterated since the 21st century. Michael Porter introduced the concept of "corporate value chain" for the first time when analyzing the production and

operation activities of the company, and proposed that the overall business activities of the company can be divided into specific activities that can create value for the company according to their link positions, nature and functions, and all links are connected to each other to form the internal value chain of the company[16]. Kogut extended this concept to the worldwide range, pointing out that all links of the value chain are vertically separated and spatially redistributed among countries in accordance with the principle of comparative advantage[17]. Arndt and Kierzkowski explained the segmentation in the production process with the theory of "fragmentation", and improved the theory of production outsourcing and global procurement of multinational enterprises. With the advancement of economic globalization since the 21st century, in order to optimize the allocation of core business resources, multinational corporations in developed countries have deeply embedded themselves in the high-end value chain and transferred some non-core production and service links to developing countries, which will further accelerate the formation of an emerging international division of labor dominated by global value chains.

In order to further clarify the position and participation degree of countries in the global value chain, many scholars put forward a number of quantitative indexes from different perspectives, such as HIY [18], the trade added value method [19], GVC position index , export complexity index based on the technical level of final products [20], and forward and backward participation index based on value chain structure [21].

3.2 Global Value Chain of Semiconductor Industry

In recent years, the increasing intensification of global strategic competition in science and technology has led to the emergence of research on the global value chain of high-tech industries, of which the semiconductor industry is the focus of analysis[22]. Relevant research mainly focuses on two aspects,the first one is the research on the transformation and upgrading of the semiconductor industry value chain. For Chinese semiconductor companies, how to climb over the "small yard, high fence"[23] and get rid of the "strangle" problem in the value chain [24] is the key to achieving safer and healthier development. Based on this, Scholars generally believe that China's semiconductor enterprises can actively integrate into the global value chain [25] and enhance the core competitiveness of their products by means of

agglomeration, collaboration and industrial policy incentives. The second is the research on the relationship between semiconductor industry chain and state power game. Presently, the world is experiencing the stage of the fourth industrial revolution, and the production and technology modes of the global value chain have put forward new challenges to the ecological balance of international power [26]. The transformation of value chain power to state power is driven by "technological innovation" and "market share" [27]. Yu et al. proposed that under the superposition of technological nationalism and zero-sum game strategic thinking, the comprehensive technological blockade and containment of China by the United States greatly affected the normal cooperative operation of the global semiconductor industry chain, bringing greater uncertainty and risk[28].

4 Impact of Sino-US Trade Friction on High-Tech Industry in China

4.1 Evolution of US Science and Technology Policy Towards China under Sino-US Trade Friction

With the transformation of U.S. policy toward China from “Engagement” to “Confinement” [29] the high-tech fireld represented by semiconductor has become the core of game between the two countries. In order to maintain its monopolistic competitive advantage in science and technology, the US government has launched a constant “market war” and “technology war” against high-tecn industry in China since 2018 [30]. From the Trump period to the Biden period, the US science and technology policy towards China has comprehensively covered many aspects such as China’s scientific research system, SOE, important scientific and technological enterprises, the cultivation of scientific research talents, and attempted to “decouple” from China in the supply chain of high-tech industries through technological containment [31].

The Trump administration takes scientific research and innovation funding, patent protection, and talent cultivation as the "self-improvement" strategy to enhance its hard power in science and technology, and supplemented by the "weakening" strategy of external competition such as export control and market compression,strengthening the implementation of its science and technology strategy against China through a two-pronged approach of "internal checks and balances" and "external checks and

balances" [32]. After taking office, the Biden administration did not change the scientific and technological policy of Trump on China,besides, it continued to strengthen the hardness and fineness of the crackdown, further expanding the scope of sanctions on relevant enterprises, strengthening the restrictions on people going to the United States, and building a "menu alliance" with other countries to exclude China, while promoting the repatriation of domestic high-tech industries,attempting to conduct a long-term blockade of China's high-tech industry [33].

4.2 The Impact of Sino-US Trade Friction on China's Semiconductor Industry

The semiconductor industry is a strategic industry of great importance to the national economy, and it is also the core pillar industry that deeply promotes the new development pattern of China's double cycle, while major countries related to the global semiconductor industry attach great necessity to the security, stability and autonomy of the supply chain, and try to occupy a high position in the global value chain [34]. At present, with the continuous escalation of Sino-US trade friction, relevant export control measures have caused a great negative impact on the global value chain position of China's semiconductor industry [35]. In addition, the high dependence on imports in high value-added products has also hindered the core technology breakthrough of China's semiconductor industry [36]. which have brought great troubles to the production of material equipment, chip equipment, wafer manufacturing and other links in China's semiconductor industry chain. Therefore, as the current Sino-US trade relationship becomes increasingly complex, it is necessary to guard against the risk of supply chain disruption caused by excessive dependence on foreign technology trade [37] and the supply disorder of the international semiconductor industry driven by the shrinking export of semiconductor products under the technology blockade [38].

Based on the above problems, some scholars also put forward policy suggestions on the development of China's semiconductor industry, mainly including strengthening the autonomy and control of the industrial chain, optimizing the training of technical talents, and expanding multilateral cooperation channels [39]. Some studies have estimated or calculated the impact of the US science and technology policy on China. Relevant scholars generally believe that the US high-tech crackdown on China has adverse effects on both China and the US, but China is

especially bad: the expansion of the export control entity list has affected the development foundation, environment and innovation capability of China's high-tech industry, and security risks are increasingly prominent [40]; Technology blockades and "decoupling" of core industries such as semiconductors have also greatly impacted the stability of industrial transnational supply chains [41].

5 Literature Review

For the study of GVC, experts mainly focus on the measurement of indicators such as position and participation in GVC. At present, the three indicators with high academic recognition and the highest application frequency are: GVC position index and GVC participation index, technical complexity index of export products, and upstream transit index. However, due to the limitation of regional input and output table data, related index can only measure the position and participation of the manufacturing industry of one country as a whole or several manufacturing categories in the global value chain division of labor, rarely involves the segmented position. Additionally, The value chain index measurement of the semiconductor industry segmentation is few and far between.

From the literatures organized, there are abundant and extensive researches by domestic and foreign scholars on the causes of Sino-US trade friction, its impact on macro-economy and global value chain, global value chain theory and mesurement methods, as well as the impact of Sino-US trade friction on semiconductor inddustry. However, based on the perspective of global value chain, there are still some gaps in the quantitative analysis of how Sino-US trade frictions affect China's semiconductor industry and the degree of impact. With the proposal of "Made in China 2025", China's high-tech field has developed rapidly, gradually expanding from the middle end of the smile curve of the global value chain to the two ends, which has aroused the attention of the United States. At present, although there is still a certain gap between the development of China's semiconductor industry and the developed countries in the world, its rapid development also poses a threat to developed countries, which is also one of the radical reasons for the occurrence of Sino-US trade frictions. The continuous extension of trade friction between the two countries has also brought a huge impact on the development of China's semiconductor industry.

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