

## **Semiconductor Geopolitics and Strategic Competition: China's Responses to the CHIPS and Science Act in the Global Political Economy**

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### **Abstract**

The U.S. CHIPS and Science Act, enacted in 2022, represents a pivotal intervention in global semiconductor politics, designed to reshape the distribution of technological capabilities and constrain China's strategic trajectory. While existing studies have examined this rivalry primarily through the lenses of industrial policy or bilateral trade competition, few have analysed China's responses as deliberate attempts to contest structural power within the global political economy. This article addresses two questions: What are China's strategic responses to the CHIPS and Science Act, and what are the broader implications for the global political economy? Drawing on an integrated framework that synthesizes Robert Gilpin's International Political Economy approach and Susan Strange's concept of structural power, the study employs qualitative case study methodology. Gilpin explains why states treat semiconductor access as a matter of strategic priority, while Strange's four structures, namely security, production, finance, and knowledge, explain how power is exercised through the frameworks governing technological exchange and governance. Findings reveal that China has mobilized state-backed semiconductor funding, expanded research and development capacity, imposed critical mineral export restrictions, deepened BRICS partnerships, and extended the Digital Silk Road, accelerating supply chain disruption, technology standard fragmentation, and the formation of competing technological blocs. The article contributes to the literature by integrating Gilpin's concept of relative gains with Strange's notion of structural power to explain China's responses to the CHIPS and Science Act and their implications for the global political economy.

**Keywords:** china industrial policy, relative gains, semiconductor geopolitics, structural power, technological competition

## Abstrak

*Undang-Undang CHIPS and Science Act Amerika Serikat yang disahkan pada tahun 2022 merupakan intervensi penting dalam politik semikonduktor global yang dirancang untuk membentuk kembali distribusi kapabilitas teknologi serta membatasi trajektori strategis Tiongkok. Meskipun berbagai studi sebelumnya telah mengkaji rivalitas ini terutama melalui perspektif kebijakan industri atau kompetisi perdagangan bilateral, hanya sedikit yang menganalisis respons Tiongkok sebagai upaya yang disengaja untuk menantang kekuasaan struktural dalam ekonomi politik global. Artikel ini mengajukan dua pertanyaan : bagaimana respons strategis Tiongkok terhadap CHIPS and Science Act, dan apa implikasi yang lebih luas dari respons tersebut terhadap ekonomi politik global? Dengan menggunakan kerangka teoritis terintegrasi yang menggabungkan pendekatan Ekonomi Politik Internasional Robert Gilpin dan konsep kekuasaan struktural Susan Strange, penelitian ini menerapkan metodologi studi kasus kualitatif. Gilpin menjelaskan mengapa negara memandang akses terhadap semikonduktor sebagai prioritas strategis, sementara empat struktur yang dikemukakan Strange, yaitu keamanan, produksi, keuangan, dan pengetahuan, menjelaskan bagaimana kekuasaan dijalankan melalui kerangka yang mengatur pertukaran dan tata kelola teknologi. Temuan penelitian menunjukkan bahwa Tiongkok memobilisasi pendanaan semikonduktor yang didukung negara, memperluas kapasitas penelitian dan pengembangan, memberlakukan pembatasan ekspor mineral kritis, memperdalam kemitraan dalam BRICS, serta memperluas Digital Silk Road. Langkah-langkah tersebut mempercepat gangguan rantai pasok global, fragmentasi standar teknologi internasional, dan pembentukan blok-blok teknologi yang saling bersaing. Artikel ini berkontribusi pada literatur dengan mengintegrasikan konsep keuntungan relatif (relative gains) dari Gilpin dan konsep kekuasaan struktural dari Strange untuk menjelaskan respons Tiongkok terhadap CHIPS and Science Act serta implikasinya terhadap ekonomi politik global.*

**Kata kunci:** kebijakan industri Tiongkok, keuntungan relatif, geopolitik semikonduktor, kekuasaan struktural, kompetisi teknologi

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## INTRODUCTION

The CHIPS and Science Act, short for “Creating Helpful Incentives to Produce Semiconductors for America,” marks a turning point in U.S. policy responses to both economic competitiveness and national security concerns. Signed into law in August 2022, the Act allocates approximately US\$280 billion to boost domestic semiconductor manufacturing, enhance research and development, and fortify critical supply chains (Dhiman, 2025). Specifically, it authorizes a 25 percent investment tax credit (ITC) and allocates US\$52.7 billion in direct support for the semiconductor industry, including US\$11 billion for research and development activities and US\$39 billion through the “CHIPS for America Fund” to encourage the construction and expansion of domestic

fabrication facilities (Ezell, 2024). This policy reflects the United States' strategic pivot toward technological self-reliance in the face of escalating geopolitical tensions, particularly with China, whose advances in semiconductor technologies have been swift and state-backed (Lewin, 2024; Luo & Van Assche, 2023).

