The Impact of the U.S. CHIPS and Science Act of 2022 on China' s Related Industries and Countermeasures: Postprint

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Abstract

As the cornerstone of modern information technology, chips represent a strategic high ground for competition and industrial development among nations worldwide. In recent years, leveraging its technological advantages, the United States has successively enacted chip acts targeting China, which seriously violates market economy principles and has exerted significant impacts on the global semiconductor industry chain. This article first reviews the development landscape of the global semiconductor industry, then introduces the background, content, and objectives of the U.S. CHIPS and Science Act of 2022 based on this foundation, subsequently analyzes the impacts of this act on the global chip market, China' s chip industry and its related industries as well as the Chinese economy, and finally proposes countermeasures tailored to China' s actual national conditions.

Full Text

Preamble

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Abstract

As the cornerstone of modern information technology, semiconductors represent the strategic commanding heights of global competition and industrial development. In recent years, the United States has leveraged its technological advantages to successively introduce chip-related legislation targeting China, which seriously violates market economy principles and significantly impacts the global semiconductor supply chain. This paper first reviews the development pattern of the global semiconductor industry, then introduces the background, content, and objectives of the U.S. CHIPS and Science Act of 2022. Subsequently, it analyzes the Act' s impacts on the global chip market, China' s chip industry and related sectors, and the broader Chinese economy. Finally, based on China' s actual conditions, the paper proposes targeted countermeasures and policy suggestions.

Keywords: CHIPS and Science Act of 2022, semiconductor industry, economic impact, China' s countermeasures

1. Development Pattern of the Global Semiconductor Industry

The semiconductor industry, born in the 1960s, is regarded as the cornerstone of information technology. Semiconductor products have transformed modern society by enabling applications across electronics, communications, internet, transportation, healthcare, aerospace, and defense, becoming a critical engine for economic growth and a symbol of technological strength worldwide. The industry is characterized by intensive technology, capital, and market demands. As the birthplace of semiconductors, the United States has developed capital markets that provide robust support for R&D and innovation, allowing some U.S. companies to monopolize multiple key segments of the semiconductor technology chain. According to the Semiconductor Industry Association' s 2022 report, the U.S. held a 72% market share in electronic design automation (EDA) and intellectual property (IP) in 2021—the crown jewels at the forefront of the semiconductor value chain. In upstream chip design segments, including logic, discrete, analog, and other devices (DAO), U.S. market shares reached 67% and 37% respectively, far ahead of other countries.

East Asia has emerged as a dominant force in chip foundry and packaging. China, South Korea, and Japan collectively command the major market shares in wafer manufacturing, with 40% (including 19% from Taiwan, China), 17%, and 16% respectively in 2021. China leads in chip packaging and testing, accounting for 57% of the global market (with Taiwan, China holding 19%). East Asia also dominates semiconductor consumption, reaching approximately $386.7 billion in 2021—about 70% of the global market. As the world' s largest single

semiconductor consumer, China' s consumption totaled $192.5 billion, representing 35% of the global market.

2. Background, Content, and Objectives of the CHIPS and Science Act of 2022

2.1 Background

The global semiconductor supply chain operates through international division of labor based on comparative advantages. However, due to labor costs and other factors, U.S. chip manufacturing has continuously relocated offshore, with its global share declining from 37% in 1990 to 12% in 2020. The Semiconductor Industry Association (SIA) attributes this decline to ambitious incentive policies offered by other countries while U.S. measures lag behind. Consequently, SIA has urged the federal government to implement stronger incentives to encourage domestic chip production, reshore manufacturing, and ensure supply chain security.

Since the 21st century, China' s rapid rise as the world' s largest trading nation and second-largest economy has intensified U.S. concerns about its economic hegemony. The U.S. has increasingly viewed China as a strategic competitor, beginning with the Obama administration's "Asia-Pacific Rebalancing Strategy," escalating through the Trump administration' s unilateral tariffs, and culminating in the Biden administration explicitly identifying China as the "primary competitor." Driven by market demand and supportive policies, China' s semiconductor industry has advanced rapidly toward higher value-added positions in the manufacturing chain, further heightening U.S. anxieties and prompting successive technological sanctions.

2.2 Content

The CHIPS and Science Act of 2022 comprises four main components [Figure 1: see original paper]. First, **government subsidies**: $52.7 billion over five years, with $50 billion allocated to chip manufacturing, R&D, and workforce development. Second, **investment tax credits**: a 25% tax reduction for semiconductor industry investments, covering equipment manufacturing, facility construction, and specialized tool production. Third, **science and technology R&D funding**: authorizing over $200 billion for NSF, Department of Commerce, NIST, and DOE over five years, expanding support across high-tech fields. Fourth, **"guardrail provisions"**: prohibiting subsidized companies from expanding or establishing new advanced semiconductor facilities (14nm and below) in China and "countries of concern" (including Russia, North Korea, and Iran) for ten years, under penalty of losing all funding.

