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The Role of Semiconductor Technologies in Taiwan's Development

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ABSTRACT

The purpose of this article is to examine the role of semiconductor technologies in Taiwan's development. The research method is descriptive-analytical, and data were collected using library resources. The results indicate that one of the main arenas of global competition is the South China Sea region, where intense rivalry between the United States and China has been underway over the past several decades. Within this context, Taiwan—as a territory claimed by China—stands at the center of these competitive dynamics. Moreover, the rapid growth of Taiwan in the electronics industry, particularly in semiconductors, has further complicated the competitive equations between China and the United States. At present, Taiwan controls 62 percent of global chip production, supplying a major share of worldwide demand. The Taiwan Semiconductor Manufacturing Company (TSMC) is the world's largest contract chip producer and the most valuable publicly listed company in Asia, with a market value of 600 billion USD, and it appears likely to maintain this position in the coming years. In fact, much of the global semiconductor supply chain is dependent on Taiwan. This position has allowed Taiwan to play a pivotal role in the strategic rivalry between China and the United States. The United States is concerned that if China gains control over Taiwan, it could dominate the global semiconductor industry and its underlying technologies. Conversely, China fears that the geographical separation between Taiwan and the Chinese mainland could lead to disruptions in its access to chips during times of crisis, thereby creating severe challenges for its electronics industries.

Keywords: *technology, semiconductor, development, Taiwan.*

Introduction

In the twenty-first century, the battleground between great powers relies more on the trade of bits, bytes, and computers than on bombs, bullets, and coal. Technological dominance has become a decisive factor in power struggles, replacing the traditional “arms race” with an “artificial intelligence race” and substituting “space” with “silicon” (1). The software arsenal of complex technologies running on artificial intelligence is built upon hardware chips no larger than a postage stamp. The entire digital ecosystem operates on silicon, which itself depends on highly interconnected and fragile semiconductor supply chains (2).

Semiconductors—or “chips”—are one of the essential components at the heart of economic growth, security, and technological innovation, and their impact on global development exceeds that of the Industrial Revolution (3).



Since semiconductors represent the core of the competing technological ambitions of the United States and China, the Chinese government has undertaken multiple measures—such as reforming relevant regulatory frameworks and establishing sovereign investment funds—to support its chip industry and integrated-circuit production, aiming to achieve self-sufficiency in supply chains and reduce dependence on American chips (4).

Semiconductors, smaller than a postage stamp, thinner than a human hair, and composed of nearly 40 billion components, are found everywhere: in medical devices, smartphones, personal computers, pacemakers, electric vehicles, aircraft, and hypersonic weapons, as well as in the digitalization of goods and services such as global e-commerce, and thus play a critical role in human life. Reports from advanced industrial countries show that demand for this sector is increasing due to growing challenges and opportunities, as emerging technologies—including artificial intelligence (AI), quantum computing, the Internet of Things, and advanced wireless communication, especially 5G—all require cutting-edge semiconductors (5).

In this article, we aim to examine the role of semiconductor technologies in Taiwan's development, raising the central question: What role do semiconductor technologies play in the advancement and development of Taiwan?

Taiwan's Economy and Industrial Structure

Taiwan was under Japanese colonial rule from 1895 to 1945, during which its economy was based on the export of agricultural products and their industrial processing. Major infrastructure projects—including railways, airports, and hydroelectric dams—were constructed during this period and laid the foundation for future development. In 1962, Taiwan's per-capita gross national product was 170 USD, placing it at an economic level similar to Zaire and the Congo at the time. By 1999, based on the Human Development Index, Taiwan's per-capita GDP had risen to approximately 19,200 USD (a 100-fold increase), making it the twenty-third country in the world (6).

Economists describe Taiwan's economy as an ideal example of growth with equality. Taiwan's rapid economic development is closely linked to the Cold War context. After World War II, General Chiang Kai-shek and the Chinese Nationalist Party governed Taiwan. During the initial years of their rule, the country faced high inflation, widespread unemployment, and pervasive corruption. However, through cooperation with and support from the United States, Taiwan gradually established a successful model of Asian capitalism (7).

