Theory and Practice of Science and Technology
2025, VOL. 6, NO. 12, 133-136
DOI: 10.47297/taposatWSP2633-456928.20250612

The Impact of Sino-American Strategic Competition on China's Semiconductor Industry Policy

Xunan Wang

Ningbo University, Ningbo, Zhejiang, 315211, China

ABSTRACT
Against the backdrop of intensifying strategic competition between China and the United States, the semiconductor industry has emerged as the focal point of technological rivalry between the two nations. Since 2018, the United States has implemented phased restrictions on China's semiconductor sector through multi-dimensional measures including export controls and investment reviews. These actions have significantly disrupted China's semiconductor supply chain across upstream, midstream, and downstream segments, resulting in obstructed equipment and material supplies upstream, stalled R&D of advanced midstream processes, and diminished competitiveness in downstream end-use applications. In response, China has established a coordinated domestic policy framework integrating fiscal, technological, and market measures. This framework advances the self-reliance and controllability of the industrial chain through short-, medium-, and long-term strategies, while expanding international cooperation pathways through multilateral partnerships and corporate collaborations. This paper examines the dynamics and implications of Sino-US semiconductor competition, offering insights for China's semiconductor industry to break through restrictions and enhance its global influence.

KEYWORDS
Sino-US strategic competition; Semiconductor industry; Technological blockade; Supply chain; Self-reliance and control; International cooperation

1 Introduction

In recent years, the strategic competition between China and the United States has become increasingly pronounced, with the contest in the technological sphere proving particularly intense. As the core of modern technological industries, the semiconductor sector has emerged as a pivotal focal point in this bilateral rivalry. Semiconductors play a critical role across numerous domains, including information technology, artificial intelligence, and national defence security. The United States has long maintained a position of global leadership in the semiconductor industry, viewing semiconductor technology as a vital pillar for upholding its global hegemony. However, China's rapid advancement in technological fields, particularly through continuous breakthroughs in semiconductor design and manufacturing processes, has altered this landscape. The United States has linked China's technological advancement to its own national security and geopolitical interests. Washington perceives the rise of China's semiconductor industry as potentially reshaping the global technological landscape and geopolitical equilibrium, thereby threatening its pre-eminence in science and technology. Consequently, the US government has implemented a series of measures aimed at curbing the development of China's semiconductor sector to preserve its hegemonic position in the technological sphere.

Since the onset of the Trump 1.0 era in 2018, the US government has implemented comprehensive technological containment measures against China's semiconductor industry through a series of policy instruments. These include export controls, technological blockades, investment restrictions, and the inclusion of Chinese chip firms on the Entity List. Under these circumstances, China's semiconductor supply chain suffered severe setbacks. Lithography equipment suppliers collaborating with China faced US sanctions intervention, halting sales to China and causing stagnation in the production of 14nm and below chips. This significantly impacted the product performance enhancements and delivery timelines for numerous Chinese mobile phone companies and the new energy vehicle sector, which relied heavily on overseas chips. During this period, the Chinese government implemented measures to attract and cultivate talent, intensified support policies for the technology sector, and reduced reliance on overseas markets. Technology companies pursued independent innovation in chip technology, achieving self-reliance and control over core technologies. Led by Huawei, these enterprises achieved significant breakthroughs in chip development, substantially enhancing China's global influence in the technology sphere. Amid the uncertainty surrounding the Trump 2.0 era and the US administration's global technological initiatives, China must prioritise achieving self-reliance in core technologies, strengthen international cooperation and exchange, and enhance its influence within the global technology landscape.

2 The United States' Restrictive Measures on China's Semiconductor Industry and Their Evolving Trends

The competition between China and the United States in the semiconductor industry continues to intensify. In an effort to curb China's rapid rise in this sector, the United States has imposed comprehensive, multi-dimensional restrictions on China's semiconductor industry. These restrictions have evolved from minor to significant, and from isolated to widespread. Against this backdrop, the development of China's semiconductor industry faces unprecedented challenges.

2.1 Restrictive Measures in the United States and Case Analyses

The United States has imposed restrictions on China's semiconductor industry across multiple dimensions, aiming to impose a comprehensive blockade on China's chip sector. Regarding technology export controls, the US Export Administration Regulations (EAR) govern the export of semiconductor equipment and materials. In 2022, the EAR restricted US companies from exporting logic chip manufacturing equipment for 14nm and below processes, extreme ultraviolet (EUV) lithography machines, and related technical support to China. Regarding investment scrutiny, the Committee on Foreign Investment in the United States (CFIUS) has intensified its review of Chinese acquisitions. In November 2016, Canyon Bridge Capital, backed by Chinese investors, sought to acquire US programmable chip manufacturer Lattice for US $1.3 billion. The transaction was repeatedly blocked by CFIUS due to concerns over intellectual property transfer risks. In September 2017, President Trump signed an executive order halting the acquisition, marking the first rejection of a Chinese technology M&A deal during his presidency. Regarding Entity List controls, the US has added multiple Chinese enterprises to its ‘Military End-User List.’ In May 2019, citing ‘national security concerns,’ the US placed Huawei and 68 of its subsidiaries on the Entity List, prohibiting US firms from conducting transactions without authorisation and severing its core technology supply chains. In terms of talent mobility restrictions, the US tightened visa screening and imposed limitations on academic exchanges between Chinese and American universities. From 2021, Chinese students pursuing studies in ‘sensitive disciplines’ such as semiconductors and quantum computing were required to submit detailed research plans. Certain institutions, including the Massachusetts Institute of Technology, terminated joint laboratory projects with Tsinghua University.