2.3 Objectives

While the Act' s subsidies and tax credits represent standard industrial policy tools, its guardrail provisions constitute a continuation of technological sanctions driven by U.S. national interests and hegemonic objectives. In the 1980s, the U.S. similarly suppressed Japan' s semiconductor industry through technology blockades and trade wars. This Act primarily targets emerging developing countries like China, aiming to exclude China from the global semiconductor supply chain by restricting key enterprises from expanding capacity in China, thereby weakening China' s influence in the semiconductor sector.

3. Impact of the CHIPS and Science Act of 2022

3.1 Impact on Global Chip Manufacturing and Market

The global semiconductor supply chain has evolved into a highly specialized and refined collaborative network that no single country can independently complete. Over 75% of chip manufacturing capacity is concentrated in East Asia—a result of market forces and corporate choices. The Act' s restrictions violate economic globalization trends by impeding the free flow and optimal allocation of production factors. Forcing the reshoring of "Made in America" and pressuring Japanese, South Korean, and Taiwanese companies to establish U.S. factories will substantially increase production costs due to equipment supply challenges, distance from core consumer markets, and scarce manufacturing talent despite abundant design expertise. SIA estimates that building and operating a semiconductor fab in the U.S. for ten years costs 30% more than in Taiwan, China, South Korea, or Singapore, and 50% more than in mainland China. The subsidies are insufficient and unsustainable compared to these cost differentials.

On the demand side, U.S. restrictions on equipment, talent, and technical services will significantly reduce China' s chip imports from the U.S. and its allies, causing severe supply-demand imbalances and soaring transaction costs that reduce market efficiency. All global market participants will suffer losses, with the extent depending on supply chain fragmentation and price elasticities. Since U.S. chip products have low substitutability and China' s imports are highly elastic, China bears greater costs. Meanwhile, the U.S. and its allies will also suffer trade losses affecting upstream enterprises. The Act represents a "lose-lose" proposition that will distort semiconductor supply chains and intensify geopolitical competition.

3.2 Impact on China' s Chip Industry and Related Sectors

3.2.1 High-End Chip Sector The guardrail provisions primarily affect China' s high-end chip segment. In the short term, China may face severe shortages in high-end chips. Due to strong exclusivity in the industry, high innovation coherence, and tacit knowledge characteristics, latecomer disadvantages are particularly pronounced. Without effective countermeasures,

the restrictions will widen the technology gap between China and the U.S. However, even without this Act, U.S. suppression of China' s high-end chips would continue, as evidenced by the comprehensive restrictions on Huawei Technologies.

In the long term, the impact will be limited. The market vacuum left by U.S. companies will be filled by other chip enterprises, while China will accelerate indigenous innovation. As Bill Gates noted, U.S. export bans force China to develop its own chips, and suppressing Huawei will not prevent Chinese enterprises from advancing but will instead strengthen their resolve for self-reliant R&D, gradually narrowing the gap with U.S. companies.

3.2.2 Related High-Tech Industries The restrictions will indirectly affect Chinese high-tech industries that rely on chips as core components, including smartphones, computers, new energy vehicles, AI, IoT, and big data. Using input-output analysis, we quantified the inter-industry linkages through full distribution coefficients, which measure the proportion of chip industry output consumed as intermediate inputs by other sectors.

Since China' s input-output tables don' t treat chips as a separate industry, we disaggregated the data as follows: (1) Identified relevant industries—chip manufacturing and packaging fall under electronic component manufacturing, while chip design belongs to software and IT services; (2) Calculated industry proportions based on 2020 data from the China Semiconductor Industry Association (chip design: ¥378 billion; manufacturing: ¥256 billion; packaging/testing: ¥251 billion), yielding approximately 11% for manufacturing/packaging in electronic components and 7% for design in software/IT services; (3) Computed full distribution coefficients using the 2020 national input-output table.

[Figure 2: see original paper] and [Figure 3: see original paper] show the top 15 industries most affected. For chip manufacturing and packaging, the most sensitive sectors include communication equipment, computers, automotive parts, power distribution equipment, audio-visual equipment, and software/IT services. For chip design, the most affected are electronic components, internet services, computers, and communication equipment. These industries are characterized by technology intensity, backward chip linkages, and high demand for supporting resources. When chip supply is constrained, the shock propagates through complex economic and technological interconnections, with impact intensity positively correlated with full distribution coefficients.

