

# The Analysis of the US's Technology Policy toward China

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**Abstract.** Since the late period of the US Obama administration, the US and China's competitions have spread from military diplomacy to trade and science and technology. As the brain of modern electronic devices, the semiconductors have a wide range of applications in various industries. So far, the US semiconductor technology issue against China has become the key axis of the current Biden administration's anti-China policy. Under the policy line of technology resistance against China, the United States and the global semiconductor industry are facing both opportunities and challenges under the strategy of "building high walls" and "multilateral alliances". To maintain its significant leading position in semiconductor key technologies, the United States should support the development of independent core technologies and standards through national policies in the semiconductor industry, while looking for major domestic and foreign semiconductor allies, industry, academia, and research and development stakeholders. It is also important for the US to observe the continuous innovation of Chinese private technology enterprises, the development of truly independent core technologies of China, the development of digital economic industry of China, as well as the Chinese government policies towards international restrictions in the face of suppression from US.

## 1 Introduction

Semiconductors are the core of modern electronic industry technological progress and are known as the brain of electronic devices. Due to its wide range of applications, the research and development, production, and manufacturing of semiconductors have gradually become one of the key strategic issues and materials that countries attach importance to, especially in the current situation where technology products and applications are closely related to military, economic, technological, safety, and consumer needs in various countries.

Since the late period of the Obama Administration, after the Trump Administration and even the current Biden Administration took office, the fields of competition between the United States and China have spread from traditional military diplomacy to trade and even science and technology. Among them, the issue of semiconductor technology from the United States to China has become the key axis of the current Biden Administration's anti-China policy. Its impact on global technology, economy, and security is quite profound and worth exploring.

In this article, this study aims to explore the recent formation, transformation, and main possible impacts of the US technology policy towards China, with a particular focus on the semiconductor industry as an example for analysis. Firstly, this paper explores the development overview of the global semiconductor technology industry. Secondly, the paper explains the semiconductor policy towards China during the Obama administration and the Trump administration.

Furthermore, this paper analyzes the formation, transformation, and possible main impacts of the current Biden administration's semiconductor policy towards China. Finally, this paper summarizes the key points of this article, and explain the future observation focus of the United States on semiconductor technology policy issues.

## 2 Development overview of global semiconductor technology industry

With the high development of technology, the research and development, manufacturing, and application of semiconductors have become the core of modern global electronic industry development. The so-called semiconductor system is composed of materials (such as silicon) with resistance between conductors and insulators, and its main products include discrete components and integrated circuits (ICs). Among them, ICs with a high proportion of production refer to the integration of components such as transistors, diodes, resistors, capacitors, etc. into a single chip through precise manufacturing technology by semiconductor manufacturers. The complete logic circuit formed by this chip can be applied in various electronic products due to its functions of control, calculation, or memory, becoming the basic component on which various electronic devices rely for operation.

In the current era of electronic technology, semiconductors have a wide range of applications. Equipment such as data processing electronics,

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military/civil aviation electronics, communication electronics, consumer electronics, automotive electronics, and industrial electronics all rely on the supply side of semiconductors for normal manufacturing and operation. In the future, emerging technological applications, such as unmanned driving, quantum computing, artificial intelligence (AI), robotics, energy-saving sensing, 5G and the Internet of Things (IoT), rely more on the production and manufacturing of the new generation of advanced semiconductors to seize the development opportunities. Thus, in the current trend of technology becoming an indispensable "hard power" for countries around the world, the research and development, production, and manufacturing of semiconductors have also become key strategic issues and materials valued by major advanced countries.

Due to the continuous innovation of global technology applications in the past decade, the size of the semiconductor market has shown a continuous upward trend. According to the World Semiconductor Trade Statistics (WSTS), the global semiconductor industry's sales in 2012 were about 291.6 billion US dollars. In 2013, it exceeded 300 billion US dollars for the first time, and in 2017, it further exceeded 400 billion US dollars. As of 2020, it remained at the level of \$440.4 billion. In 2022, driven by the double-digit growth demand for global memory, the global semiconductor industry's sales amount exceeded the new high level of \$600 billion.

### **3 The formation and transformation of the US semiconductor policy towards China**

#### **3.1 Industrial policies and trade interests**

Compared with the Trump government's desire to comprehensively improve the US trade deficit with China, and to raise tariffs and exert pressure, the Biden government adopted the strategy of "small yard, high fence" and "multilateral alliance" to deal with China's security threats at the beginning of taking office [1]. Although the Biden administration has so far maintained some restrictive measures and tariffs on China's trade during the Trump administration, it has focused on science and technology as the main axis, targeted China in key areas, clarified and identified specific technologies and fields directly related to the national security of the United States (the so-called courtyard), and established appropriate strategic boundaries (the so-called high wall). The approach of increasing countermeasures and blockades within specific technologies and fields, but considering reopening or maintaining the status quo outside specific technologies and fields, has become a new strategy for the United States in its science and technology policy towards China. In addition, the Biden government adopted the strategy of "multilateral alliance", including inviting 19 major international technology enterprises, including Taiwan Semiconductor Manufacturing Company

Limited, Samsung, and Intel, to hold the "Semiconductor and Supply Chain Resilience Summit", and held summits with leaders of Japan, South Korea and the European Union, and promised to strengthen the strategic cooperation relationship between the two sides in semiconductor industry [2]. All these are the Biden government's bilateral ways to change the past of the Trump government and actively establish a multilateral anti-China technology alliance.

