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Impact of China-U.S. Trade Friction on China's Integrated Circuit Industry

Siyuan Li[1], Liangliang Zheng[2], Ming Zhou[3,a,*]

[1]*School of Humanities and Social Sciences, Beijing Institute of Technology, Beijing, 100081, China*
[2]*School of Economics and Management, Hebei Agricultural University, Baoding, 071000, China*
[3]*School of International Education, Beijing Institute of Technology, Beijing, 100081, China*
a. a02361586@aggies.usu.edu
**corresponding author*

Abstract: With the development of economic trade between China and the United States, the frictions generated by it have an impact on China's integrated circuit(IC) industry. This literature research makes a specific analysis of the integrated circuit industry in terms of its future development trend and prospects, in order to study the impact of China-US trade frictions on China's Integrated Circuit Industry （IC industry） as a topic. The research uses the literature research method, factor analysis method, and inductive summary method. After analyzing the current situation of the IC industry, the research came up with three basic development problems, which are the more obvious phenomenon of China's IC import dependence, the overall strength of China's IC industry is still insufficient, and the lack of China's IC industry chain capability. After the analysis of three aspects: economic, social and technological, the research proposes three recommendations: improve the technology level, increase independent intellectual property rights, and policy support. The results obtained show that the industrial chain of the IC industry is getting better and better, the trend of substitution of domestic chips will continue to develop, the demand for emerging applications in downstream markets increases, and it can be recognized by domestic and international.

Keywords: China-U.S. trade frictions, integrated circuits, influencing factors

1. Introduction

In 2017, China's semiconductor industry has shown a high growth trend, and its output value reached 517.6 billion Yuan, with an annual growth rate of 19.39% [1]. However, behind the high growth rate also hides a huge crisis. In July 2018, due to the gradual widening of the trade deficit between China and U.S., U.S. began to impose a 25% tariff on imports from China. Since then, as China-US trade frictions continue to intensify, high-tech frontier industries, including the IC industry, have become the focus of competition between the two countries [2].

In foreign studies on the causes of China-US trade frictions, some scholars argue that the negative impact of U.S. high-tech control policies is an important reason for the imbalance in U.S. foreign trade [3]. Other scholars argue that China's rapid development, the optimization of its industrial structure, and the increased international competitiveness of Chinese products are important sources of the pressure the United States feels in foreign trade between the two countries [4]. In addition,

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some Chinese scholars argue that the trade imbalance between China and the United States is not the most fundamental reason for the occurrence of trade frictions. As China's influence in the global value chain continues to grow and the gap between the high-tech industries of China and the U.S. gradually narrows, the U.S. initiated trade sanctions in order to strengthen its competitive containment against China in the global division of labor [5].

The China-US trade frictions have had a serious impact on the development of China's IC industry. In 2018, as the trade frictions heated up, the U.S. began to focus on blocking IC products and technologies, including some Chinese companies in the "entity list" and imposing export controls on high-end chip products, which greatly hindered the upgrading of China's IC production value chain [6]. Some scholars argue that due to China's deficiencies in the manufacture of core equipment, the identification and protection of intellectual property rights, resulting in its IC industry becoming the main target of the U.S. side in trade frictions [7]. For China, foreign technology blockade and sanctions against Huawei, ZTE and other companies have also exposed the serious "Neck-jamming" technology problem in its IC industry [8]. At present, most of the research on the impact of China-U.S. trade frictions on China's IC industry is qualitative studies. They mainly focus on the global value chain, comparison of previous trade frictions in the U.S., competition of intellectual property rights in trade frictions, the impact on the industrial chain and the overall economy.

Both China and the United States play an important role in the global chip industry, and frictions between the two sides in the IC industry may greatly affect the economic development of both countries, and even the global development. Therefore, it is significant to research the causes and solutions of friction between China and the US in the IC industry. This research paper mainly uses literature research method to explore the impact of China-U.S. trade frictions on China's IC industry. The research is divided into five parts, which are the historical background of China-U.S. trade frictions, the current situation of China’s IC industry, the suggestions for the development of China's IC industry, and the prospect of China's IC industry development. In the section about the current situation of the industry, the research mainly describes the scale of the industry, the import and export situation, and its development problems.

