Practical Logic and Evolutionary Characteristics of South Korea's Semiconductor Strategy (2018-2024) from the Perspective of Technonationalism

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Abstract. Against the backdrop of the technological and market competition between China and the United States from 2018 to 2024, South Korea's semiconductor industry is facing a predicament. China, as a core market for South Korean semiconductors, plays an irreplaceable role in South Korea's industrial development, while the United States serves as a core technology source and an alliance constraint for South Korean semiconductor technological advancement. So, its technologies are dependent on the United States, and its market is dependent on China. This study takes technonationalism as its core theoretical perspective and primarily employs qualitative methods to explore the practical logic and evolutionary characteristics of South Korean semiconductor strategy. Research has found that South Korea achieves a balance through both defensive and offensive paths. Firstly, it ensures industrial security and technological autonomy. Secondly, it leverages international collaboration and technological iteration to expand competitiveness. This study clarifies the balance logic between South Korean alliance obligations and economic interests, providing a reference for medium-sized technology countries in the context of the global industrial chain reconstruction.

Keywords: International politics and economy, Semiconductor industry, Technonationalism.

1 Introduction

In the context of the rapid development of global technology and the digital economy, the semiconductor industry has grown rapidly and become one of the most important areas of global economic development. However, the semiconductor industry has also been included in the scope of the Sino-US game.

The Chips and Science Act (hereinafter referred to as the *Chips Act*, issued by the United States in 2022, intends to enhance the capacity of partner countries such as Mexico by supporting the development of the semiconductor industry in the Western Hemisphere. This helps reduce reliance on Asia's semiconductor industry and supply chain, especially China's. However, this series of measures has inhibited the interaction of the East Asia industrial chain formed by South Korea, China, and Japan, undermining the

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sustainable development of South Korea's semiconductor industry. Meanwhile, as the homogenization of exports between China and South Korea gradually increases and the rise of Chinese brands, coupled with the promotion of a series of policies issued by China in recent years, China's semiconductor R&D and manufacturing capabilities have rapidly improved, which has led to a decline in the proportion of South Korean exports to China and further increased the threat to South Korea's semiconductor industry.

As both China and South Korea are important participants in the global semiconductor industry, how South Korea makes decisions in the Sino-US game is a question of research value. Firstly, South Korea has an ally relationship with the United States. Secondly, China holds the largest share in the South Korean semiconductor trade market, and the semiconductor industries of China and South Korea are characterized by complementarity. Therefore, South Korea has to respond to the alliance demands of the United States while also being reluctant to lose China, its core market. This has led to its strategic decisions being caught in a dilemma.

2 Literature Review

At present, academic research on South Korean semiconductor strategy under the Sino-US game mainly focuses on its external pressure, complementary industrial model, and theoretical research. However, none of these have yet utilized complete and systematic theories to analyze their policies, which indicates a significant research gap.

2.1 Summary and Limitations of Existing Studies

The Influence of the Containment by the United States and the Pressure from its Allies. Jinfeng Li pointed out that the United States has pressured South Korea to cooperate with its containment of China through the Chip Quartet Alliance, subsidies under the *Chip Act*, and technology control [1]. Li Li and others further analyzed the predicament of the United States-South Korea alliance, which uncovers that South Korea is wavering in its strategy due to its technological reliance on the United States and concerns about losing the Chinese market [2]. However, these kinds of research lack theoretical exploration and a summary of the strategic decision-making model in South Korea.

The Advantages and Limitations of the Complementarity Relationship between China and South Korea's Semiconductor Industry. Jiachen Wang has confirmed the high complementarity of the semiconductor industries between China and South Korea through data [3]. Also, RCEP and existing trade models can alleviate the negative impact brought by the United States' block. However, most of this research has remained at the stage of sorting out the static complementary characteristics in its industrial development, without analyzing the dynamic adverse impact of the guardrail clause in the *Chip Act* on the complementary relationship of the industry, nor has it associated RCEP with South Korean-specific response strategies.