The Act main aim is as cited in the Congress summary of CHIPS Act of 2022 is “... to carry out activities relating to the creation of incentives to produce semiconductors in the United States” (CHIPS and Science Act, 2022). Although the United States remains home to major global semiconductor companies, in 2021, only 43 percent of their total production takes place on U.S. soil (Hufbauer & Hogan, 2022). The Semiconductor Industry Association (SIA) even estimates that by 2030,

China's share of global semiconductor manufacturing will increase to 24%, while the United States' share is expected to decline to only 10%. In contrast, East Asia as a whole is projected to dominate with a combined share of approximately 77%. This shift arguably attributed to the United States' limited incentives for domestic manufacturing, which has made offshore production more attractive for industry players (Varas et al., 2020).

This situation is reflected in the 2021 market distribution data, where China accounted for 34.6 percent of global semiconductor production and the Asia-Pacific region 27 percent, while the United States represented only 21.9 percent (Hufbauer & Hogan, 2022). This imbalance highlights the increasing dependence of the U.S. semiconductor supply chain on overseas manufacturing, despite the continued global dominance of U.S.-based companies. With recent fiscal incentives, it is expected that U.S. semiconductor manufacturers will begin shifting more production back to domestic facilities.

The Act also seeks to revitalize the sector by establishing ambitious targets, such as achieving a 28% global market share in logic chips by 2033 and generating up to 44,000 new jobs within the semiconductor ecosystem (Dhiman, 2025). These objectives reflect broader efforts to reduce dependency on foreign manufacturers, especially those in Taiwan and South Korea, and to counter China's rising dominance in chip production and AI development.

Analysts note that the CHIPS and Science Act is not just an economic measure but also a deliberate manoeuvre in what is increasingly viewed as a "techno-geopolitical" competition with China (Luo & Van Assche, 2023). The rivalry now centres on leadership in next-generation technologies, including advanced semiconductors, artificial intelligence, and quantum computing, which are essential for both economic resilience and military superiority. Consequently, the Act embodies the intersection of national security, innovation policy, and global power dynamics.

Historically, U.S.–China technological ties were shaped by a form of competitive interdependence (Naughton, 2021). China's economic modernization and integration into global value chains brought mutual benefits: the U.S. gained from China's manufacturing scale and low costs, while China relied on American innovation to fuel its industrial upgrades (Doshi, 2021). However, as China shifted toward high-quality growth and began prioritizing capital- and tech-intensive exports, it emerged as a credible competitor to U.S. leadership in sectors like semiconductors, AI, and 5G (Kim, 2016). This evolving dynamic which marked by intellectual property disputes, export restrictions, and sanctions on firms like Huawei has redefined the relationship as one of overt technological rivalry.

The transformation in U.S.–China tech relations has been driven by several interrelated factors. First, China's bold

state-led strategies such as *Made in China 2025* and its National AI Development Plan have raised alarms in Washington, especially because many of these technologies have dual-use military potential (Zenglein & Holzmann, 2019). Second, growing techno-nationalism has prompted both countries to assert greater government control over strategic industries. In the U.S., this shift has taken form through tighter export controls, reshoring incentives, and foreign investment reviews, while China continues to support its national champions and limit market access to American firms (Kania, 2025). Third, vulnerabilities in global supply chains which exposed during the COVID-19 pandemic and exacerbated by China's use of critical minerals as leverage have led Washington to prioritize supply chain "resilience" over efficiency (Bown, 2020; Gereffi, 2020).

In this context, this article addresses two core questions: What are China's strategic responses to the CHIPS and Science Act? And what are the global implications of the U.S.–China technology rivalry? Understanding China's countermeasures that ranging from export restrictions and industrial subsidies to its efforts in global governance of emerging technologies is essential to assessing how the global order in advanced technologies may evolve. At the same time, this rivalry has broader repercussions, potentially reshaping global supply chains, international standards, and alliances in

the emerging techno-political world order.

While much of the existing literature has focused on the domestic ramifications of the CHIPS Act for the US, this paper offers a distinct contribution by examining China's evolving strategic posture and how this rivalry is reshaping global technology governance, supply chain dynamics, and international cooperation. The following sections will first explore China's multidimensional response through industrial policy, diplomatic strategies, and international partnerships, before analysing the implications for global actors and the rules-based international order.