2. Background and History of China-U.S. Trade Frictions

Since the establishment of diplomatic relations between China and the United States in 1979 and the signing of the bilateral trade agreement, the trade between the two countries has developed very rapidly, and accompanied by friction. Throughout the development of China and the United States, the United States expanded dramatically after World War II, and its GDP production and industrial strength became the first in the world as early as 1895. And destroyed the old colonial system created by Britain and France, established the Bretton Woods system centered on the U.S. dollar, pegged the dollar to gold, and greatly enhanced the international status of the United States. In World War II, the United States became the world's richest country and the most technologically advanced country by selling arms and scavenging gold materials from other countries. After the founding of New China, through a series of measures such as reform and opening up, China has come to a new historical period of socialist modernization, advancing through twists and turns, opening up the right path to building socialism with Chinese characteristics, and substantially increasing its comprehensive national power. Trade relations between China and the U.S. developed with friction and twists and turns. With the gradual growth of both countries' power levels, an imbalance began to arise in trade between China and the U.S., which was the direct cause of the start of the trade war between the two countries. China has an advantage in the export sector, but not much in the import and technological knowledge sector. The US has launched trade sanctions against China to curb its development of key technologies.

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3. The Current Status of China's IC Industry

3.1. IC Industry Scale

IC is widely used in a number of front-end technology areas and is an important foundation for the modern development of China's information industry. The market scale of the IC industry has been steadily rising under the general macroeconomic environment of China's positive operation. Figure 1 shows: China's national IC sales rose from 541.13 billion Yuan in 2017 to 1,045.83 billion Yuan in 2021 [9]. Although sales growth slowed after 2018 due to COVID-19 and the trade frictions, overall market sales grew nearly twofold.

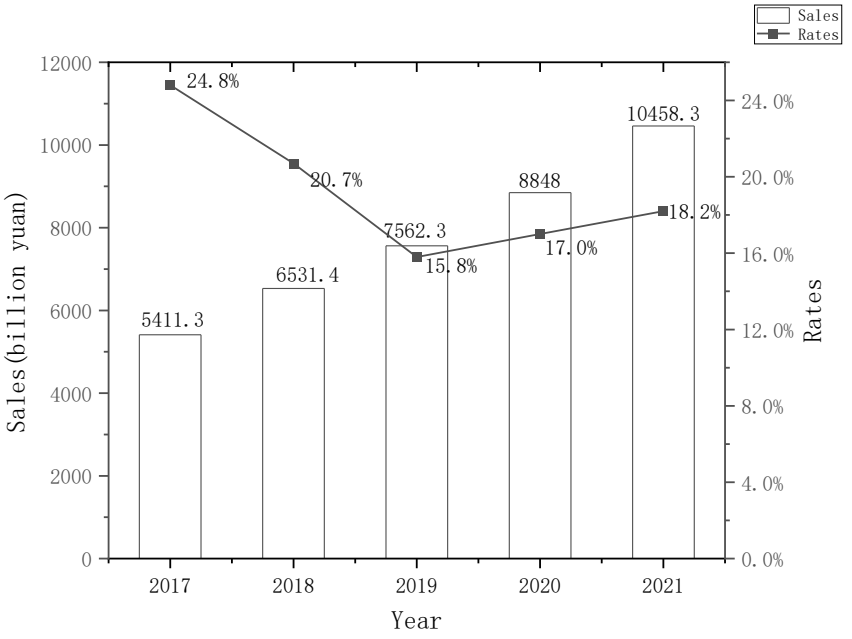

Figure 1: China IC sales (2017-2021) [9].

3.2. Import and Export Situation

Overall, from 2017-2021 China's import and export of IC products have maintained a high growth rate. As shown in Figure 2, China's IC imports in 2021 were US$432.55 billion and import volume was 635.48 billion pieces, up by 23.6% and 16.9% year-on-year, respectively [9].