Taiwan's post-war industrial development began with import-substitution policies through the establishment of public enterprises in steel, oil refining, and shipbuilding, while simultaneously supporting private investment in textiles, plastics, and synthetic fibers. With American financial assistance, expert consultation, and preferential access to U.S. markets, Taiwan was able by the 1960s to shift to selective export-substitution policies. Initial efforts focused on labor-intensive industries such as textiles, footwear, plastics, and bicycles. Over time, Taiwan replaced its early industrial structure—characterized by large, often state-owned primary industries—with extensive networks of small and medium-sized private enterprises. Taiwan developed a capitalist economy in which foreign investment plays a significant role. In recent decades, investment by major European companies has made Taiwan one of the world's largest producers and exporters of electronic components. By 2008, Taiwan became the second-largest source of U.S. imports after Japan (6).

Taiwan's remarkable economic growth from the early 1950s to the mid-1980s transformed it into one of the "Four Asian Tigers," alongside Singapore and South Korea. As a result of economic reforms, Taiwan achieved an average growth rate of 7.8% between 1952 and 1982, rising to 9.6% between 1983 and 1986. Moreover, its gross national product increased by 360% between 1965 and 1986. Notably, unlike many countries that face widening inequality

during development, Taiwan's social inequality, measured by the Gini index, decreased from 0.558 in 1953 to 0.303 in 1980—an uncommon outcome in development trajectories.

Growth of Taiwan's Electronics Industry

Taiwan's electronics sector accounts for the largest share of foreign direct investment inflows. Indeed, Taiwan's importance to the global semiconductor industry cannot be overstated. The Taiwan Semiconductor Manufacturing Company (TSMC) is the world's largest contract chip manufacturer and the most valuable publicly listed company in Asia, with a market valuation of 600 billion USD (1). The majority of the global semiconductor supply chain depends on Taiwan, and a detailed review of foreign greenfield investment projects shows that electronics dominated domestic investment in 2019, 2020, and 2021.

For decades, Taiwan has been the leading actor in silicon foundries and has solidified its central role in the global semiconductor industry and its value chain. TSMC has thrived by maintaining strategic neutrality—producing Chinese- and American-designed chips and supplying them to rivals such as Apple and Huawei, thereby operating simultaneously in both markets (1).

Over several decades, Taiwan has become Asia's technology hub through simultaneous manufacturing and research-and-development activities. Today, more than three-quarters of the world's personal computers, half of LCD displays, and one-fifth of mobile phones are produced in Taiwan (8).

If leadership in silicon chips were not already enough to position Taiwan as a pivotal actor in U.S.–China competition, the market is expected to become even more complex in the coming years. As technologies become increasingly specialized, custom chips will be required to meet the intense computational demands of machine learning. TSMC's ability to design and manufacture the world's most advanced chips capable of supporting artificial intelligence applications places it in a strong position within a market estimated to reach 16 billion USD in the next three years (1).

Taiwan's semiconductor sector may become a collateral victim of U.S. and Chinese suspicion, which could accelerate technological localization. Regardless of future developments, the global interconnectedness of semiconductor supply chains among China, the United States, and Taiwan highlights the triadic nature of geo-technological relations (9).

Taiwan's Role in Chip Manufacturing

Taiwan is a well-known name in global technology industries and, through the Taiwan Semiconductor Manufacturing Company (TSMC), plays a critical role in this market, with many companies worldwide depending on it. By producing 51.5 percent of the global foundry market and manufacturing the world's most advanced chips (10 nanometers or smaller), TSMC has found itself caught between global superpowers (2). TSMC supports both American and Chinese companies, including major technology giants such as Apple, Qualcomm, Broadcom, and Xilinx. Until recently, the company also supplied Huawei, but in May 2020 it severed relations with the Chinese giant after the U.S. Department of Commerce imposed restrictions on Huawei's suppliers due to security concerns (4). Taiwan holds an almost monopolistic position over this product category, which is strategically tied to security and the global economy, producing 63 percent of the global semiconductor market and nearly 90 percent of the world's most advanced chips, with an industrial value of 107.53 billion USD in 2020.

The major Taiwanese semiconductor producer, TSMC, is the world's largest contract chip manufacturer and plays a vital role in powering the products designed by technology firms such as Apple, Qualcomm, and Nvidia. TSMC is also one of Asia's most valuable companies and holds 90 percent of the global supply of ultra-advanced chips.