### **Theoretical Framework**

This analysis utilizes an integrated theoretical framework, synthesizing the core insights of International Political Economy (IPE), as defined by Robert Gilpin, with political economy with Susan Strange's concept of structural power. Together, these perspectives provide a foundation for analysing the geopolitical contest surrounding semiconductor technology, the CHIPS and Science Act, and China's strategic responses. While Gilpin explains why states engage in technological and economic competition, Strange explains how power is exercised through the structures that shape economic and political outcomes.

The IPE component establishes the fundamental motivation for this rivalry: the struggle over relative gains. According to Gilpin, states are fundamentally concerned not just with absolute

wealth and prosperity, but with how their gains compare to those of rival powers. Economic activity, therefore, is never politically neutral; it inherently possesses distributive consequences that alter the balance of power. Gilpin further emphasizes that states frequently intervene in markets to preserve national autonomy and strengthen their position within the international economy. (Gilpin, 2011) From this perspective, major economic interventions, such as massive state subsidies or targeted trade restrictions, are interpreted as calculated political actions to manipulate technological markets and global supply chains. The goal is to secure or deny specific high-tech capabilities, ensuring that any economic growth translates directly into a favourable shift in the global hierarchy of technological and strategic influence.

While Gilpin highlights the motivations underlying interstate competition, Strange focuses on the forms of power through which such competition is conducted. Strange distinguishes relational power, the ability to influence others' behaviour, from structural power, the ability to shape the frameworks within which actors operate. She argues that structural power has become increasingly important in the global political economy. According to Strange, structural power operates through four interrelated structures: security, production, finance, and knowledge. The security structure rests on the provision of protection against threats, while the production, financial, and knowledge

structures derive respectively from control over production, credit, and access to knowledge. Particularly significant is Strange's argument that technology represents a highly valued form of knowledge capable of reinforcing power across production, finance, and security domains (Strange, 2015).

The integration of Gilpin and Strange provides a framework for understanding China's strategic responses to the CHIPS and Science Act and their implications for the global political economy. Gilpin explains China's pursuit of technological capabilities, national autonomy, and relative gains in the semiconductor sector, while Strange explains how these efforts influence the production, financial, security, and knowledge structures that underpin the global technology industry. Accordingly, this framework is used to analyse China's industrial and regulatory strategies and their consequences for global supply chains, technology standard fragmentation, and the formation of competing technological blocs. In doing so, the study examines how China's responses extend beyond national adaptation to shape the broader structure of competition in the global semiconductor industry.

### **Research Method**

This study employs a qualitative case study design and adopts a desk-based research approach to examine China's strategic responses to the U.S. CHIPS and Science Act of 2022. Desk-based research relies on the systematic analysis of existing sources and is

particularly suitable for investigating complex political and economic issues through documentary evidence (Bassot, 2022). Data were collected from three categories of sources. Primary sources include the CHIPS and Science Act (H.R. 4346, 2022), Chinese government policy documents, official statements, speeches, and multilateral declarations. Secondary sources comprise peer-reviewed journal articles, academic books, and reports from institutions such as the Peterson Institute for International Economics, the Centre for Strategic and International Studies, the Information Technology and Innovation Foundation, and MERICS. Reuters and The Diplomat were consulted to document recent developments, while academic databases were used to identify relevant materials.

Data were interpreted through Robert Gilpin's concepts of relative gains and national autonomy and Susan Strange's framework of structural power. The analysis was organized around themes related to industrial policy, technological capabilities, regulatory measures, strategic alliances, supply chains, and technology governance. Evidence from official documents, academic literature, policy reports, and media sources was compared to strengthen the reliability of the findings. The study is limited by its reliance on publicly available and predominantly English-language.

## **RESULT AND DISCUSSION**

### **China's Strategic Responses to the CHIPS and Science Act**

#### *China's Industrial Policy and Technological Capabilities in the Semiconductor Sector*

China's semiconductor industrial policy must be read not as market intervention alone, but as a deliberate attempt to alter its structural position within global hierarchies through state investment, preferential regulation, and cultivation of national champions capable of reducing dependence on foreign technologies. From Gilpin's perspective, industrial policy is a strategy through which states pursue relative gains in technological capabilities that translate directly into national power, intervening not for economic efficiency but to improve their position relative to rivals. Strange complements this by situating semiconductor capabilities within the production and knowledge structures of the international political economy, where control over advanced fabrication and proprietary knowledge shapes the conditions under which other states and firms must operate

