

The Impact of the U.S. Chip Act and the Chip4 Alliance, and China How to Respond It

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Abstract. On August 9, 2022, local time, U.S. President Biden officially signed the Chip and Science Act. Prior to signing this act, the U.S. proposed the formation of a so-called "Quad Alliance" consisting of the United States, Japan, South Korea, and Taiwan. This move was aimed at fostering alliances with countries with strong semiconductor industries and collaborating with other nations to suppress semiconductor development in mainland China. However, it is important to note that China has a large domestic market, which may not be completely suppressed by the "Quad Alliance" in terms of semiconductor development.

Keywords: U.S. Chip Act; Chip4 Alliance; China's Response Strategy.

1. Introduction

The Chip and Science Act signed in the United States includes two core components. Firstly, it provides approximately \$52.7 billion in funding support to the semiconductor industry. Out of this, \$39 billion is allocated to incentivize companies to establish semiconductor factories in the U.S., while \$11 billion is dedicated to semiconductor technology research and development, along with substantial subsidies for chip manufacturing and R&D. Additionally, it offers tax credits worth roughly \$24 billion to companies. Secondly, the act pledges around \$200 billion in research funding over the coming years, with a focus on cutting-edge technologies such as artificial intelligence, robotics, and quantum computing, to boost job creation. Moreover, the Chip and Science Act contains provisions implying competition with China. It states that companies receiving subsidies cannot expand their semiconductor factories in China within a decade. In case of violation, the U.S. Department of Commerce retains the authority to retract all subsidies. The enactment of this act signifies an intensifying technological competition between the U.S. and China in the semiconductor industry. It also has significant implications for China.

2. The "Chip Bill" has an Impact on the Chip Alliance.

The "chip bill" offers generous subsidies to attract major semiconductor companies to establish factories in the United States, while also introducing provisions targeting China's semiconductor development. These provisions aim to restrict companies like TSMC, which possess advanced semiconductor technologies, from setting up semiconductor factories in mainland China. This is done to prevent mainland China from surpassing the United States in terms of advanced semiconductor processes and technologies. The implementation of the chip bill policies does not have any impact on companies that were not planning to establish factories in mainland China. However, companies like Samsung, Intel, and TSMC face difficult choices as a result.

The chip alliance, which is closely related to the chip bill, appears to be a collaborative effort among the United States and other countries to promote semiconductor division of labor. While the alliance aims for win-win outcomes, there are indeed conflicting interests among the participating countries regarding semiconductor development. After the release of the Chip and Science Act, this conflict of interests has become a matter that Taiwan and South Korea need to consider.

For South Korea, the Chinese mainland is the main export market for semiconductor chips. Samsung Electronics, one of the three major chip giants in South Korea, has chip factories in the Chinese mainland. Over the past three years, the proportion of chips exported from South Korea to China has accounted for 40% of the total export volume each year. If the semiconductor chips exported to Hong Kong are included, the export proportion can reach as high as 60%, with a significant portion of the chips exported to Hong Kong flowing into the Chinese mainland. China has fast industrial development and a high level of consumer spending, making it a lucrative market for the semiconductor and other technology industries. If South Korea chooses to accept semiconductor subsidies from the US government, it would risk losing the Chinese mainland market, which would undoubtedly be a huge loss for South Korea. South Korea's decision to join the Quad Alliance for semiconductors was forced by its special political relationship with the US. If South Korea does not voluntarily join the Quad Alliance, the US is likely to impose a ban and compel South Korea to reduce its cooperation with the Chinese mainland in the semiconductor field. Therefore, the ultimate consideration depends on whether Samsung and Intel are willing to pay the price for the expensive semiconductor subsidies from the US, which remains unknown at this point. TSMC, as the leading semiconductor technology developer in Taiwan, faces the risk of technology outflow and loss of its dominant position in chip manufacturing if it overly cooperates with any US policies.

The ultimate goal of the United States in forming the Chip4 Alliance is twofold. Firstly, it aims to enhance the development of American semiconductor technology. Secondly, it aims to absorb high-tech chip technologies from South Korea and Taiwan. This would enable the United States to achieve self-sufficiency in the fields of semiconductors and chips, creating an ecological balance. It would also reduce foreign dependency. However, the ultimate objective is still to curb the semiconductor development in mainland China. These potential conflicting interests exist within the current members of the Chip4 Alliance. For China, mainland China needs continuous development in semiconductor technology, mastery of cutting-edge talent in the semiconductor industry, and strategic strategies to break free from the encirclement by the United States.

3. The "Chip Act" and its Impact on the World and China.

In October 2022, the United States implemented new restrictions on semiconductor exports to China, requiring US semiconductor factories to obtain a license to export materials for the manufacturing equipment of related semiconductors to China. This move undoubtedly limits China's wafer manufacturing industry, as relevant factories are unable to acquire the capabilities to produce advanced logic process chips or smaller half-pitch chips. Additionally, the new regulations also restrict Americans from engaging in chip manufacturing-related work in China. It is unclear how the US will further strengthen restrictions on chip exports to China in the future. Bloomberg reports suggest that if the US government tightens restrictions again, it could once again impact the global chip manufacturing industry. Currently, about 17 categories of equipment used in chip and semiconductor fabrication require corresponding licenses, especially when dealing with Chinese customers. If more countries continue to impose restrictions in the future, this number could increase significantly. Currently, the US only restricts advanced processes. However, if they include mature processes in the restrictions, it would undoubtedly deal a significant blow to the global semiconductor supply chain.