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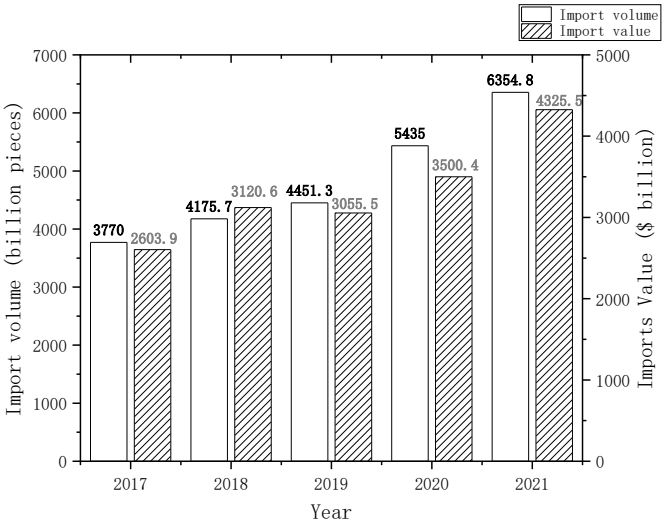

Figure 2: China's imports of IC products (2017-2021) [9].

As shown in Figure 3, China's IC exports in 2021 were US$153.79 billion and export volume was 310.7 billion pieces, up by 32% and 19.6% year-on-year, respectively [9].

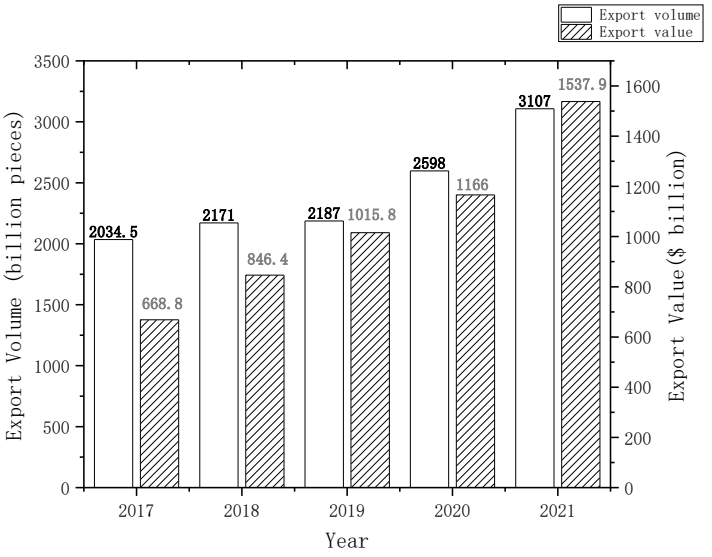

Figure 3: China's exports of IC products (2017-2021) [9].

3.3. Development Problems

3.3.1. Import Dependence Problem on China's IC Industry

In 2017, China's IC deficit amounted to $173.55 billion, and in 2021 the deficit has grown to $324.78 billion [9]. As China has not yet breached some of the technical barriers in the industry, certain key technologies are still dependent on imports. This becomes one of the fundamental reasons why China's foreign trade in the IC industry presents a long aggravated trade deficit.

Although the scale of the whole market is expanding, the supply of some advanced equipment and technological innovation is relatively weak, and the self-sufficiency rate is low. According to IC

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Insights, China's domestic IC self-sufficiency rate will be only about 16.7% in 2021, which is far from achieving the goal of 70% self-sufficiency rate in 2025.

3.3.2. The Overall Strength of China's IC Industry is Still Insufficient

Due to the late start and weak technical foundation of China's IC industry, there is still a gap between its development level and the world level. Although packaging and testing technology was once called the "light of China's domestic production" and had a good momentum of development in the early 2010s, the growth rate of the domestic packaging and testing industry has fallen to the slowest among the three segments in recent years due to the impact of the COVID-19 epidemic, China-U.S. trade frictions and the global semiconductor market downturn.