Central to this strategy is the National Integrated Circuit Industry Investment Fund, widely known as the "Big Fund." Since its launch in 2014, the Fund has expanded through multiple phases reflecting rising national ambitions. Phase I (2014–2018) mobilized approximately \$21 billion, followed by \$29 billion in Phase II (2019–2023). Phase III, initiated in May 2024, raised an unprecedented ¥344 billion (around \$47.5 billion), highlighting Beijing's intensified pursuit of semiconductor self-sufficiency (Reuters, 2024). The third

phase formally began operations on December 31, 2024 under Huaxin Investment Management, with early allocations of ¥93 billion (\$12.685 billion) directed toward upstream and midstream components such as ultra-pure chemicals, silicon wafers, and wafer fabrication equipment. Yet even this substantial figure remains modest compared to global leaders: ASML invested \$4.308 billion in R&D in 2023, while Applied Materials allocated \$3.233 billion in 2024 (Shilov, 2025). These contrasts underscore the deep technological hurdles China continues to face despite unprecedented capital injections.

Nonetheless, Chinese firms have demonstrated notable gains in internal capabilities, reshaping assessments of China's technological trajectory. A pivotal example is Semiconductor Manufacturing International Corporation (SMIC), which succeeded in fabricating 7-nanometer chips for Huawei's Mate 60 Pro smartphone despite being blacklisted by the U.S. Department of Commerce since 2020. This breakthrough signalled the cumulative effect of incremental R&D advancements and process optimization. As Douglas Fuller of Copenhagen Business School observed, "If they [the U.S.] don't get tougher on SMIC, then this policy doesn't make any sense" (Fuller, 2023) underscoring the policy implications of China's progress under sanctions.

Memory manufacturing has followed a similar pattern of accelerated capability development. Yangtze Memory Technologies Co. (YMTC) has advanced

rapidly through its "Xtacking" hybrid bonding architecture, which has demonstrated greater scalability than the through-silicon via (TSV) methods used by competitors such as Samsung and SK Hynix. As NAND layers surpass 400, traditional stacking approaches confront mounting bottlenecks, positioning hybrid bonding as a viable solution for next-generation memory architectures. YMTC's progress has been significant enough to pressure Samsung Electronics that already facing internal challenges with its 1c DRAM redesign and lagging NAND layer innovations to consider licensing YMTC's technology (Soo & Eun, 2025). This development reflects not only YMTC's growing competitiveness but also China's potential to influence future global technology standards.

Provincial governments have played a complementary role by providing local subsidies, tax incentives, and infrastructural support to attract semiconductor firms and research institutions. Cities such as Shanghai, Shenzhen, and Wuhan have developed dense industrial clusters anchored in chip manufacturing, design houses, and university-affiliated laboratories. By 2022, semiconductor-related subsidies were estimated to exceed \$150 billion. In September 2023, the Ministry of Finance increased the national R&D tax credit for semiconductor investments by 20 percent, reinforcing the state's strategy of strengthening domestic resilience in response to U.S. export controls and the guardrails imposed by the CHIPS and Science Act (Ebrahimi, 2023).

These industrial incentives have helped cultivate increasingly mature local innovation ecosystems. Technology parks and research clusters in Suzhou, Nanjing, and Chengdu now host start-ups and laboratories focused on chip design, advanced materials, AI processors, and quantum computing (EE World, 2021; Nanjing University, 2025). Although many of these initiatives remain in early stages, they collectively contribute to an evolving national innovation system that extends beyond replication toward gradual technological independence.

Taken together, the evidence presented in this section illustrates the dual logic that Gilpin and Strange identify as central to great power technological competition. The successive phases of the Big Fund, provincial subsidies, R&D tax incentives, and the cultivation of innovation clusters collectively reflect a state-directed strategy oriented toward relative gains, seeking not merely economic growth but measurable improvement in China's technological position relative to the United States and its allies. From Strange's perspective, these developments represent China's attempt to strengthen its position within both the production structure, by developing sovereign fabrication capacity across critical nodes of the semiconductor supply chain, and the knowledge structure, by cultivating proprietary process technologies, architectural innovations such as Xtacking, and domestic innovation ecosystems capable of generating rather than merely absorbing technological knowledge. While significant structural gaps remain, the trajectory of China's industrial policy signals a sustained effort to

reshape the structural conditions of global semiconductor competition in its favour.