2.2 Phases of US Restrictions on China's Semiconductor Industry

The United States' restrictions on China's semiconductor industry have primarily unfolded across three distinct phases. During the initial phase (2018 to 2020), against the backdrop of the ‘trade war,’ the US government's measures centred on imposing tariffs on Chinese chips and sanctioning specific high-tech enterprises. These actions constituted exploratory restrictions rather than a comprehensive blockade of Chinese semiconductor firms. During the escalation phase (2021–2022), following the Biden administration's inauguration, the US policy focus shifted from trade restrictions to technological containment. The US targeted advanced manufacturing processes with precision, blocking the deployment of cutting-edge technologies within China. US restrictions on China's semiconductor sector expanded from product import/export controls to encompass personnel blockades and sanctions. Consequently, China's advanced chip mass production faced severe impediments, highlighting critical bottlenecks within its semiconductor industry. During the comprehensive containment phase (2023 to present), US restrictions on Chinese semiconductors have escalated from ‘selective technological blockades’ to ‘full-spectrum coverage across the entire industrial chain.’ The US has mobilised allies to establish a ‘chip alliance,’ leveraging this framework to pressure other nations into prohibiting the supply of lithography equipment and technical support to China. Facing total supply disruption, China must now prioritise independent development of core semiconductor technologies.

3 Impact of US Restrictive Measures on China's Semiconductor Industry Supply Chain

In the upstream sector, the United States' restrictions on critical chip manufacturing equipment for China stand out most prominently. This upstream domain encompasses core apparatus for the semiconductor industry, including lithography machines and etching equipment. Through a series of political interventions targeting international supply chains and curtailing technological collaboration, the US has severed Chinese chip firms' access to advanced semiconductor manufacturing equipment. In 2019, the US government exerted political pressure through diplomatic lobbying to intervene with Dutch firm ASML, compelling it to halt exports of EUV lithography machines to China on ‘national security’ grounds. This left SMIC's development of processes below 14nm in dire straits, forcing subsequent iteration plans for this chip series to be shelved. From 2020 onwards, the US added over a hundred semiconductor enterprises—including Huawei's HiSilicon, Cambricon, and AMEC—to its ‘Entity List’. With cutting-edge technological cooperation blocked by the US, these firms were compelled to divert substantial resources towards independent R&D to replace previous chip manufacturing solutions. Consequently, the pace of innovation and mass production for high-end computer chips by Chinese enterprises has markedly slowed, even reaching a standstill. Regarding the semiconductor materials supply chain, leading Japanese firms Shin-Etsu Chemical and JSR, under pressure from the United States, reduced supplies of high-purity photoresist and large-size silicon wafers to Chinese chip manufacturers. This further constrained production capacity at some chip factories, leading to shutdowns in some cases.

In the midstream segment, China's semiconductor manufacturing sector has suffered severe setbacks. Domestic wafer fabs, which had originally planned to vigorously develop advanced processes at 14nm and below, have faced obstacles in importing essential equipment. To avoid stagnation, enterprises have instead intensified R&D efforts on mature processes at 28nm and above. While these processes can meet some computer and internet demands, their technological added value is comparatively lower than that of 14nm and below. This not only leads to inefficient resource allocation but also hampers the overall upgrading of China's chip manufacturing industry. Concurrently, US restrictions have exposed Chinese chipmakers to the risk of losing foundry orders. Concerned about potential entanglement in US sanctions, some international clients have reduced or cancelled cooperation orders with Chinese chip manufacturers, further compressing the domestic enterprises' market space. As a midstream back-end process, packaging and testing relies on imported equipment for its advanced technologies. The US's inclusion of advanced packaging equipment such as CoWoS and Chiplet within its export control scope in 2022 has prevented Chinese companies from accessing the latest flip-chip packaging equipment.

In downstream segments, the impact on application sectors has been significant. Electronic products such as smartphones and tablets have substantial demand for chips, with these devices heavily reliant on high-end processor chips. Under the influence of US Department of Commerce export controls, mobile phone enterprises such as Xiaomi and OPPO have encountered obstacles in procuring Snapdragon 8 series chips. Certain models have been unable to obtain authorised chip supplies on schedule, hindering performance enhancements for flagship devices under these premium brands. Concurrently, Apple Inc. has consolidated its high-end market share through in-house chip development and a stable supply chain. Consequently, the global competitiveness of Chinese mobile phone brands has weakened, leading to a loss of market influence. Within the new energy vehicle sector, Chinese manufacturers like NIO and Li Auto have faced repeated production halts due to automotive chip shortages. Delayed vehicle deliveries have intensified operational pressures for these companies, constraining the broader development of the new energy vehicle industry. Within the internet and cloud computing sectors, cloud service providers exhibit substantial demand for high-end server chips. Leading enterprises such as Alibaba Cloud and Tencent Cloud have been impacted by unstable supplies of premium chips, limiting computational capacity growth in domestic data centres and diminishing capabilities for AI training and large-scale model deployment. This places Chinese cloud service providers at a disadvantage in global market competition.