Theoretical Explanation of the Allies' Strategic Choices. Although the theoretical research of Shengli Ling involves the analysis of the behaviors of South Korea and its Allies, it still ignores one of the important factors, which is the United States' technological monopoly on South Korean decision-making [4]. Moreover, it can't totally explain the motivation behind South Korea's implementation of selective compromise. So, further supplement and more in-depth research on the content and theory are needed.

2.2 Innovations of This Study

To make up for the defects that existing researches have, this study will take technonationalism as the main theoretical perspective, focusing on the development background and status of South Korea's semiconductor industry from 2018 to 2024, analyzing how South Korea balanced the defensive-offensive development strategy in the Sino-US game. This study will reveal the dynamic impact of external factors on the industrial relations between China and South Korea, and relate the specific actions of international organizations and South Korea, using this theory to explain the decision-making logic of South Korea and enrich the relevant theoretical and practical analysis.

3 Research Design and Methodology

3.1 Research Design

The core issue of this study is: What are the practical logic and evolutionary characteristics of South Korean semiconductor strategy against the backdrop of the Sino-US game? The objective of this research will focus on two main dimensions. One is to explore how South Korea, under the dual constraints of technological dependence on the United States and market dependence on China, strikes a balance between defensive and offensive strategic choices. The other one is to reveal the dynamic impact of external policy pressures, such as the United States *Chips Act* and regional cooperation rules, on the decision-making of South Korea's semiconductor industry.

To completely split the complex interactive relationships above, the research will adopt qualitative analysis as the core method. By systematically sorting out policy texts, enterprise strategic reports, official trade data, and authoritative media reports, it can build an analytical chain for the external environment, strategic response, and implementation effect, which will avoid the limitations of a single data dimension and ensure that the interpretation of the strategic logic of South Korea's semiconductor industry is both theoretically profound and practically relevant.

3.2 Data Sources

The research data are all from public and official channels and are specifically classified into four categories:

The policy documents mainly include the *K-Semiconductor Strategy* issued by the South Korean government, the *Chips Act* of the United States, and the announcements of the RCEP Secretariat, which are used to study the constraints of policy and guide the direction of the industry. Enterprise reports include the annual financial reports, announcements on production capacity layout, and statements on technology iteration of Samsung and SK Hynix, supporting analysis of strategic practices at the enterprise level. The trade data mainly consists of the semiconductor export statistics of the Ministry of Trade, Industry, and Energy of South Korea and the detailed data of China-South Korea semiconductor trade in the United Nations Comtrade database, quantifying the significance of the Chinese market to South Korea. Finally, there are academic and media materials. Most of the research results related to international journals and industry reports from the Korea Economic Daily and The Wall Street Journal serve as supplements to theoretical and real-time dynamic information.

3.3 Data Analysis Methods

This study comprehensively employs three analytical methods to form complementary verifications among them. First, the comparative analysis method is used. It takes the specific practices of aggressive technonationalism in the United States and defensive technonationalism in Japan as case references to highlight the uniqueness of South Korean strategic decisions. Then the content analysis method was used to analyze policy documents such as the *K-Semiconductor Strategy* and the *Chip Act*, and explore the relevant policy orientations. Lastly, the case study method is adopted. By taking SK Hynix's acquisition of Intel's NAND business and other typical cases as examples, the path and effect of strategic implementation are concretized.

3.4 Limitations of This Study

This study has three limitations. First of all, the data relies on public information, which makes it difficult to obtain non-public information such as the allocation of R&D investment within the enterprise and the details of government-enterprise negotiations. That may affect the completeness of the analysis of strategic motivations. Secondly, policies such as the *Chips Act* in the United States and the *K-Semiconductor Strategy* in South Korea are still in the implementation stage. This means some of their long-term impacts have not yet fully emerged. Additionally, the timeliness of these policies may impose certain constraints on the generalization of the conclusions. Thirdly, this study did not cover the microdata of specific links in the semiconductor industry chain, such as materials and equipment. Therefore, the depth of interpretation of local issues in the industry by this study is limited.