#### *Regulatory and Legal Countermeasures*

In parallel with its industrial investments and retaliatory policies, China has intensified its regulatory arsenal as a countermeasure to U.S. technological containment. Two prominent instruments in this strategy are the escalation of export controls on critical minerals and the revision of national security laws aimed at foreign technology firms.

First, China's export controls on gallium and germanium, two critical inputs for semiconductor and defence applications, signal a new phase of weaponizing supply chain dependencies. On December 3, 2024, Beijing imposed its most targeted restrictions to date, banning the export of gallium, germanium, antimony, and other strategic materials to the United States. This marked the first instance where export curbs on critical minerals were directed specifically at a single country, rather than being globally applied. These restrictions came in direct response to Washington's tightening of semiconductor-related export rules, illustrating a calibrated tit-for-tat escalation in the tech war. The move also coincided with the release of an updated Dual-Use Export Control List by China's Ministry of Commerce, which provides a legal and institutional framework for future restrictions, enabling Chinese authorities to extend bans to other minerals such as tungsten and graphite under the guise of

national security (Baskaran & Schwartz, 2024).

In addition to trade tools, China has bolstered its domestic legal environment, particularly through revisions to its Cybersecurity Law and Anti-Espionage Law. The 2023 amendments to the Anti-Espionage Law significantly expanded the definition of espionage to include not only conventional intelligence activities but also data transfers that may “endanger national security.” As a result, foreign firms such as Micron have been subjected to national security reviews under vague and sweeping legal justifications. These laws also adopt the protective principle in international law, allowing extraterritorial application to acts committed outside of Chinese territory (Jun, 2025). This legal ambiguity generates a chilling effect for foreign technology firms operating in China, especially amid increasing scrutiny of their cross-border data practices. The growing overlap between trade regulation and legal instruments illustrates a fusion of economic statecraft and legal deterrence, allowing Beijing to shield its market while exerting coercive leverage against foreign actors.

Taken together, the regulatory and legal measures examined in this subsection are not merely administrative or defensive in character; rather, they constitute deliberate instruments of economic statecraft operating within the logic of relative gains articulated by Gilpin. By imposing export controls on critical minerals and expanding national security provisions through domestic legislation, Beijing seeks to restrict its principal rival’s

access to essential technological and material inputs—a distributive strategy aimed at reshaping the balance of technological power. At the same time, these measures reflect the construction of what Strange conceptualizes as a Security Structure: a framework of coercive power that constrains the strategic choices of foreign firms and governments, thereby inducing a geopolitically driven redistribution of production, investment, and technological access. The deliberate ambiguity embedded in the revised Anti-Espionage Law and the Cybersecurity Law further reinforces this dual logic, positioning legal instruments as tools of both economic exclusion and strategic deterrence. In this sense, China’s regulatory response exemplifies a form of security-driven economic statecraft in which legal mechanisms are systematically mobilized to advance both relative economic advantage and national security imperatives.

#### *Geopolitical and Geoeconomic Alliances*

As China grapples with escalating technological decoupling from the United States, it has simultaneously deepened strategic partnerships within multipolar forums, particularly BRICS, to dilute the hegemony of U.S.-centric financial and technological systems. Within this framework, the BRICS Cross-Border Payments Initiative (BCBPI) has emerged as a prospective tool for geoeconomics hedging.

At the 16<sup>th</sup> BRICS Summit in Kazan, member states reiterated their commitment to enhancing payment infrastructures that bypass Western-controlled mechanisms like SWIFT.

Underpinning this initiative is BRICS Pay, a proposed decentralized payment system that would allow member countries to settle transactions in local currencies. The plan, although still in its nascent stages, leverages existing platforms such as India's Unified Payment Interface (UPI), Russia's Mir, and China's WeChat Pay and AliPay. It could potentially integrate blockchain technology and digital currency wallets to ensure transparency and efficiency. If successfully implemented, BRICS Pay could also serve as a digital bridge connecting the e-Yuan, e-Rupee, and other national currencies, an explicit challenge to dollar dominance in global settlements (The Lowy Institute, 2024).

Despite reservations from some members, particularly India and China, regarding the scope and implementation of such an initiative, the political will to insulate BRICS economies from Western sanctions is evident. For instance, President Lula of Brazil explicitly called for a new financial system free from U.S. dominance, and Russia, the most isolated member post-Ukraine invasion, continues to push for de-dollarization. Although still framed as a "feasibility study," the idea has drawn international attention, prompting institutions like the IMF and BIS to re-evaluate their multilateral digital payment strategies (The Lowy Institute, 2024). Should BRICS Pay materialize, it would symbolize a geopolitical realignment, shifting digital economic governance away from transatlantic dominance and reinforcing

an alternative techno-economic bloc led by China, India, and Russia.