4 China's Response Strategy and International Cooperation Model

4.1 Exploring Domestic Policy Response Systems and Pathways to Self-Reliance and Control in Industrial Chains

Amidst the strategic competition between China and the United States, the Chinese government has implemented a multi-tiered response system. At the fiscal and financial level, the government has expanded investment in the national integrated circuit industry, established special loan interest subsidy policies, and supported high-tech enterprises in securing financing, thereby injecting vitality into the sector's development. Regarding breakthroughs in critical technologies, the focus centres on overcoming bottleneck technologies such as EDA tools, lithography machines, and high-end photoresists. By forming cross-enterprise and cross-university innovation consortia, efforts are concentrated to overcome technical barriers. In market cultivation, the application of domestically produced chips is being expanded in sectors like new energy vehicles and industrial internet, reducing reliance on overseas markets and thereby establishing a comprehensive domestic support system. China has established phased objectives for achieving self-reliance across the semiconductor supply chain, implementing a staged approach to enhance resilience. In the short term (1-3 years), the focus is on achieving full self-sufficiency for mid-to-low-end chips. Prioritise securing the supply chain for mature process chips at 28nm and above. Key efforts will concentrate on achieving domestic substitution for critical materials like photoresists and specialty gases, alongside packaging and testing equipment within this process node. Concurrently, consolidate domestic mature-process wafer fab resources to boost production capacity, ensuring stable chip supply for automotive electronics and industrial control sectors while establishing a market foundation. Secondly, within the medium term (3-5 years), concentrate efforts on mid-tier process technologies to overcome core bottlenecks. With 14nm FinFET as the primary target, pool resources to breach technical barriers in related lithography machines and EDA tools. Drive the large-scale application of domestically produced 14nm chips in 5G base stations, artificial intelligence edge computing, and other domains. Simultaneously, refine supporting mid-tier industrial chains to achieve full-chain connectivity, expanding the application scenarios of domestic chips into technology-intensive sectors. Finally, in the long term (5-10 years), lay the groundwork for advanced process reserves to compete globally. Target 7nm and below advanced processes, increase investment in cutting-edge technologies such as quantum chips and advanced packaging, and propel domestically produced advanced chips into high-end server and premium smartphone markets. This will break the monopoly of international giants and enhance the global influence and competitiveness of China's semiconductor industry.

4.2 Innovation in International Cooperation Models

China is expanding cooperation avenues through multiple channels to innovate international collaboration models, integrating global resources while circumventing external constraints to inject external momentum into the semiconductor industry's development. Regarding multilateral cooperation mechanisms, China has moved beyond restrictive frameworks such as the US-led CHIPS and Science Act. It actively leverages global organisations like the WTO to promote fair and transparent semiconductor trade rules. Concurrently, China collaborates with BRICS nations and Belt and Road countries possessing semiconductor industry foundations or requirements to establish technology-sharing and R&D platforms. This fosters technical exchange and cooperation through mutual learning and complementary resources. Regarding collaboration pathways among semiconductor enterprises, Chinese firms have established technical cooperation platforms with non-US entities such as ASML and Samsung. Through cross-licensing of patents and joint ventures for factory construction, they are deploying collaborative projects in chip manufacturing and R&D within mainland China or third countries. This approach circumvents US restrictions on technology transfer while enabling direct access to advanced technologies and management expertise. Regarding regional industrial chain synergy, China deepens collaboration with Southeast Asian nations like Malaysia and Thailand in packaging/testing and semiconductor materials, forming a coordinated model of ‘design in China, manufacturing in the region, application globally.’ This reduces production costs, diversifies supply chain risks, and enhances the international reach and influence of China's semiconductor industry through regional cooperation. Constructing a ‘China + Southeast Asia’ semiconductor manufacturing industrial chain fully leverages regional advantages to achieve mutual benefit and shared success.

5 Conclusion

The multi-stage, multi-dimensional restrictions imposed by the United States on China's semiconductor industry have significantly disrupted various segments of China's chip supply chain. However, this has spurred China to accelerate its pace of independent innovation. Through policy support, technological breakthroughs, and market cultivation, China has established a comprehensive domestic support system, advancing the self-reliance and controllability of its industrial chain in phases. Concurrently, China is expanding its international cooperation through multilateral partnerships and corporate collaboration, actively integrating global resources. Moving forward, by steadfastly upholding the core principle of autonomy and control while deepening open cooperation, China's semiconductor industry will undoubtedly break through these barriers. It will secure its place within the global technological landscape, demonstrating remarkable resilience in its development trajectory.

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