4 Theoretical Analysis of Technonationalism in the Semiconductor Field

4.1 Concept and Connotation of Technonationalism

Technonationalism was first proposed by the American scholar Robert Ritchie, who coined the term to describe the collection of policies and ideological trends formed by a country in the high-tech field regarding security and competition [5]. Specifically, it refers to the action system formed by the state in high-tech fields such as semiconductors and artificial intelligence, with the core goals of maintaining technological security and competing for competitive advantages through government policy intervention or social trend guidance. Its essence is to bind technological strength with national power and economic security. The core logic of this principle is manifested as maintaining one's uniqueness and absolute leading position in a certain technological field compared with other countries through government guidance or direct measures taken. The means are mainly divided into two types: offensive technonationalism and defensive technonationalism, and the most significant difference between the two types of means lies in their goal orientation. Additionally, the means are mainly divided into two types: offensive technonationalism and defensive technonationalism, and the most significant difference between the two types of means lies in their goal orientation. Among them, offensive measures focus on containing the opponent, that is, mainly suppressing or restricting competitors. Through measures such as export control, alliance containment, and market access restrictions, it prevents latecomer countries from catching up in technology, thereby maintaining its dominant position in key technological fields. Different from this, Defensive technonationalism centers on self-strengthening, focusing more on enhancing one's own scientific and technological strength. Through paths such as industrial policy support, localization in key areas, and talent system construction. It reduces reliance on external technologies, thereby achieving technological self-strengthening and gaining a relatively advantageous position in this field [6]. To be noticed, both serve the country's leading position in the field of technology.

As a policy ideology, the theoretical foundation of technonationalism can be traced back to economic nationalism and realistic international political theory. It emphasizes that technology is the engine of economic growth and a core element of national power and security. This stands in sharp contrast to the concept of global technological cooperation and deep integration of supply chains advocated by liberalism. Although technonationalism runs counter to the trend of technological globalization, it is still not entirely equivalent to technological decoupling. Technonationalism is actually more inclined towards a kind of selective decoupling or coupling under control, that is, participating in global cooperation under certain conditions and the premise of ensuring its own technological security and advantages. Thus, this theoretical framework can provide a powerful analytical approach for analyzing South Korea's strategy of seeking cooperation with both sides while emphasizing independent development and innovation under the competition between China and the United States.

The theory is the essential tool for analyzing the behaviors of some countries in the global semiconductor industry, and the practices of the United States and Japan in the semiconductor field are typical cases that can reflect the underlying logic of these two types of approaches.

4.2 Practical Examples of Technonationalism: A Comparison between the Offensive and Defensive Types

Given the particularity of the semiconductor industry, which is technology-intensive and has a long industrial chain and strong geographical attributes, the two types of practices of technonationalism present clear differentiated characteristics. Also, the semiconductor development processes of the United States and Japan are the most representative and highly valuable samples for research.

Offensive Technonationalism: Technological Monopoly and Policy Containment in the United States Semiconductor Strategy. As the technological hegemonic country in the global arena, the United States' technonationalism has always centered on maintaining its technological monopoly position. It mainly adopts a strategy that combines external containment of rivals' development with internal strengthening of technological innovation, directly transforming its technological advantages into geopolitical status and dominance.

In the semiconductor field, the containment measures that the United States implemented against Japan are the most representative. In the 1980s, Japan's semiconductor industry rose to prominence [7]. Fearing that its development would pose an excessive threat to itself, the United States promptly forced Japan to open its market through *the United States-Japan Semiconductor Agreement* and, in collaboration with enterprises, established the Semiconductor Manufacturing Technology Alliance through methods such as technology sharing and government research and development subsidies. It helped companies like Intel break through Japan's monopoly on DRAM technology and eventually regain its position as the world's largest semiconductor company in 1993, which is a typical offensive logic of maintaining one's own technological monopoly by suppressing rivals [8].