Concurrently, China has engaged in diplomatic counter-efforts to resist technological isolation imposed by U.S. alliances. In response to Western restrictions on its 5G vendors, Beijing has offered highly subsidized deals and turnkey infrastructure packages to countries in the Global South. For example, as part of the Digital Silk Road, China has extended Huawei-backed digital networks and cloud computing services across Southeast Asia, Africa, and parts of Latin America. These incentives are often paired with concessional loans and capacity-building programs, creating long-term dependencies while countering U.S. efforts to forge a "Clean Network" coalition (Yanik & Yildirim, 2025). Such initiatives illustrate China's dual-track strategy of technological de-risking at home while fostering strategic interdependence abroad.

From Gilpin's perspective, China's pursuit of BRICS Pay and alternative payment architectures reflects a concern with relative gains and national autonomy, seeking to reduce dependence on SWIFT and diminish the coercive leverage that dollar-denominated financial infrastructure affords Washington. From Strange's perspective, BRICS Pay challenges the existing financial structure, while the Digital Silk Road, Huawei-backed networks, and capacity-building programs extend China's reach within the knowledge structure by shaping the digital

infrastructure and technological dependencies of partner states. Together, these initiatives represent China's sustained attempt to construct alternative structural frameworks that expand Beijing's autonomy in response to U.S. technological competition.

## **Global Implications of US–China Tech Rivalry**

### *Global Supply Chain Disruption*

The global semiconductor industry has now become a battleground for strategic dominance. As chips underpin everything from smartphones and data centers to autonomous weapons systems and artificial intelligence, they are no longer just commercial goods, but strategic assets. The technological decoupling between the United States and China has thus begun to fracture the very supply chains that made the industry so efficient and innovative.

Since 2022, the U.S. has imposed stringent export controls on advanced semiconductor technology, especially those related to AI chips, lithography equipment, and high-performance GPUs such as those produced by NVIDIA. These measures aim to stall China's military and AI capabilities by choking its access to critical components and fabrication tools. However, the ripple effects have not spared U.S. firms. NVIDIA, for example, has warned that these restrictions could cost the company billions in lost revenue, while Apple and others are shifting segments of their production from China to Southeast Asia (Rudge, 2025)

China has responded by weaponizing its control over strategic materials. In July 2023, it imposed sweeping restrictions on gallium and germanium—elements indispensable for chipmaking, telecommunications equipment, and defense systems. With China supplying roughly 94% of the world's gallium and 60% of its germanium, these restrictions sent shockwaves across global technology hubs (Rudge, 2025).

This coercive leverage is further reinforced by China's overwhelming dominance in battery and critical mineral supply chains, which underpin not only electric vehicles and energy storage systems but also AI data centers, advanced computing, and semiconductor manufacturing. According to recent UN Comtrade data, China accounts for 44% of global imports and 58% of global exports of raw and processed battery minerals. Beijing's role is even more pronounced in specific mineral segments: it processes over 90% of the world's graphite, controls more than two-thirds of global lithium and cobalt refining capacity, and Chinese firms own 80% of cobalt production in Congo, where the majority of global cobalt reserves are located. China also dominates the manufacturing stage, producing over 70% of global cathodes, 85% of anodes, and 74% of separators, and controlling nearly 85% of the world's battery cell production capacity (Clark, 2025).

This mineral and materials dominance has become a structural

vulnerability for other major economies. Countries such as Japan, South Korea, and members of the European Union have scrambled to diversify import sources and develop domestic alternatives, while forming new partnerships with producers in Australia, Canada, and Latin America. Yet experts caution that establishing alternative supply lines for both semiconductors and critical minerals will require years of sustained investment. Smaller firms—lacking the resources to absorb volatility in cost, procurement, and regulatory uncertainty—face the greatest risk as the global technology ecosystem adjusts to a more fractured and strategically contested landscape (Rudge, 2025)

Supply chain disruption reflects deliberate competition over relative gains and structural power rather than purely economic friction. From Gilpin's perspective, U.S. export controls and China's mineral restrictions are policy instruments designed to preserve technological advantages, impose asymmetric costs on rivals, and protect national autonomy. From Strange's perspective, control over fabrication capacity, critical mineral processing, and proprietary knowledge constitutes structural power within the production and knowledge structures, enabling states to shape the choices available to others. This competition ultimately concerns who possesses the power to organize the structural conditions within which global technological production takes place.