3.3 Impact on China' s Economy

Using the hypothetical extraction method based on input-output models, we measured the impact of supply chain disruptions on China' s overall economy. This method compares economic performance before and after a hypothetical industry shutdown. In 2020, China imported approximately 10% of its chips from the "Five Eyes" alliance (U.S., UK, Canada, Australia, New Zealand),

while imports from Taiwan, China, South Korea, and ASEAN accounted for about 70%, indicating limited direct dependence on the Five Eyes.

We analyzed two scenarios: (1) The Five Eyes alliance implements a complete chip export embargo on China; (2) An extreme case where the U.S. also includes Taiwan, China and South Korea in the embargo. The chip industry' s economic impact includes both direct contributions and indirect spillovers to downstream sectors.

Short-term results: The Act' s shock would reduce China' s GDP by 0.09–0.71 percentage points (based on 2020 GDP).

Long-term results: The impact will gradually diminish. Trade diversion effects will cause non-participating economies to increase chip exports to China to capture market share. Additionally, chip supply constraints will prompt China to intensify R&D investment and policy support. Increased domestic chip production will substitute for imports, promote coordinated upstream-downstream development, and enhance economic resilience.

4. Policy Suggestions

4.1 Leverage National System Advantages to Enhance Technological Self-Reliance

Chip technology development from basic research to commercial application is lengthy and complex, requiring full utilization of China's national system advantages. The state should deploy major projects and tasks at critical nodes of the next-generation semiconductor technology chain, mobilizing national strategic scientific forces and social resources to overcome key technological challenges. China possesses the world' s largest chip consumer market and is accelerating the construction of a unified national market, providing strong support for indigenous innovation. We recommend increasing support from the National Integrated Circuit Industry Investment Fund, providing long-term stable funding for chip technology R&D, particularly in high-end segments. Concurrently, we should promote innovation platform construction, encourage enterprises to establish research institutions, and organize CAS and universities to conduct critical technology R&D, accelerating the domestic substitution process.

4.2 Develop Chip Talent Through Multiple Channels and Optimize Training Systems

Talent is crucial for industrial development and technological competitiveness. The China Semiconductor Industry Association projects a talent gap exceeding 250,000 in 2022, expanding to 300,000 by 2025, with severe shortages in basic research personnel. Basic research differs from applied research—it may yield no short-term economic returns but provides the foundation for innovation by identifying directions, pathways, and methods. We recommend a dual approach of

attracting and cultivating talent. Strengthen talent recruitment in semiconductors while enhancing basic education in related disciplines. Encourage joint innovation platforms among research institutions, universities, and enterprises to implement collaborative training programs, developing high-quality, multi-level talent in basic research, technology development, and engineering. Establish diversified evaluation systems for basic and applied research to better stimulate innovation vitality.

4.3 Strengthen Coordination to Build Chip Industry Ecosystem and Cultivate World-Class Enterprises

The government should enhance coordination, optimize resource allocation through top-level design, and promote ecosystem construction. Application-driven technology breakthroughs should be encouraged, along with strong enterprise alliances and intellectual property protection, to cultivate internationally competitive leading enterprises. Establish a national chip industry development center to investigate major issues and provide policy recommendations for short, medium, and long-term development. Rely on market forces, implement supportive fiscal, tax, credit, trade, IP, and market policies, and create favorable innovation conditions. Facilitate industry-academia-research translation, support application-oriented commercialization, improve technology transfer efficiency, and cultivate more world-class domestic chip enterprises.

4.4 Utilize Market Advantages to Implement Differentiated Policies and Counter U.S. Technology Blockade

Although the CHIPS Act promises substantial subsidies, these pale in comparison to China' s vast market. As the world' s largest and fastest-growing semiconductor consumer, China accounts for over 50% of export shares from East Asian and ASEAN chip-producing regions. The semiconductor industry remains market-driven, and commercial logic hasn' t changed. China should steadfastly pursue opening-up strategies, leverage its super-large market advantage, and scientifically assess the stakes among major global chip enterprises. Implement differentiated policies: place enterprises that threaten national security or disrupt market rules on the "entity list" to restrict market access; offer fiscal, tax, and credit incentives to enterprises willing to establish factories and trade in China, with special subsidies for "bottleneck" technologies, granting them access to China' s market for returns exceeding U.S. factory benefits. Simultaneously, build a China-centered semiconductor supply chain system, adopt stronger joint strategies with key chip enterprises, divide U.S.-led chip alliances, and dismantle America' s attempts to exclude China from global supply chains through multiple measures.

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