On March 31, 2023, the Chip Act opened applications for subsidies to semiconductor industry companies that establish factories in the United States. The subsidy amounts to nearly \$53 billion, but semiconductor companies applying for the subsidy must adhere to specific regulations. For example, they need to provide information on different types of chip production capacity, projected earnings, and disclose detailed data related to semiconductor production. Upon the announcement, there was a comment from Liu De, Chairman of Taiwan Semiconductor Manufacturing Company (TSMC), expressing dissatisfaction with certain aspects of the provision and stating that TSMC cannot accept it. TSMC will continue to communicate with the US government to avoid any negative impact on Taiwanese manufacturers. This provision, often referred to as the "bully clause,"

unilaterally demands that companies provide core technology secrets under the pretext of national security, completely infringing on the interests of others. The provision imposed by the US undermines the rights of other countries and regions, hindering global technological cooperation and progress.

4. The Current Situation of Domestic Chips

Currently, the manufacturing process of Chinese chips mainly involves lithography machines, wafer dicing machines, plasma etching machines, ion implantation machines, and other equipment. Additionally, certain materials such as wafer substrates and photoresists are used in chip production. Most of these equipment and materials are imported from other countries since China cannot independently produce advanced chip manufacturing equipment. The United States has not completely cut off the supply of critical equipment to mainland China. However, if the US were to prohibit the import of chip equipment with feature sizes below 14 nanometers, China's wafer manufacturing would continue to lag behind companies like Samsung, Intel, and TSMC. This would lead to a significant loss of competitiveness for Chinese chips and impose substantial limitations on the storage chip sector as well.

The chip bill introduced by the United States, along with the formation of the chip4 chip alliance consisting of South Korea, Taiwan, and Japan, all aim to suppress the chip production and semiconductor development in mainland China in the long run. The US, leveraging its advantages, has elevated chip manufacturing and export as a matter of national politics, and has actively "isolated" and suppressed China. However, whether the chip bill and the chip4 chip alliance can completely change the global chip landscape remains debatable. After all, major chip companies have established chip factories in China, and the difficulty of chip transfer and reproduction is significant. Therefore, to break through the current state of semiconductor development, China needs to focus on its own chip manufacturing industry, continuously challenge itself, and prioritize the development of chip technology specific to the mainland. It is crucial to cultivate talent in semiconductor chip manufacturing and strive to overcome the current technological bottlenecks. The development of mainland China's semiconductor industry has been increasingly positive in recent years, and efforts are being made to manufacture our own chip equipment. Once China can rely entirely on itself to produce key chip manufacturing equipment, it will no longer need to import foreign equipment for chip production, achieving self-sufficiency in semiconductor chips.

5. "The Inflation Reduction Bill"

The "Inflation Reduction Bill" was passed by both the Senate and the House of Representatives in the United States in August 2022 and officially implemented in early 2023. The bill aims to reduce inflation in the United States and includes provisions for investment and subsidies in the domestic clean energy industry, encouraging businesses to procure key supplies domestically, and relatively lowering healthcare costs. The bill plans to generate \$700 billion in revenue over 10 years, with \$400 billion allocated as subsidies to the clean energy industry, while the remaining \$300 billion will be used to reduce the government deficit and decrease inflation. The U.S. "Inflation Reduction Bill" has attracted attention from countries worldwide, particularly European Union members. EU countries are concerned that the bill may significantly impact the European electric car industry. The core of the bill involves providing subsidies to the domestic clean energy industry, reducing its costs. This may reduce the competitiveness of certain automotive brands, such as Volkswagen from Germany, Citroen from France, Nissan from Japan, which currently cannot establish factories in the United States. After the bill was enacted in the United States, the EU is most worried about companies transferring their operations to the U.S. due to higher electricity and fuel costs in Europe, and some factories have already planned to relocate outside the EU. The bill sends a signal to establish factories in the U.S., prompting the EU to consider providing subsidies to retain factories within the EU.

This bill currently has minimal short-term impact on China. This is because China's domestic market is already able to sustain its electric vehicle industry. Less than 5% of electric vehicles exported to the United States come from China, so in the short term, it does not have a substantial effect on China. However, the bill includes batteries in the scope of localization, and even the materials used in battery manufacturing must be sourced from the United States. Currently, China holds 75% of the world's battery production capacity. If manufacturers need to cater to the U.S. market, they may gradually reduce their focus on the Chinese market.

References

- [1] Chen, K. (2022). What Does the Signing of the "Chip Act" Mean? [J]. China Report, 2022(09).
- [2] Chinese Association for Science and Technology Innovation Strategy. Innovation Research Report, Issue 62 (Total Issue 490) [R]. Beijing: Chinese Association for Science and Technology Innovation Strategy, 2021.
- [3] Semiconductor Industry Association, Boston Consulting Group. Strengthening Global Semiconductor Supply Chains in Uncertain Times [R]. United States: Semiconductor Industry Association, Boston Consulting Group, 2021.
- [4] Tan, X. (2022). The "Chip Act" in the United States: Aimed at Containing China, But Ultimately Self-Destructive [J]. World Knowledge, 2022(17).