#### **3.2 Technology regulation**

In terms of science and technology control, the Biden government's policy towards China roughly follows the legal basis and policy direction of the Trump government's Export Control Reform Act (ECRA) and the 2018 Foreign Investment Risk Review and Modernization Act (FIRRMA) for science and technology control over China. In the near future, the Biden government will also follow the path of strengthening science and technology control over China. After the Trump government's ban on Semiconductor Manufacturing International Corporation (SMIC) and Huawei, the United States first identified seven Chinese institutions in April 2021 involved in assisting China's military modernization and developing weapons of mass destruction, and American enterprises are restricted from doing business with them. At the beginning of June 2021, President Biden signed an order to modify the Trump government's investment ban on Chinese enterprises, listing 59 Chinese enterprises related to the Chinese military or belonging to the monitoring industry. Besides Huawei, the three major telecommunications companies (China Unicom, China Mobile and China Telecom) in China were also in the list. The ban came into effect in August 2021, stipulating that American investors must withdraw their investment within one year after it came into effect [3].

#### **3.3 Future technological dominance**

Among the major priority governance projects unveiled by the Biden administration, one of its major governance goals is to revive the economy and ensure the US position in the world. The Biden administration's recently released "100 Day Key Supply Chain Survey Report", suggesting that if the United States wants to enhance its leadership and resilience in the semiconductor industry, it must provide at least \$50 billion in funds to implement the Chip Act (CHIPS), as support measures for advanced chip manufacturing production, ensuring the safety of mature node chip production supply chains, and the production safety of domestic and foreign allies and business partners. In addition, the United States should also focus on supporting manufacturing, research and development, and establishing a multilateral fund for semiconductors. Lastly, the United States should find international allies to jointly implement export control, foreign direct investment review, supply chain security, intellectual property protection, and subsidy transparency

requirements for semiconductor technology, ensuring the dominant position of the United States in future technology [4].

## 4 The impacts of the US semiconductor technology policy

In recent years, there have been significant changes in the US semiconductor technology policy towards China since the late Obama administration. China has been promoting two consecutive "National Integrated Circuit Industry Investment Funds" since 2014, attempting to support the domestic semiconductor industry. In 2015, the "Made in China 2025 Plan" was proposed, aiming to achieve a 70% chip production rate by 2025. In recent years, China has actively invested in and acquired American semiconductor companies, gradually arousing the US government's vigilance towards China's technology strategy. Up to the time of the Trump administration, the United States and China have conducted a relatively comprehensive competition from trade war, science and technology war, diplomatic war and military strength display. Until the Biden administration took office, although the intensification of strategic competition between the United States and China has not fundamentally changed, under the Biden administration's policy of focusing on the technology sector and adopting a strategy of "small courtyards and high walls" and "multilateral alliances" to resist China, it may bring the following opportunities and challenges to the United States and the global semiconductor industry, which may have the main potential impact.

### 4.1 Opportunity

The United States and China are the top two major consumer markets of semiconductors in the world, including communication, computers, consumer electronics, automobiles, as well as emerging technological needs such as artificial intelligence, quantum computing, 5G, Internet of Things, electronic game equipment, medical equipment, aviation, 3D printing, auto drive system, virtual/augmented reality. In the semiconductor industry, the United States and China's own preferred semiconductor industry and supply chain manufacturers may have new development opportunities arising from the technological confrontation [5].

The recent support policies promoted by the US government for the semiconductor industry have led major international semiconductor companies such as Taiwan Semiconductor Manufacturing Company Limited (TSMC), Samsung, Intel, and Global Foundries to announce their plans to invest in and establish semiconductor wafer fabs in the US, which will help support the development of the local semiconductor supply chain and create employment opportunities in the US. Taking TSMC as an example, it would invest \$12 billion to establish a 5-nanometer advanced process wafer factory in Phoenix, Arizona, USA. After

production, it is estimated to produce about 20000 wafers per month and hire 1600 employees.

The Biden administration emphasizes "multilateral alliances" in its policy path of technological resistance, and through the issue of semiconductor industry cooperation, the United States can increase strategic cooperation with its allies or like-minded countries or businesses. On the one hand, it can coordinate and solve the problem of international chip supply shortage, and on the other hand, it can enhance the international competitiveness of American semiconductor industry to strengthen its leadership position in semiconductor technology [6].