In recent years, the semiconductor restrictions imposed on China, such as the guardrail provisions in the *Chips Act*, which require subsidized enterprises not to expand production in China for 10 years, are essentially economic constraints to limit the capacity expansion of competitors like South Korea and China. Meanwhile, the United States is consolidating its domestic semiconductor manufacturing capabilities, which is a major means of converting technological advantages into geopolitical tools. All of these means directly affect the global semiconductor industry chain layout and continue the effective means of suppressing rivals through alliances and regulation [9].

Defensive Technonationalism: Technological Catch-up and Development Limitations in Japan's Semiconductor Industry. As a latecomer in the semiconductor field, Japanese technonationalism mainly aims at technological self-strengthening and catching up. To achieve breakthroughs in technology and industry, Japan has chosen to rely on government guidance and the introduction, digestion, and re-innovation of technology as its methods.

In the 1970s to 1980s, the Ministry of International Trade and Industry (MITI) of Japan took the lead in establishing a research group for very large-scale integrated circuits (VLSI) technology, and eventually achieved technological catch-up with the United States in the DRAM field [10]. This is the behavioral logic of a country striving for an advantage in its field by completing internal innovation.

However, this practice has limitations. As presented in Table 1, Japan has overly focused on applied technologies, thereby neglecting the R&D investment in basic links such as upstream materials and equipment [11]. Moreover, insufficient investment in innovation, coupled with the United States' external containment of its industry, has led Japan's semiconductor industry to gradually fall into the Galapagos syndrome after the 1990s. This exposes the predicament of defensive technonationalism, which is 'easy to catch up in the short term but difficult to maintain a leading position in the long term'.

Table 1. Comparison of Two Types of Technonationalism Taking the United States and Japan as Examples.

Comparison Dimensions	Offensive Technonationalism (the United States)	Defensive Technonationalism (Japan)
Core Objectives	Maintain global technological monopoly and curb the catch-up of late-developing countries.	Achieve self-reliance in technology and break through the technological blockade by early-developing countries.
Main Means	Export controls, alliance containment, market access restrictions	Government-led joint research and development, localization of key technologies, and talent reserve
Typical Cases	U.S.-Japan Semiconductor Agreement, CHIPS and Science Act, Chip 4 Alliance	VLSI Technology Research Association in the 1970s, DRAM localization
Effects and Limitations	Suppress rivals in the short term, but easily trigger countermeasures	Achieve technological catch-up in the short term, but become disconnected from global standards in the long term

4.3 Strategic Analysis of South Korea's Semiconductor

The practices of the United States and Japan clearly present the internal logic and practical characteristics of the two forms of technonationalism. The offensive nature of the United States highlights how technological hegemonic countries use technology as a tool to maintain monopolies, while Japan's defensive stance reflects how latecomer countries achieve progress and breakthroughs through independent strategies.

South Korea, as a medium-sized technological power in the semiconductor field, is neither a technological hegemonic country like the United States nor a latecomer rising country like Japan. Its strategic choices in the semiconductor field are facing the contradiction of external technological constraints and domestic autonomy demands similar to those in the practices of the United States and Japan, while falling into a relatively more complex decision-making situation due to its technological dependence on the United States and market reliance on China.

The following text will analyze what adverse impacts were brought to South Korea's semiconductor industry by the Sino-US game, focusing on the semiconductor strategy adopted by South Korea from 2018 to 2024. By combining the theory of technonationalism with the actual situation of its industry, it will reveal the core logic of the dynamic balance between defensiveness and offensive strategies.

