

Weaponized Interdependence and Dynamics of Partial Decoupling: Chokepoints, Adaptation, and the Security Dilemma in Advanced Technologies

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Abstract

This paper examines the erosion of U.S.–China technological engagement through the lens of weaponized interdependence. It focuses specifically on advanced technology sectors, particularly semiconductors, as a representative case study. Through examining U.S. export restraints after the first Trump administration, this paper argues that current instability in U.S.–China relations arises less from complete ideological divergence or failure of outright containment policy than from a structured reaction–counterreaction dynamic triggered by chokepoint activation. When the United States employs export controls and allied coordination to manage perceived technological risks, China responds through defensive reconfiguration aimed at reducing asymmetric vulnerability, in addition to retaliation in rare-earth export controls. Over time, these interactions generate three structural transformations: supply-chain reconfiguration, substitution, and regulations reinforcing segmentation. While previous literature is based primarily on the short-term effectiveness of coercion, this paper shifts attention to technological restraints’ longer-term structural consequences. In summary, this paper suggests that technological interdependence is not dissolving but being selectively restructured. The result is a durable condition of partial, segmented decoupling in which interdependence persists under increasingly politicized rules of access.

Introduction

For much of the post-Cold War period, economic interdependence was understood as a stabilizing force in the field of international relations. Trade, investment, and technological exchange were assumed to generate shared interests that moderated rivalry between old hegemons and newly rising powers. This logic underpinned the United States' policy of engagement with China from the early 1990s onward. Integrating China into global markets was expected not only to promote economic convergence, but also to reduce incentives for strategic confrontation.

Yet in the past decade, this assumption has eroded, most dramatically in the technological domain. Rather than reinforcing cooperation, deep integration in advanced technologies came to be viewed as a source of strategic vulnerability. The result has been a sustained shift toward export controls, targeted sanctions, and coordination with strategic allies aimed at restricting access to critical technological inputs.¹ However, these measures have not produced wholesale disengagement. Instead, they generate an escalating cycle of restriction, adaptation, and selective separation that has fundamentally altered the structure of interdependence between China and the United States.

This paper seeks to understand why engagement has proven especially unstable in advanced technology sectors. Rather than asking if technological engagement has “failed,” it examines how the structure of interdependence in these sectors shapes state behavior once security concerns become salient. The core puzzle is therefore not about ideological divergence or policy miscalculation, but why deep integration in technologies such as semiconductors has created conditions conducive to strategic denial of market access and fragmentation. Building on existing scholarship on weaponized interdependence, this paper shifts attention from episodic coercion to the longer-term structural effects that repeated chokepoint activation can generate. In this context, “chokepoint” may be understood as a strategically central node within a supply chain through which a disproportionate volume of technology or specialized input must pass. “Chokepoint activation” is thus conceptualized as a state's active and deliberate exertion of leverage over such a node. In the case of semiconductors, chokepoint activation refers to the different measures the United States used (export controls, licensing regimes, or allied coordination) to condition or restrict access for strategic purposes.

¹ Ana Swanson, “Trump's Trade War with China Is Officially Underway,” *The New York Times*, July 5, 2018, <https://www.nytimes.com/2018/07/05/business/china-us-trade-war-trump-tariffs.html>.

It advances a central argument: in advanced technology sectors characterized by cumulative innovation, limited substitutability, dual-use applications, and highly concentrated production networks, interdependence allocates vulnerability asymmetrical.² Once these asymmetries become legible and politically salient, interdependence ceases to function solely as a stabilizing constraint. Instead, it becomes a channel through which coercion and counter-coercion operate, generating incentives for defensive reconfiguration. The outcome is not full technological separation, but a condition of *partial, segmented decoupling* in which interdependence persists under increasingly politicized rules of access.

To substantiate this argument, the paper proceeds in three steps. First, it specifies the conditions under which technological interdependence becomes self-destabilizing rather than merely coercive, extending existing work on weaponized interdependence by shifting attention from episodic leverage to system-level dynamics over time. Second, it traces how decades of U.S.–China engagement in semiconductors unintentionally produced the concentrated supply-chain structures that make chokepoint coercion feasible, recasting engagement itself as an endogenous source of vulnerability. Third, it analyzes the post-2013 period through a coercer–target framework, examining U.S. export controls and allied coordination, a strategy of strategic alignment between allies to strengthen or bypass export control measures, alongside China’s adaptive responses.³ Together, these interactions generate a stable but tense equilibrium of partial decoupling that reshapes, rather than dissolves, technological interdependence.