Due to its anti-China strategy, the United States is re-evaluating and reviewing the supply chain of its key industry sectors, assisting its semiconductor industry and semiconductor end-users in identifying the sole or primary source of various semiconductor key materials. This would help the United States strengthen its semiconductor supply chain resilience in supplier diversification, diversifying supplier geopolitical distribution risks, and establishing demonstration guidelines [7].

### 4.2 Challenge

The global semiconductor industry, which has been established based on economic comparative advantages over the past 30 years, may face the impact of adjustment or restructuring due to intensified technological competition and confrontation between the United States and China [8].

In the face of technological competition and confrontation between the United States and China, the world would pay more attention to the geopolitical risks of the semiconductor industry, and pay more attention to policy promotion to improve domestic semiconductor production rates under the influence of chip supply shortages. According to a research report released by Boston Consulting Group (BCG) and the American Semiconductor Association (SIA) in April 2021, the global semiconductor industry would need to invest at least \$1 trillion in initial capital investment to meet the current semiconductor consumption needs of major regions worldwide and pursue complete self-sufficiency in supply. Due to the significant additional capital expenditures, semiconductor cost may increase by 35% to 65%, ultimately leading to an increase in the cost of electronic devices that rely on semiconductor product supply for manufacturing. This will also increase the consumption costs of global electronic terminal device users and bring unfavorable variables to future global economic growth [9].

In the ongoing intensification of technology competition between the United States and China, it may lead to the risk of losing business opportunities in the Chinese semiconductor consumer market due to the need for American semiconductor manufacturers and foreign companies to rely on the American semiconductor consumer market to make choices between the United States and China. The revenue of the global

semiconductor industry may decline as a result, which would undermine the ability of semiconductor manufacturers to maintain a global semiconductor consumer market to support massive research and development, and innovation expenditures [10]. This will also have an adverse impact on innovation in the semiconductor and other related industries.

Promoting positive US-China cooperation stands out as a crucial element in tackling the plethora of opportunities and challenges on the international scene. Through fostering diplomatic relations and creating a climate that is favorable to cooperation, both countries can actively participate in the development of a competitive environment that benefits both parties. Prioritizing common interests in a strategic alignment can open doors for innovation, economic expansion, and improved international stability. Accepting the possibility of cooperation emphasizes a diplomatic stance that looks for points of agreement and promotes communication and comprehension. With the power to overcome antagonistic dynamics, this cooperative framework can create a setting where international interdependence acts as a catalyst for peaceful and sustainable development.

## 5 Conclusion

The semiconductor system is a modern electronic device brain with a wide range of applications. Due to the fact that current technological products and applications are closely related to the military, economic and trade, science and technology, safety, and people's consumption needs of various countries, the research and development, production, and manufacturing of semiconductors have become a key strategic material that countries attach great importance to. Since the late period of the US Obama administration, the US and China's competitions have also spread from military diplomacy to trade and science and technology. So far, the US semiconductor technology issue against China has become the key axis of the current Biden administration's anti-China policy. Until the Biden administration took office, although the intensified strategic competition between the United States and China has not fundamentally changed, the Biden administration has particularly focused on the technology sector, especially semiconductor industry.

Under the policy line of technology resistance against China, the United States and the global semiconductor industry are facing both opportunities and challenges under the strategy of "building high walls" and "multilateral alliances". Firstly, in terms of industrial policies and trade interests, the relevant semiconductor support policies and anti-China bills promoted by the Biden administration would be formally submitted to President Biden for signing after consultation between the two houses of Congress, along with the actual budget size and implementation level of the bills. It would determine the effectiveness of the Biden administration in promoting technological resistance in the semiconductor industry and strengthening the leadership

position of the US semiconductor industry. Secondly, in terms of science and technology regulation, the Biden government continues the Trump government's line of science and technology regulation on China in the past. In the future, if it further develops in the direction of more rigorous and expanded scope, the countermeasures that China would take, the specific impact on the US and other foreign semiconductor companies, and the respond from the US and foreign semiconductor companies would all be questionable. Lastly, in terms of future technological dominance, according to research by the US-China Economic and Security Review Commission (USCC), Chinese semiconductor companies still lag behind major international competitors by one to two generations in technology, and are highly dependent on foreign semiconductor technology for production.

However, the United States is well aware of China's expertise in semiconductor assembly, advanced packaging, and more key raw materials, optical electronics and other fields have gained international competitiveness, while actively supporting the development of independent core technologies and standards through national policies. Therefore, whether the United States continues to maintain its significant leading position in semiconductor key technologies in the future depends on its participation and implementation of current policies that assist and support the development of the US semiconductor industry. The United States would also need major domestic and foreign semiconductor allies, industry, academia, and research and development stakeholders. It is necessary to observe whether the Chinese government could promote the continuous innovation of Chinese private technology enterprises and continue to lead their digital economic industry development, as well as whether Chinese technology industry can break through international restrictions and develop truly independent core technologies in the face of suppression from US.

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