5 Multidimensional Impact Analysis of China-US Competition on South Korea

5.1 Shock of U.S. Policies on South Korea

One of the most direct actions taken by the United States to impact the semiconductor industry is the *Chips Act*, which it has enacted in recent years. By dismantling the industrial chain in various ways, it aims to achieve anti-globalization and ultimately reach its goal of De-Sinicization. For instance, the *Chips Act* stipulates that if enterprises receive US subsidies, they are not allowed to expand their advanced process production capacity in China within the next ten years. Due to the lack of international technology transfer licenses, South Korea's main intellectual property rights in the semiconductor industry have long been constrained by the United States. That constraint has led to South Korean technological upgrades having to rely on the United States alliance system. Furthermore, South Korea is unable to independently break through the bottlenecks of advanced manufacturing processes. Therefore, this clause directly restricts the technological upgrade path of leading enterprises such as Samsung. If they do not accept subsidies, the funding gap for domestic advanced process research and development will reach 20%. If accepted, it will lose the opportunity to implement the technology in the Chinese market and restrict its future investment capacity in China. The United States has pressured South Korea to restrict the export of advanced NAND chips to China, resulting in an 18% decline in South Korean semiconductor exports to China in 2022-2023. This forced South Korea to readjust its global production capacity layout-the SK Hynix factory, which was originally planned to expand in Wuxi, China, had to transfer 30% of its equipment to the factory in Massachusetts, the United States. This had led to a 40% reduction in market response speed [12]. This move has undermined the foundation of industrial complementarity between China and South Korea, making South Korea reevaluate its global production capacity layout.

Meanwhile, the United States has also enlisted South Korea and other countries to establish technological alliances such as the Chip Quartet Alliance, thereby creating a technological blockade against China. The alliance has demanded that member states share supply chain information, which forces South Korea to cut off some of its cooperation with Chinese semiconductor material enterprises such as SMIC's silicon wafer suppliers. This has led to the risk of material supply disruptions for South Korean factories in China. For example, in 2023, Samsung's Xi'an factory suffered a sunk cost of approximately 500 million dollars due to delayed material imports, which directly impacted the regional coordination of the semiconductor industry chain in East Asia [13].

5.2 Irreplaceability of China's Market for South Korea

As for China, the three East Asian countries (China, Japan, and South Korea) have long been complementary in the semiconductor industry. However, due to significant changes in the development environment and international market for Chinese and South Korean semiconductor industries, the two countries have gradually moved towards competition in finance and trade as well as technological R&D. However, despite competition has become intensive, China accounted for 38% of South Korean semiconductor export market in 2023, still remaining the largest export market for South Korean semiconductors [13]. Moreover, the global production capacity contributed by Samsung's Xi'an factory and SK Hynix's Wuxi factory still accounts for almost half of the total. It can be said that if South Korean semiconductor companies were to completely withdraw from the Chinese market, their annual revenue would decrease by 25% and their R&D investment capacity would decline by 30%. This is also the core reason why South Korea is resolutely striving for an indefinite export exemption. As the core market of South Korea's semiconductors, China's position as the core market for South Korea's semiconductor industry is unlikely to be shaken in the short term [14]. Also, it is not feasible for South Korea to completely cut off economic ties with China. At the same time, in order to deal with the negative impacts brought by the *Chips Act*, China is committed to deepening the coordination with partner countries in the fields of technology and funds. After the Lee Jae-myung administration came to power, friendly communication was held with it, and both sides expressed their willingness to cooperate amicably with each other.

The conflict between the United States' demand for de-Sinicization and South Korea's demand for the Chinese market is essentially a dilemma of choosing between technological development and economic development, and it is also the fundamental driving force behind South Korean strategic decisions. Overall, the current restrictions and obstacles faced by South Korea's semiconductor industry mainly come from the United States.