In addition, the level of the chip design industry and manufacturing industry is more likely to be hindered by technical barriers, so the gap between the level of the two and the world's developed countries is more obvious. In chip design, foreign design companies (such as Qualcomm) have formed a more complete industrial chain and have a wealth of experience and strong technical support. For China’s chip design companies (such as Huawei), on the one hand, they are hindered by foreign key technology " neck-jamming ", on the other hand, the companies’ design capabilities and experience still need to be improved. In the equipment manufacturing industry, China's domestic self-sufficiency rate is gradually increasing, but there is still a big gap compared to the target demand.

3.3.3. The Lack of China's IC Industry Chain Capability

The layout of China's IC industry chain has taken initial shape, but there are still relatively few chain master enterprises with industry chain pulling and integration capabilities [10]. In the 2021 corporate sales revenue ranking, China's IC industry has not yet been among the top ten, the sub-sectors on the list are also almost all monopolized by Japan and the United States.

First of all, from the actual situation, most China’s enterprises either have insufficient chip manufacturing capacity, or the existence of core technology is "neck-jammed", so the whole capacity of the industry chain is subject to greater restrictions.

Second, China's IC industry still has a shortage of capital chain. From the perspective of the fund allocation structure, though China has invested a large number of support policies, there are still problems such as insufficient incentive for innovation, low investment efficiency and slow flow of funds. On the one hand, large funds are more in the possession of leading enterprises, and some projects with low entry barriers often have investment redundancy, while many small enterprises that want to focus on areas with high investment needs will have difficulty in applying for sufficient funds. On the other hand, this is reflected in the lack of overall investment in larger clusters of enterprises and multiple links of the industrial chain.

Finally, there is a gap in the supply and demand of talents in the IC industry chain [11]. The IC industry needs a large number of high-end talents. With the escalating China-U.S. trade frictions, on the one hand, foreign countries have increased restrictions on the majors that can be applied to study by Chinese students, and on the other hand, the introduction of overseas talents has been affected. Moreover, as China attaches more and more importance to the development of the IC industry, the demand for high-end talents in related areas is expanding rapidly, which will lead to further widening the gap between the supply and demand of talents in the industry chain.

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4. Reasons Behind the China-U.S. IC Trade Frictions

4.1. Economic Factors

From the current situation of China-U.S. trade frictions, the trade deficit between the two countries continues to increase, and Chinese high-tech enterprises touching US interests are one of the main economic reasons for the great trade protectionism in the United States [12]. First, regarding the statistical method of import/export balance, China calculates its exports to the U.S. based on FOB prices, while the U.S. calculates the difference based on ship-side transaction prices and CIF prices. While this certainly leads to a bias in the measurement of the trade deficit between the two sides, it still cannot be ignored that the trade imbalance is generated by the U.S.'s own trade structure problems and over-consumptionism. Second, ZTE, Huawei and other enterprises pose a greater threat to the U.S. high-tech industry. Compared to the high value-added U.S. high-tech products, Chinese companies have lower prices and guaranteed quality, and their market competitiveness is gradually catching up with some U.S. enterprises. Thus, in 2018, the U.S. launched trade sanctions against ZTE, Huawei and other Chinese companies.

From the perspective of competitive relationship, the U.S. sees China's semiconductor industry as a "strategic competitor" and hopes to maintain its international market position by "decoupling" from China in related high-tech industries [13]. According to the National Institute of Standards and Technology (NIST), U.S. semiconductor production capacity accounted for about 40 percent of the world in the 1990s, but has fallen to 11 percent in 2019. In addition, the rapid development of China's integrated circuit industry in the past decade has posed a greater threat to the international competitiveness of the U.S. high-tech industry. Therefore, in this trade frictions, a series of high-tech industries represented by the IC industry have become the focal object of trade sanctions launched by the U.S.

4.2. Social Factors

In terms of the sanctions approaches, the U.S. has mostly used the traditional strategy of anti-dumping in successive frictions, which no longer achieves the desired effect of the U.S. as China's economy develops and experience accumulates [14]. However, in the IC industry, intellectual property is one of the most important issues. China's IC industry had a late start, lacked international IPR-related response experience and systematic response procedures. Thus, increasing sanctions on intellectual property rights of China's high-tech industry became the main economic tool of the U.S. in trade frictions [15].