Taiwan has also become a geopolitical focal point, as the Trump administration's efforts to strengthen U.S.–Taiwan relations increased tensions in the Taiwan Strait and intensified China's military activity in the region, testing the resolve of the Biden administration. Together, these factors create significant risks for the global semiconductor industry. Taiwan represents a fundamental part of this complex industrial ecosystem and illustrates the growing difficulty faced by companies and states attempting to insulate themselves from geopolitics—particularly amid pressures driving the technological decoupling of the United States and China (7).

Despite semiconductors being at the heart of U.S.–China strategic and technological rivalry, the industry continues to experience a wide array of protective tariff and non-tariff measures that threaten production and competitiveness. According to FP Insider, semiconductors reflect the core technological ambitions of the United States and China and simultaneously constitute a major technological vulnerability for both countries (3). Even as semiconductors lie at the center of strategic competition, the sector remains affected by restrictive measures that put its stability and global competitiveness at risk.

Given that Taiwan has long been positioned at the center of these commercial and technological tensions—and considering its critical role in semiconductor manufacturing and technology supply chains—China is likely to expand its economic influence by using trade restrictions, talent recruitment, and cyberspace operations to target key Taiwanese companies in an effort to acquire semiconductor assets essential to strengthening its domestic industry (4).

The reality is that the most advanced chips—especially next-generation logic devices—will initially be manufactured in Taiwan and South Korea. However, subsidies and tax incentives embedded in the U.S. CHIPS Act help significantly narrow the gap with these countries. Still, 52 billion USD alone will not be enough for the United States to regain a leading position. For example, the U.S. semiconductor industry has extensive engineering needs that American university programs cannot meet, and many segments of the semiconductor supply chain will remain in Asia (9).

Any conflict in Taiwan could worsen the global chip shortage that has already strained the global automotive industry. The Taiwan Strait is also a critical shipping route for cargo vessels transporting goods between Asia and the West.

Taiwan's Challenges in the Semiconductor Industry

The escalation of the U.S.–China trade war has directly and indirectly drawn Taiwan into cross-fire. Taiwanese companies have been directly harmed by U.S. sanctions. Washington's growing fear of China-origin technologies has pushed the United States to rely on coercive rather than cooperative approaches. In July 2018, the U.S. Congress passed a bipartisan bill known as the "Microchip Act" specifically to defend against foreign threats to the semiconductor supply chain. Subsequent rounds of tariffs and sanctions placed growing pressure on technology firms in both countries, positioning Taiwan squarely in the middle.

This culminated in May 2019 when U.S. President Donald Trump blacklisted Huawei and 70 affiliated firms, asserting that the interconnected supply chains posed a serious threat to U.S. national security (1). American

companies such as Intel and Qualcomm were prohibited from selling chips to the blacklisted entities. Rumors also circulated that the United States had criticized TSMC for continuing to supply chips to Huawei. The United States views Taiwan—the third major player in the semiconductor supply chain—as the weak link through which China could access technology restricted by U.S. regulations (2). TSMC rejected these claims and argued that its continued shipments to Huawei were justified by its supply-chain management system, which ensured that exports contained insufficient American intellectual property to fall under the sanctions. Despite these tensions, TSMC is likely to seek strong ties with Huawei due to the large volume of business the Chinese firm represents (1).

Through ambiguity or strategic loyalty, Taiwanese firms continue to operate in the gray areas of sanctions. Whether Taiwan finds ways to mitigate the effects of direct restrictions or not, halting joint production by blacklisting Chinese companies disrupts the system as a whole and creates long-term shockwaves. Therefore, the Trump administration's narrative is a dangerous one. Despite claiming to protect national interests, such hostility may ultimately harm the United States and pull Taiwan deeper into the conflict. Conversely, these disruptions may benefit China in the long run: reducing China's dependence on imported technology strengthens its technological autonomy (3).

Economic Relations Between China and Taiwan

China is Taiwan's largest trading partner, and according to the Taiwanese government, bilateral trade worth 273 billion USD last year accounted for 33 percent of the island's total trade with the rest of the world. The self-governed island, with a population exceeding 24 million, is a leading global producer and supplier of semiconductor chips, an essential component in nearly all modern electronic devices—from automobiles to refrigerators and mobile phones.