Analytical Framework

Existing work on weaponized interdependence emphasizes how states can exploit their position within global networks to coerce others through

² Dual-use application refers to applications in both civilian and military products. Many advanced semiconductors are today found in modern warfighting technologies and weapons modeling systems. See Jeanne Whalen, “Three Months, 700 Steps: Why It Takes so Long to Produce a Computer Chip,” *The Washington Post*, July 7, 2021, <https://www.washingtonpost.com/technology/2021/07/07/making-semiconductors-is-hard/>; Matthew Schleich, “Securing Semiconductors: How to Scale-up Global Semiconductor Production and Protect U.S. National Security at the Same Time,” *United States Department of State*, May 16, 2023, <https://2021-2025.state.gov/securing-semiconductors-how-to-scale-up-global-semiconductor-production-and-protect-u-s-national-security-at-the-same-time/>.

³ Allied coordination refers here to a strategic alignment between Western countries to block China from accessing the high-end of the semiconductor supply chain. It may also refer to China’s active process of seeking allies to counter Western coercion. In other words, this term is simply a replacement of coalition-based export control.

panopticon or chokepoint effects.⁴ This paper builds on that insight by shifting the unit of analysis from isolated episodes of coercion to the iterated interactions that such coercion generates. Rather than treating network structures as static sources of leverage, the framework conceptualizes weaponized interdependence as a process that unfolds through feedback effects. Chokepoint activation alters expectations about future access, induces behavioral adaptation by firms and states, and generates political pressures for further adjustments in the international system.

The temporal focus of this analysis begins in the early 2010s, when technological interdependence between the United States and China became explicitly securitized. Although frictions over technology transfer and industrial policy existed earlier, advanced technologies such as semiconductors were increasingly reframed during this period as national security assets rather than primarily commercial goods.⁵ Export controls and defensive reconfiguration mark a qualitative departure from earlier strategies of engagement.

Within this framework, the United States and China are treated analytically as structural rather than normative actors.⁶ The United States functions as the coercer insofar as it exercises jurisdictional control over upstream chokepoints in semiconductor supply chains, including design software, manufacturing equipment, and frontier fabrication capabilities. China occupies the position of the target due to an asymmetric exposure to these chokepoints that has been unintentionally built through its history of engagement. Importantly, neither actor's strategy is treated as exogenous. Instead, the framework emphasizes how policies on both sides evolve in

⁴ See Daniel W. Drezner, *The Uses and Abuses of Weaponized Interdependence* (Washington, DC: Brookings Institution Press, 2021); Douglas B. Fuller, "Weaponizing Interdependence and Global Value Chains: U.S. Export Controls on Huawei," *APSA Annual Meeting Paper*, 2022; Victor D. Cha, "Collective Resilience: Deterring China's Weaponization of Economic Interdependence," *International Security* 48, no. 1 (2023): 91–124, https://doi.org/10.1162/isec_a_00465.

⁵ A major inflection point came in 2013 with the Snowden disclosures. The revelations exposed the extent to which U.S. information and communications technologies were embedded within global surveillance architectures and subject to American jurisdiction. For China, what had once been viewed as benign interdependence was now reinterpreted as structural vulnerability. In the aftermath, Chinese media and policy discourse increasingly emphasized technology security, indigenous breakthroughs, and the need for trusted national networks. Tan's empirical evidence shows a clear rise in the salience of terms related to decoupling and technology security following this initial knowledge shock. See Yeling Tan et al., "Driven to Self-Reliance: Technological Interdependence and the Chinese Innovation Ecosystem," *International Studies Quarterly* 69, no. 2 (March 17, 2025), <https://doi.org/10.1093/isq/sqaf017>.

⁶ By "structural actors," this paper treats states as entities responding to incentives and constraints embedded within the international system, rather than as actors primarily motivated by ideological commitments or normative claims.

response to perceived vulnerability and adaptation of the other actor. Coercive measures may succeed in constraining specific technologies or firms, but they also generate adaptive responses that reshape incentives for investment, innovation, and cooperation. Similarly, defensive strategies aimed at reducing vulnerability may alleviate exposure while introducing new inefficiencies and dependencies. The interaction between coercion and adaptation thus produces an evolving equilibrium characterized by selective separation and managed interdependence.

Iterated chokepoint activation is argued to generate three durable structural transformations: i) supply-chain reconfiguration, ii) substitution and redundancy, iii) regulatory and standards segmentation. Figure 1 explains the definitions of these transformations, while Figure 2 illustrates the causal sequence linking chokepoint activation with adaptation, regulatory tightening, and the consequence of a segmented equilibrium.