In terms of the contrast between Chinese and American values, the U.S. advocates the America-first principle and attaches great importance to the competition for interests, while China advocates the building of a community of human destiny, pursuing peaceful coexistence and win-win cooperation, and the conflict in values between the two sides is also an inherent reason for the escalating trade frictions [16]. As China's concept of multilateralism diplomacy continues to achieve outstanding results in international forums, China's value system has been recognized by more and more countries, and this has, to some extent, dealt a blow to the international standing of American values.

4.3. Technical Factors

In terms of capacity issues, the current U.S. chip manufacturing capacity has not been able to meet the supply needs of the local industry chain [17]. According to Semiconductor Industry Association (SIA), chip demand in the U.S. rises by about 17% in 2019-2021, but chip production capacity remains virtually unchanged. In fact, the vast majority of the world's chip manufacturing comes from

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East Asia (mainly South Korea and Taiwan Province of China), which is unacceptable to the United States. Therefore, the U.S. is eager to make some of the chip production capacity back through trade sanctions to make up for the shortcomings in the high-tech industry and maintain its dominant position in the international market competition.

In terms of industry chain control, the United States, through the introduction of laws and regulations related to the IC industry, intends to solve the problem of hollowing out of the domestic manufacturing industry and to take full control of the global IC industry chain [18]. The U.S. is attempting to rebuild the global IC industry chain pattern and dominate the control of the whole chain operation, which is used to ensure the security of its own supply chain, then it can solve the problem of hollowing out of the manufacturing industry. However, since China proposed the strategy of "science and technology is the first productive force", the high-tech industry, represented by the integrated circuit industry, has played a crucial role in ensuring and boosting the long-term stable growth of China's economy. Therefore, relying on its long-term monopoly of key high-tech industries, the U.S. has gradually expanded the scope of restrictions on the export of Chinese high-tech products, and attempted to cut off the China's IC industry chain, to completely curb the development of China's related industries.

5. Suggestions on Sino-US Trade Frictions

5.1. Improve the Technical Level

China's integrated circuit industry is fully aware of the economic and trade friction between China and the United States and that there is still a gap between the leading enterprises in the United States and the need to master the core technology. Therefore, China should increase the investment in integrated circuits, increase the research and development capacity, improve the technical level, reduce the dependence on foreign supply chains, and break the dilemma of technology being controlled by others. The core of the development of the IC industry is to focus on improving the technical level. Technological innovation is the key to the development of the integrated circuit industry, and it can also accelerate the pace of the scale expansion of the integrated circuit industry. Research on core technologies in emerging information fields such as big data and the Internet of Things, focusing on the development of important chips such as memories and sensors, so as to gradually increase the strength of China's integrated circuit industry. While paying attention to technology research and development, China should also constantly improve the quality of manufacturing process and the performance of related equipment, and do a good job in the brand construction of high-quality integrated circuit products.

5.2. Increase Independent Intellectual Property Rights

In the context of trade friction between China and the US, China should accelerate independent innovation and build a safe industrial supply chain. It is very critical to break through the technical bottleneck of independent research and development in the integrated circuit industry. Its core lies in the research and development and the training and introduction of high-end talents. Solving the technical bottleneck also means that a country can gain a voice in the industry. It is very necessary that the core technologies of the integrated circuit industry have independent intellectual property rights. Only by constantly making breakthroughs in China's existing technologies can they not be restricted by other countries. Some technologies will cause an industrial chain to operate normally and affect people's lives. From the Huawei event, China can conclude that high-end chips only cultivate their own talent. China should pay attention to the training of technical personnel in the integrated circuit industry, and at the same time introduce a large number of technical personnel and

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managerial personnel to drive the development of China's integrated circuit industry towards the high-end industrial chain.