The share of Taiwan's total exports to China (including Hong Kong) increased from 12.74 percent in 1990 to 41.78 percent in 2010, an increase of 29.05 percentage points. After 2010, the growth in Taiwan's export share to China became less pronounced, primarily because Taiwanese LCD panel manufacturers and related industries faced intensified competition from South Korean and Chinese producers. Since 2010, the share of Taiwanese exports going to China has either increased very slowly or even declined in certain years (such as 2015). Meanwhile, the share of Taiwan's total exports to ASEAN countries increased from 10.22 percent in 1990 to 19.24 percent in 2013, a rise of 9.02 percentage points. However, after 2013, there was a slight decline, mostly due to reduced exports of refined petroleum products from Taiwan to Southeast Asia as a result of falling international oil prices (9).

China is Taiwan's most important trading partner. More than 40 percent of Taiwan's exports went to China and Hong Kong in 2021. Approximately 22 percent of Taiwan's imports come from China. Taiwan is also one of the largest investors in mainland China. Taiwanese companies such as Hon Hai Precision Industry—commonly known as Foxconn—assemble Apple's iPhones as well as devices for numerous global brands, operating factories that employ hundreds of thousands of workers. According to the Taipei government, from 1991 to the end of May 2021, Taiwanese companies invested around 194 billion USD in a total of 44,577 projects in China. However, in recent years, as tensions between Beijing and Taipei have increased, China has attempted to impose greater economic pressure by reducing tourism flows to Taiwan and marginalizing the island in international trade. In retaliation for the recent visit of Nancy Pelosi, the Speaker of the U.S. House of Representatives, to Taipei, China banned imports of citrus fruits, fish, and hundreds of other Taiwanese food products. Beijing also prohibited the export of sand to

Taiwan, which the construction industry relies upon. However, China has placed no restrictions on the flow of microchips or semiconductors—components essential for Chinese factories.

China has steadily become an increasingly important source of Taiwan's imports, with Taiwan's import share from China rising from 0.40 percent in 1990 to 19.30 percent in 2015. Capital and technology from around the world have flowed into China due to cheap land for factory construction and low-cost labor, while broad state support has also contributed to the rapid growth of Chinese industry. As Chinese export products expanded—often characterized by low prices—markets like Taiwan were significantly affected by Chinese imports. By 2014, China had become Taiwan's largest source of imports. Moreover, by 2014, there were fourteen other economies—besides Taiwan—for which China had also become the largest source of imports, including major economies such as Japan, Australia, the United States, Russia, and South Korea (9).

Even before U.S.–China relations began deteriorating, China had already launched efforts to achieve self-sufficiency. “Made in China 2025,” an ambitious set of technological development goals, made its global debut in 2015. As part of this plan, the Chinese government seeks to increase domestic semiconductor production to 305 billion USD by 2030, meeting 80 percent of domestic demand. To accomplish these challenging goals, a state-backed 29-billion-dollar fund was established to finance China's nascent semiconductor industry. Given how much China currently spends on chip imports, this is likely a profitable investment. Before the announcement of the “Made in China” initiative, Chinese manufacturers supplied 29 percent of domestic demand; they now supply 49 percent. China's shift away from foreign dependence already appears to be yielding results. For example, Alibaba and Huawei have recently announced the development of specialized AI chips for cloud computing, machine learning, and autonomous driving applications. Early developments indicate that China is achieving high-quality, high-volume production. AI chips represent a segment where China may achieve the greatest progress relative to Taiwanese and American competitors. Moore's Law—setting limits on growth in computing power—may also constrain the speed of China's advancement. In a world governed by Moore's Law, where computing power doubles every two years and costs are halved, China—already five to ten years behind—remains at a competitive disadvantage (1).

Moreover, the economies of China and Taiwan are deeply interconnected. China is Taiwan's largest export market, with export values reaching 515 billion USD from January 2017 to January 2022—more than double that of the United States, Taiwan's second-largest trading partner. Taiwan's exports through the Strait to mainland China reached their highest level in 2021. Perhaps more importantly, the small island has placed China in a semiconductor chokepoint. In 2020, China spent more money importing chips than oil. Estimates suggest that China will likely remain far from achieving semiconductor self-sufficiency for at least another decade. For this reason, some experts believe there is a significant risk that any Chinese attack on Taiwan within the next five years could damage or destroy many technological infrastructures that China relies upon to supply its electronics and manufacturing industries with critical components (4).