### *Fragmentation of Global Technology Standards*

Beyond supply chains, the U.S.–China tech rivalry is also disrupting the rules that govern global technological innovation. One of the most illustrative cases is the growing contention over RISC-V, an open-source semiconductor architecture that allows hardware designers to customize instruction sets without relying on proprietary IP from firms like Intel or ARM.

RISC-V began as an academic project at UC Berkeley but has since gained global traction, especially among firms in China, the EU, and the U.S. Yet in November 2023, the U.S. Congress's Select Committee on the CCP urged the Commerce Department to consider restricting American participation in RISC-V development, citing concerns that China might leverage the open standard to bypass Western controls and enhance its own tech ecosystem (Cory, 2024).

Such proposals misunderstand the distinction between a standard and its implementation. RISC-V, as a standard, is open and publicly documented, meaning China will continue using it regardless of U.S. participation. What matters is not the architecture itself, but how companies implement and refine it. Even within the x86 architecture, Intel and AMD have vastly different microarchitectures. Chinese firms still lack access to advanced foundry technology and lag behind in high-performance chip implementation, meaning RISC-V alone will not close the technological gap (Cory, 2024).

Nonetheless, attempts to isolate RISC-V development could fragment the global software ecosystem, creating incompatible forks. This would not only disadvantage U.S. developers who rely on shared standards to optimize software tools and compilers but also weaken collaborative efforts between allies. For instance, DARPA, NASA, and the Japanese government have all invested in RISC-V-based projects precisely because of its flexibility, cost-effectiveness, and long-term security potential. RISC-V also offers opportunities for countries seeking alternatives to the U.S.-China binary. The EU, India, and Japan are all developing RISC-V initiatives to reduce reliance on Intel and ARM architectures. If U.S. firms are restricted from participating, the leadership of RISC-V may shift toward China or others, with long-term implications for global standard-setting and market share in semiconductor design (Cory, 2024).

From Gilpin's perspective, competition over RISC-V reflects a contest over relative gains, where leadership in standard-setting secures long-term advantages in innovation capacity, market access, and national power. U.S. congressional pressure and China's cultivation of its own RISC-V ecosystem both reflect this distributional logic rather than purely technical concerns. From Strange's perspective, the struggle illustrates structural power within the knowledge structure: the capacity to shape the standards and knowledge systems through which innovation occurs determines the framework within

which all other actors must operate. Fragmentation of standards therefore reflects a fundamental contest over who governs the architecture of global technological innovation.

#### *Geopolitical Alignment and Tech Blocs*

The intensifying technological rivalry between the United States and China has catalysed a global realignment of digital infrastructure, investment strategies, and technological standards, prompting both powers to cultivate competing spheres of influence. For Washington, this means leveraging alliances and economic tools to deter the adoption of Chinese technologies. For Beijing, it entails doubling down on its Digital Silk Road (DSR) and promoting normative alternatives to the Western-led digital order.

The United States, particularly under the Biden administration, has broadened its digital and development diplomacy in response to China's expanding digital footprint. Whereas the Trump administration focused primarily on warning about the security risks of Chinese 5G providers such as Huawei, the Biden administration has emphasized offering attractive alternatives to developing countries. Tools such as Open RAN, the expansion of subsea cable connectivity, and digital infrastructure financing through the U.S. Development Finance Corporation and the Export-Import Bank reflect Washington's effort to enhance both domestic capacity and global competitiveness (Segal, 2020). In parallel, multilateral frameworks like the

Blue Dot Network aim to certify high-standard infrastructure, including digital infrastructure, with an emphasis on sustainability and transparency.

In the broader Indo-Pacific, the U.S. seeks to counter China's "Safe City" model, which bundles surveillance systems with 5G hardware, by promoting alternative smart city frameworks that prioritize data privacy and ethical governance. These initiatives not only challenge the commercial dominance of Chinese firms like Huawei and ZTE, but also reflect a normative contest over what constitutes a secure and democratic digital future. Collaboration between American and Japanese firms such as Dell and NTT's partnership in Las Vegas that serves as a model for allied digital leadership in both developed and developing markets (Patil & Gupta, 2025).