5.3. Policies Support

In the process of independent research and development technology, China needs the support of the government. In terms of increasing research and development investment, government departments can cooperate with leading enterprises to invest a large amount of funds into the leading enterprises in the supply chain of the integrated circuit industry, so as to promote the technical bottleneck of China's integrated circuit industry. Government policies and regulation are the key to the vigorous development of the IC industry. The Chinese government should give the integrated circuit industry comprehensive support for the development of the integrated circuit industry, and can make comprehensive planning from many aspects such as fiscal policy and industrial investment. For example, the research and development of chip technology needs a lot of money, the government can provide financial support and tax incentives to help these enterprises get better development opportunities. At the same time, the government also bears the regulatory responsibility, which requires the strict supervision of the norms and environmental standards of the integrated circuit industry.

6. Development Prospect of Integrated Circuit Industry

6.1. The Integrated Circuit Industry Chain is Improved

In recent years, with the increase of trade friction between China and the US, China is bound to have its own storage technology, and it has become an inevitable trend to actively develop the integrated circuit industry. As the main consumer market of global electronic products, China has an important position in the world, which provides a good opportunity for the development of China's integrated circuit industry. At present, with the coordinated development of China's upstream and downstream markets, the research and development of high-tech, integrated circuit raw materials products, the industrial chain of integrated circuit is increasingly perfect.

6.2. The Replacement Trend of Domestic Chips Continues

Chip is the foundation of many modern technologies, and the irreplaceable key components for emerging applications such as the Internet of Things, big data, cloud computing and 5G. Domestic core has a very important strategic significance for the promotion of China's informatization. At present, there is still a gap between China's chip research and development of chips and the United States, Japanese and South Korean enterprises. Due to the frequent friction between China and the United States, independent supply of chips has become an inevitable trend, and domestic chips have a great space for development.

6.3. Increased Demand for Emerging Applications in the Downstream Market

With the wide application of the Internet of things, consumer electronics, computers and peripherals, network communications, industrial and medical, automotive electronics, the development of downstream applications, AI, 5G, smart home, smart car and other emerging application demand, bring more demand for the integrated circuit industry, domestic chip manufacturers market competitiveness increase at the same time, the emerging application of the downstream market will also bring new development opportunities for the integrated circuit industry.

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6.4. Universal Recognition

People's living standards have improved, so the demand for integrated circuit products has also greatly increased. With the booming development of China's integrated circuit industry and the support of the government, so people will reduce the purchase of foreign brands, and more and more recognized domestic brand people's recognition of domestic brands. At the same time, the development of China's integrated circuit enterprises is bound to drive international exchanges, strengthen the cooperation with international leading enterprises, and further improve the technical level and market competitiveness through exchanges and learning.

7. Conclusion

The United States has always been leading the world in the development of the integrated circuit industry. Later, China vigorously developed the integrated circuit industry, which has great advantages in the export field, and has gradually become an important country in the global chip industry. The United States has the import and technical knowledge that China is not good at in the integrated circuit industry, and wants to curb the development of China's integrated circuit industry, leading to a trade war between China and the United States. The friction between China and the United States in the development of the integrated circuit industry will greatly affect the economic development of the two countries and even the world. Therefore, it is of great significance to study the causes and solutions for the conflicts between China and the United States in the process of integrated circuit development. The research in the IC industry development in the background of the friction, from the current scale of Chinese integrated circuit industry, import and export situation and government policy, found that China to further improve the development of integrated circuit industry problems, such as China's lack of integrated circuit industry chain, integrated circuit industry overall strength, integrated circuit import dependence phenomenon is obvious, according to the above problems proposed China needs to improve the technical level, increase policy support and increase independent intellectual property rights. It is believed that in the future, with the gradual improvement of China's integrated circuit industry chain, the continuous replacement trend of domestic chips and the increasing demand for emerging applications in the downstream market, it can be unanimously recognized at home and abroad. The paper only explores the basic factors of trade frictions in the integrated circuit industry between China and the United States, without delving into them. Suggestions on how to respond to the more complex situation in the integrated circuit industry are worth strengthening. This paper can be further improved by researching the basic factors and related fields that lead to trade frictions in the integrated circuit industry between China and the United States, and increasing the completeness of suggestions for China's development of the integrated circuit industry chain.

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