Taiwan: The Front Line of the U.S.–China Rivalry

Despite expanding areas of cooperation—especially in economic dimensions—the United States and China also face multiple challenges that could shape the future of relations between Beijing and Washington. The Taiwan issue is the most fundamental crisis between the United States and China. The United States has accepted a peaceful solution by China regarding the Taiwan question. At the same time, the United States provides both China and Taiwan with the technological capabilities needed for development, and by supplying air and naval equipment to

Taiwan, it potentially seeks to control maritime territories that are vital to the economies of Japan and South Korea (7).

In its “Free and Open Indo-Pacific Strategy,” the United States presents itself as a defender of Taiwan’s right to autonomy—an island that Beijing views as part of China’s territorial integrity and vows will one day return to the mainland, even by force if peaceful means fail. Taiwan’s unique position in semiconductor production reveals a significant portion of the hidden intent behind Washington’s policy of strategic ambiguity. The U.S. approach toward Taiwan is based on this ambiguity: it does not openly support separatism on the island, yet it provides Taipei with military assistance and has never clearly stated how it would react if China attacked Taiwan. Taiwan’s special role in chip production reveals much of the concealed rationale behind this strategy.

For several years, the United States and China have been competing in twenty-first century information technologies, including fifth-generation mobile communications. Semiconductors—one of the most crucial ancillary industries in this domain—have become another field of competition, placing Taiwan, as a major actor in this sector, in a challenging position. According to some estimates, Taiwan alone controls about 92 percent of the world’s most advanced chip and semiconductor market (other estimates place this share at a minimum of 63 percent). Experts believe Taiwan’s chip industry has become the front line of the U.S.–China struggle. The island dominates the production of chips that power nearly all advanced civilian and military technologies—making both the American and Chinese economies heavily dependent upon it, including their weapons systems. Thus, both superpowers now find themselves deeply reliant on a small island that lies at the center of their escalating rivalry.

In forward-looking scenarios, if Taiwan were reunited with China peacefully, the United States would not accept Beijing’s control over TSMC, the world’s largest chip foundry. In the event of a possible Chinese attack on Taiwan, TSMC could easily become a casualty of war, cutting off chip supplies not only to China’s massive electronics industry but to the entire world. In reality, the semiconductor industry functions as a defensive shield for Taiwan. Yet, if one draws even a minimal comparison between Ukraine and Taiwan, it becomes evident that China—like Russia—will not tolerate U.S. encroachment on its red lines, and Taiwan’s significance to Washington is far greater than Ukraine’s. Any military confrontation would therefore be far more unpredictable. For this reason, despite their deep hostility, both China and the United States place high priority on managing their relationship. The Biden administration’s move to block the transfer of advanced chips to China has pushed the relations of the world’s two largest economies into a new stage—one in which trade becomes far less important compared to their intensifying competition to become the dominant global power in both military and technological realms.

It appears that strategic trade theory—prioritizing domestic investment to enhance global export competitiveness over free trade and seeking to restrict imports—has become the dominant policy model for both countries. Therefore, international mechanisms governing global political-economic relations, such as World Trade Organization rules built upon liberal economic principles and free-trade systems, are likely to undergo revision in the future.

The U.S.–China Battlefront in Semiconductors

According to FP Insider, for decades the United States has been the global leader in the semiconductor industry, capturing 48 percent—or 193 billion USD—of global market share by revenue in 2020. Based on IC Insights, eight of the world’s fifteen largest semiconductor companies are U.S.-based, with Intel ranked first in global sales. China, meanwhile, is a net importer of semiconductors, relying heavily on foreign producers—especially those in the United

States—to support the development of its own technologies. China imported 350 billion USD worth of chips in 2020, a 14.6 percent increase compared to 2019.

As rising trade tensions threaten to disrupt the semiconductor supply chain and sanctions restrict the exchange of technology between the United States and mainland China, Taiwan finds itself in a difficult geopolitical—indeed, geotechnological—position. If the technological economies of the world’s two most powerful states were to decouple entirely, Taiwan might ultimately be forced to choose with whom it will trade.

Experts argue that Taiwan’s chip industry has emerged as the front line of the U.S.–China rivalry. As reported by Reuters, the island dominates the production of chips that power nearly all advanced civilian and military technologies—rendering both the American and Chinese economies deeply dependent on it. Even the machinery and vehicles that would be used on the front lines in a potential conflict over Taiwan depend on these chips. TSMC, the Taiwanese semiconductor giant, leads the world in manufacturing the most advanced semiconductors, creating technologies essential for present and future digital devices and advanced weapons systems. Thus, both superpowers now find themselves deeply dependent on the small island at the center of their tense struggle.