6 Practice of South Korean Semiconductor Strategy

6.1 Defensive Practice

Supply Chain Security Guarantee Measures. Under the framework of defensive technonationalism, South Korea has ensured the security of its semiconductor industry by promoting the localization of materials and equipment. This reduces its reliance on the supply chains of the United States and Japan. Facing the impact and pressure from

Japanese hydrogen fluoride export control in 2019 and the United States *Chips Act*, Dongjin Chemical commercialized display photoresist in 2022, and Soulbrain began supplying high-purity hydrogen fluoride to Samsung in 2023. This cooperation originated from the South Korean government taking the lead in promoting a special plan for the localization of hydrogen fluoride after Japan imposed export control on South Korea. Soulbrain has received government research and development subsidies, collaborating with the Korea Advanced Institute of Science and Technology (KAIST). It has broken through high-purity purification technology and supplied hydrogen fluoride to Samsung's Xi'an factory in 2023, meeting 80% of its production needs. By 2024, South Korean domestic enterprises will have occupied 65% of the domestic hydrogen fluoride market share. The country's reliance on Japanese hydrogen fluoride imports has dropped from 0% in 2019 to 35%, completely eliminating the risk of supply disruption and production suspension, and successfully resolving the supply chain bottleneck problem that the United States has been pressuring through its Allies [13]. In the equipment sector, the South Korean government established a 1 trillion won *Special Fund for Semiconductor Equipment Investment* in 2021, providing low-interest loans and a 30% to 40% research and development tax credit to support the development of domestic equipment enterprises. After the policy was implemented, domestic equipment enterprises such as Semes and AP Systems became the core beneficiaries. Among them, Semes received a low-interest loan from the government and developed the 14nm process etching equipment. In 2023, it delivered the equipment to SK Hynix's Wuxi factory, replacing the equipment it originally relied on from Lam Research in the United States. AP Systems has broken through the technology of wafer inspection equipment by developing tax credits, which significantly reduced its reliance on equipment from the United States and Japan.

The main purpose of this decision is to achieve autonomy at the security level. In 2019, Japanese hydrogen fluoride control led to a 20% decline in South Korean semiconductor production capacity. Now, it has broken through the supply chain security predicament under the technological blockade of the United States and Japan. At the same time, South Korea rejected the United States' export restrictions on China, retaining 38% of its export share in the Chinese market. While safeguarding its independence, it also protected economic development, achieving a strategic balance between security and the economy.

Strategic Layout For Technological Autonomy. Based on the strategic demand for technological autonomy, South Korea has promoted the independent layout of core semiconductor technologies through top-level policy planning and talent reserves. The *K-Semiconductor Strategy*, released in 2021, explicitly set the goal of achieving a 50% self-sufficiency rate of materials by 2030 and built a K-semiconductor industrial belt. In 2024, high-bandwidth memory (HBM) will be further designated as a national strategic technology, and special tax incentives will be provided for companies. In terms of talent support, the South Korean government plans to cultivate 150,000 semiconductor professionals from 2024 to 2034, expand the enrollment quotas for related majors in universities, and enhance talent reserves by jointly training professionals with enterprises and universities [15].

Market Risk Prevention Mechanism. To balance its reliance on the Chinese market, South Korea has chosen to mitigate the risk of its reliance on the Chinese market and maintain global production capacity stability by taking advantage of regional trade rules and diplomatic negotiations. South Korea has taken advantage of the tariff preference rules of the RCEP to include Chinese-made silicon wafers, which account for 35% of its imports, in the regional value component accounting in order to avoid the tariff barriers of the United States. The 40% share of production capacity in the Chinese market has driven negotiations between the South Korean government and the United States government. In October 2023, after several rounds of negotiations, South Korea finally won the indefinite export exemption granted by the United States Department of Commerce to Samsung's Xi'an factory and SK Hynix's Wuxi factory, ensuring the normal supply of advanced process equipment such as 236-layer NAND [14]. This decision responds to the alliance's responsibility from the United States, that is, not completely violating its technological blockade and retaining the Chinese market, thus avoiding idle production capacity and enabling South Korean factories in China to maintain a certain share of global production capacity.