In contrast, Beijing has been vigorously expanding the Digital Silk Road (DSR), a key pillar of the Belt and Road Initiative (BRI), into Southeast Asia and beyond. Between 2017 and 2023, China undertook 176 digital infrastructure projects in the region, with Indonesia, Singapore, and Malaysia receiving the majority of investments. These projects range from data centres and e-commerce platforms to 5G base stations and smart city deployments, largely driven by private tech giants like Huawei, Tencent, Alibaba, and ZTE (Zheng, 2024). Beijing has institutionalized the DSR through regional cooperation mechanisms such as the ASEAN-China Digital Economy

Partnership Initiative (2020) and the Action Plan on ASEAN-China Digital Cooperation (2021–2025). The Chinese government supports these engagements not only through policy but also by enabling tech companies to train local officials and offer technology-transfer programs under initiatives like Huawei's "Seeds for the Future" (Taidong, 2022)

Yet, this engagement has provoked concerns in host countries over data privacy and sovereignty, particularly in light of China's National Intelligence Law, which mandates corporate cooperation with state intelligence efforts. These concerns, coupled with local economic considerations, have led Southeast Asian states to adopt mixed strategies, welcoming Chinese investment while implementing legal safeguards against overreach. For instance, Indonesia's restrictions on social media platforms' role in e-commerce highlight the region's selective embrace of DSR-related projects (Business Indonesia, 2023).

Meanwhile, Europe finds itself in a precarious position within this bifurcating technological landscape. While the European Union shares U.S. concerns over cybersecurity and unfair industrial practices such as forced technology transfers and state subsidies that it also resists being drawn into an overly confrontational posture. The EU's response has been framed by its pursuit of "strategic autonomy," a doctrine that emphasizes technological self-reliance without full alignment with Washington's containment agenda (Odgaard, 2021).

The rollout of the EU Chips Act, which aims to double Europe's semiconductor market share from 10% to 20% by mobilizing €43 billion in public and private investment, represents a key component of this ambition. However, intra-European divergence on Huawei and 5G infrastructure illustrates the bloc's persistent fragmentation. While countries like France and the UK have moved to phase out Huawei equipment, others, such as Germany and Italy, remain more ambivalent. The EU has also introduced the EU Toolbox for 5G Security and investment screening frameworks to scrutinize Chinese acquisitions in strategic sectors, including semiconductors, aerospace, and AI (The Council of the European Union, 2025).

Concurrently, the EU-China Comprehensive Agreement on Investment (CAI), concluded in principle in 2020, seeks to rebalance trade relations by expanding EU access to China's digital sectors and standard-setting bodies. While not yet ratified, the CAI reflects Brussels' dual-track approach: cooperating with Beijing on mutual economic interests while hedging against systemic vulnerabilities through regulatory and technological safeguards (Grieger, 2020).

The geopolitical contest over technology has produced a multipolar alignment in which states simultaneously seek to shape or resist being shaped by the global digital order. From Gilpin's perspective, competing technology blocs

reflect strategic competition over relative gains, with digital infrastructure frameworks becoming instruments through which states pursue wealth and power concurrently. From Strange's perspective, what is at stake is structural power itself: both Washington and Beijing are contesting the frameworks governing technological exchange, finance, production, and knowledge creation. The struggle is ultimately not over specific technologies but over the authority to define the rules organizing global technological development.

## CONCLUSION

The CHIPS and Science Act signifies more than a revival of U.S. industrial policy. Understood through the integrated framework of Gilpin and Strange, it represents a calculated effort to reshape the distribution of technological capabilities and relative gains, denying China the semiconductor access that would otherwise translate into expanded wealth, military power, and systemic influence. China's responses, equally, are not merely defensive adaptations. They constitute deliberate attempts to reduce structural dependence and improve China's position within the production, financial, and knowledge structures that organize the global technology industry, precisely the structures through which Strange argues that durable power is exercised.

The rivalry has already produced far-reaching consequences. Disrupted semiconductor supply chains, fragmented technology standards, and bifurcated digital ecosystems reflect the distributional logic Gilpin identifies:

economic outcomes are never politically neutral, and each structural shift carries consequences for the broader balance of power. Middle powers in Southeast Asia and Europe now navigate complex interdependencies with both Washington and Beijing, balancing development needs, security imperatives, and digital sovereignty, illustrating how structural competition among great powers constrains the choices available to all other actors.

At a broader level, the U.S. and China technological rivalry is increasingly a contest over the authority to define the rules, standards, institutions, and

networks that organize global innovation. It is, in Strange's terms, a struggle over structural power itself, over who shapes the frameworks within which states, firms, and societies must operate. Whether this contest produces deeper fragmentation or a reconfigured multilateralism will depend not only on great-power strategies but on how regional actors assert agency over their own technological futures and digital sovereignty in an era where the international political economy and technological order are becoming inseparable.

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