Chinese control over TSMC’s foundries—facilities crucial to U.S. military and technological leadership—is unacceptable to Washington. Yet, in the event of an attack, there is no guarantee China could seize these foundries intact. The facilities could easily become casualties of war, halting chip supplies to China’s vast electronics industry. Even if the foundries survived, they would almost certainly be cut off from the global supply chains essential to their operation. These facilities are so valuable to the global economy that many analysts refer to Taiwan’s semiconductor sector as the “silicon shield”—a factor that deters Chinese aggression and secures American support. As China’s military maneuvers and threats toward Taiwan increase, the U.S. becomes increasingly anxious due to its dependency on advanced chips. The White House’s concern grows as scenarios of a Chinese attack become more plausible, prompting warnings—such as those from former CIA intelligence officer Martin Rasor—that such an event would deal “a devastating blow to the U.S. economy and military power.”

In May 2020, TSMC announced plans to build a highly advanced chip-manufacturing plant worth 12 billion USD in the state of Arizona. Construction is expected to take at least three years, making it one of the most expensive facilities of its kind in the world. According to planning, construction was set to begin in 2021, with production expected to start in 2024. After completion, the Arizona plant will produce only one-quarter of the output of TSMC’s largest facility in Taiwan and account for just 3 percent of the company’s total production capacity. In Taiwan, TSMC operates four major manufacturing complexes, each consisting of six or seven fabs, producing a total of 13 million chips annually.

China’s Objectives in Dominating Semiconductor Technologies

Taiwan produced 63 percent of the world’s semiconductor products in 2019. In comparison with the United States’ 12-percent share in the previous year, China supplied approximately 16 percent of global semiconductors. China’s first short-term objective is to fully meet its domestic needs for all types of chips. In this regard, China emphasizes avoiding escalation and confrontation with the United States and seeks to resolve its chip-supply challenges—especially the needs of Huawei—through negotiations with both the American and Taiwanese sides (4).

Nevertheless, the Chinese government entered dialogue with the United States cautiously. Negative political messaging against China regarding the origin of the coronavirus and the tensions arising from this issue could

easily overshadow the chip question and lead to sanctions on the sale of Taiwanese-made chips to China or on the purchase of Chinese chips in U.S. and European markets. The Chinese are fully aware that such a situation does not merely represent a dispute over Huawei but would instead mark the beginning of an economic world war whose dangerous consequences would fall most heavily on China. Beijing also fully understands that the United States would never willingly enter such a conflict.

The sanctions on Huawei have revealed not only pressure on China but also the weaknesses of the U.S. semiconductor sector, particularly in advanced chip manufacturing. Under these conditions, it is clear that Americans need a resolution to the Huawei-chip confrontation at least as much as China does (4).

Therefore, as semiconductor technologies lie at the heart of U.S.–China rivalry, Washington may require a national strategy that brings together commercial, academic, and governmental sectors to implement an industrial-technology agenda. The federal government must commit seriously to modernizing U.S. institutional tools, including the military, to prepare for an extended period of strategic risk (7).

Conclusion

According to some estimates, Taiwan alone controls around 62 percent of the global market for microchips and semiconductors. Today, Taiwan's chip industry has become the front line of the U.S.–China rivalry. The island dominates the production of chips that power nearly all advanced civilian and military technologies—making both the American and Chinese economies heavily dependent on it, including their weapons systems. As a result, both superpowers now find themselves deeply reliant on a small island at the center of their high-stakes competition (1).

The current trade-war environment forces Taiwanese manufacturers into the middle of an intense struggle between the United States and China. While further decoupling may compel Taiwan, along with other East Asian economies, to choose a side, it may also severely harm Taiwan's semiconductor giant. With China pursuing self-sufficiency and the United States remaining suspicious of external intervention, neither country wants to depend on Taiwanese chips.

At present, Taiwan is caught in the middle of a technological trade conflict—a small yet crucial actor whose strategic advantage lies in semiconductor technologies. The future of Taiwan is therefore deeply tied to the fate of its semiconductor capabilities (2).

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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