6.2 Offensive Practice

External Collaboration and International Discourse Expansion. In 2022, South Korea joined the Semiconductor Working Group of the Indo-Pacific Economic Framework. In February 2023, it further participated in the first video conference of the Chip4 Alliance. Within this alliance, Samsung shares the 3nm process yield improvement technology with other members. In exchange, Samsung obtains the EUV supporting equipment maintenance technology authorization from Applied Materials (AMAT) of the United States and the packaging and testing technology support from Tokyo Electron (TEL) of Japan. At the same time, relying on the alliance's *Supply Chain Redundancy Plan*, the South Korean factory in Texas has received priority supply from the local silicon wafer enterprise CoorsTek. The 3nm production capacity of this factory is expected to increase by 40% in 2024. It is precisely with such technological and production capacity gains as the pulling force, coupled with the threat of technological blockade, that the United States has forced South Korea to join the alliance. However, in order to retain the Chinese market, South Korea explicitly refuses to impose export restrictions on China. Even though it was in a passive position to join, South Korea still took the initiative to secure some leeway for its development.

Under the framework of the *K-Semiconductor Strategy*, South Korea actively promotes the formulation of international standards in areas such as semiconductor testing and packaging. In 2024, it took the lead in establishing the East Asia Semiconductor Technology Alliance, attracting 12 international equipment enterprises to participate [14]. It can be seen that South Korea is making an effort to build a third-party technical discourse system outside China and the United States by converting its domestic technical specifications into regional standards. This is also one of the manifestations of offensive technonationalism.

Further Development of Technology in the Global Market. Relying on its comparative advantage in the field of memory, South Korea has consolidated its market position through technological iteration. Samsung's Xi'an factory started flash production of 236-layer NAND in 2023. During the sluggish period when the global NAND market price dropped by an average of 40% annually in 2023, this technology helped Samsung achieve a 12% revenue growth. This breakthrough relies on the tax incentives of the South Korean government's *HBM National Strategic Technology* and Samsung's 15% investment in research and development expenses [14]. It is a typical achievement of government-enterprise collaboration. Compared with the previous generation of products, the wafer input has been reduced by 30%, achieving cost leadership globally. SK Hynix successfully increased its global market share to 34% by acquiring Intel's NAND business, in line with the South Korean government's strategic goal of building a global semiconductor manufacturing hub. At the same time as the acquisition, SK Hynix quickly completed the equipment integration by leveraging the special fund for semiconductor equipment investment previously established by the South Korean government. In contrast to the situation in 2019, when Fujitsu's Japanese DRAM share dropped from 30% to 5% due to the lack of government-enterprise collaboration, South Korean companies' mergers and acquisition strategies as the main approach and policy support as a supplement are the keys to its comprehensive strength.

7 Analysis of the Development Paths and Models of South Korea's Semiconductor Industry

The semiconductor industry chain mainly consists of three links. The upstream mainly involves design business, manufacturing equipment and materials, the midstream mainly focuses on the manufacturing and packaging and testing of integrated circuits, discrete devices, and optoelectronic components, and the downstream is the production of digital terminals for enterprises and individual consumers. From the perspective of the global semiconductor trade and industrial landscape, South Korea holds a significant position in multiple links of the global industrial chain. In the materials sector, it formed close regional trade interactions with China and Japan in 2019. Although there is still reliance on the equipment sector, local enterprises have gradually achieved breakthroughs. Therefore, it can be said that South Korea is deeply involved in all aspects of global semiconductor design, manufacturing, packaging and testing, materials, and equipment. Among them, midstream manufacturing is its core investment and advantageous link. It leads the global market share and trade proportion, and is one of the key focuses of global semiconductor manufacturing.

From the perspective of development models, the domestic semiconductor industry in South Korea follows a model supported by the government and dominated by chaebols, which means large private chaebols such as Samsung, SK, and Hynix serve as the core of industrial development, undertaking large-scale research and development and vertically integrated production, accounting for over 90% of South Korean semiconductor sales. The government provides industrial support by setting up special funds and issuing preferential policies, and at the same time coordinates government and enterprise resources through institutions such as the Electronic Communication Research Institute [16]. This kind of vertical integration model is significantly superior to that of Japanese and American enterprises. Unlike Japan's application-oriented approach and the policy constraints of the United States, South Korea has achieved resilient industrial development through government-enterprise collaboration and a dual-market layout. Specifically, Samsung has achieved full coverage of the chain, like design, manufacturing, packaging, and testing-materials. In 2023, the self-sufficiency rate of all self-developed materials reached 45% [17]. Even facing the equipment restrictions from the United States, it can still maintain production capacity through the substitution of domestic materials. SK Hynix has avoided the core flaws of the Japan-US model by adopting a dual layout of subsidies for its US factories and production capacity for its Chinese factories, taking into account both policy compliance and market interests. This is also the key step for it to maintain its competitiveness in the competition between China and the United States.

In light of the background of the Sino-US game, the development model of South Korea's semiconductor industry can be characterized as a development paradigm of a medium-sized technological power that focuses on the midstream of the industry and achieves bilateral balance. That is, it depends on the United States' technology and its alliance system, while at the same time, it anchors on China in the market to maintain its export scale. It builds defense capabilities by promoting the localization of materials and equipment takes the manufacturing advantages dominated by chaebols as the core, achieving a dynamic balance between alliance obligations and economic interests, technological dependence, and industrial security. All in all, it has become a typical sample in the global semiconductor industry chain that takes into account both global cooperation and independent development.

8 Conclusion

This study systematically responds to two core issues: how South Korea weighs decisions between China and the United States and the core logic behind its strategies. The main conclusions are summarized as follows:

Firstly, the Sino-US game in terms of technology and market is the core environment for South Korea's semiconductor strategy. The United States used the *Chips Act* to build a technological blockade and exploited South Korean reliance on US technology to force it to cooperate. China, as a core export market and component supplier for South Korean semiconductors, provides irreplaceable economic support. This contradiction has trapped South Korea in a dilemma between alliance restraint and economic interests, becoming the fundamental driving force for its strategic decisions.

Secondly, South Korea has built a bottom line for industrial security through defensive technonationalism to defuse external pressure. It reduces external dependence by achieving supply chain autonomy, jointly reserving technical talents by universities and enterprises, hedging market risks through RCEP and diplomatic negotiations, and maintaining stable production capacity.

Thirdly, South Korea expands its global competitive space through offensive technonationalism methods. It acquires resources through alliance collaboration, expands market share by relying on technological advantages, leads regional technological alliances to build a third-party discourse system, and proactively breaks through external constraints.

Fourth, the essence of South Korea's semiconductor strategy is a dynamic balance in the competition among major powers. Unlike the United States and Japan, South Korea has not sacrificed the Chinese market to cater to the United States. Nor has it lost its technological support by breaking away from its alliance. Instead, South Korea has focused on its industrial positioning. It ensures security through defensive measures and expands its competitive space through offensive strategies. This proactive balance responds to the existing research discussions on South Korean selective compromise and supplies the correlation analysis between RCEP and South Korean response strategies, improving the understanding of the semiconductor decision-making logic of medium-sized technological powers.

From a broader perspective, South Korea's actions provide an important reference for the world's medium-sized technological powers to deal with technological competition. Against the backdrop of the global industrial chain's reconstruction, neither merely aggressive hegemony nor passive defensive catch-up can maintain sustainable development. While relying on its own industrial foundation, seeking development opportunities through independent innovation and international collaboration has become a viable path that can ensure the long-term survival and development of the industry. This research reveals the response patterns of medium-sized technological powers in the reshaping of global technology governance, providing inspiration for subsequent comparative studies.

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