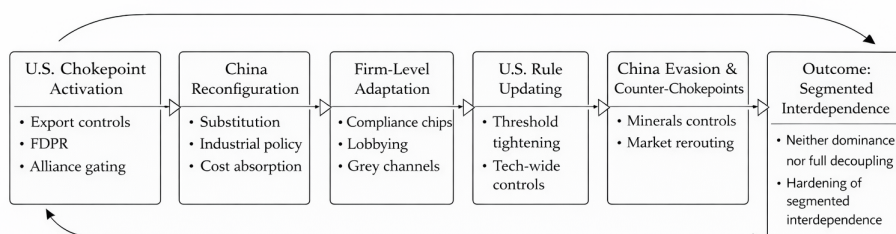
Figure 1. Structural Transformations Under Weaponized Interdependence

Structural Indicator	Analytical Meaning	Observable Manifestations
Supply-Chain Reconfiguration	Reorganization of production networks in response to political and security risk, without full withdrawal from global markets	Re-shoring or friend-shoring of fabrication and equipment supply; geographic diversification of critical nodes; avoidance of politically exposed jurisdictions
Indigenous Substitution and Capability Building	Deliberate efforts to reduce reliance on foreign chokepoints through domestic alternatives, even at higher cost or lower efficiency	State-supported development of domestic equipment, materials, and design tools; tolerance for duplication and inefficiency to reduce vulnerability
Regulatory and Standards Segmentation	Fragmentation of previously integrated markets through divergent legal, technical, and compliance frameworks	Parallel standards systems; differentiated export control regimes; increased transaction costs for cross-jurisdictional participation

This mechanism, however, does not apply universally. It is unlikely to operate in markets characterized by high substitutability, diffuse production, and low switching costs, such as commodity markets. Nor does it describe domains in which no actor possesses jurisdictional control over the high-end, decisive nodes. The argument advanced here is therefore sector-specific: it applies most strongly to advanced technologies that combine cumulative innovation, concentrated supply chains, and dual-use significance. The result of this sector-specific coercion is a partial interdependence between the two opponents. Since neither nation can completely

dominate the supply chain, a stalemate of competition is achieved. Hardening of such segmented interdependence only generates further rounds of chokepoint activation and counter-measures, a process that looks poised to continue until one side completely falls out of this competition.

Figure 2. Hypothetical Mechanism Diagram for Causal Sequence in Technological Interdependence



Under these conditions, the framework seems to highlight a security dilemma-like dynamic rooted in technological governance. Chokepoint activation becomes the opening move in an iterated process that generates feedback effects on both sides. Measures adopted by the coercer to mitigate future risk (e.g. targeted export controls) may be interpreted by the target as long-term containment, even when framed as narrow or preventive. Adaptive responses aimed at reducing vulnerability can, in turn, be perceived as evidence of latent capability-building, reinforcing incentives for further restriction. Over time, the outcome is not full decoupling, but a stable equilibrium of partial decoupling in which interdependence persists under tighter political control.

Why Existing Accounts of Engagement Breakdown Are Incomplete

A large literature seeks to explain the erosion of U.S.–China engagement. These explanations can be grouped into two broad camps: structural accounts and agent-centered accounts.⁷ While they illuminate why political support for engagement weakened, they do not explain why advanced

⁷ In fact, opinions about how to deal with China have been divided roughly into four major camps: Bull-Hawks, Bear-Hawks, Bull-Dove, Bear-Dove. Bulls and Bears refer to conceptions of China's development, whether it will continue to rise or has already peaked. Hawk and Doves refer to what policy the United States should take, whether its aggressive counter-measures or a window for cooperative opportunity. This essay concerns only with arguments from the hawks, as utilizing chokepoints in the technology sector is prone to cause containment and decoupling rather than cooperation or engagement.

technologies, rather than trade in general, became the primary locus of instability.

Structural explanations locate the breakdown of engagement in systemic shifts associated with China's rise. From this perspective, engagement was unsustainable because a rising power with divergent political and institutional characteristics inevitably threatened the position of the established hegemon.⁸ Power transition theories emphasize how relative gains and security competition intensify as material capabilities converge, while institutional accounts stress incompatibilities between China's party-state capitalism and rule-based global economic governance.⁹ Together, these arguments help explain why rivalry deepened, but they treat technological conflict as an epiphenomenon of broader strategic competition rather than as a distinct source of instability.

Agent-centered explanations focus instead on beliefs, and domestic political backlash. Engagement persisted, in this view, because policymakers overestimated the transformative effects of economic integration and underestimated the resilience of China's political and economic system.¹⁰ As evidence accumulated that integration did not produce convergence, especially that China's industrial and regulatory practices also generated asymmetric risks, support for engagement eroded.¹¹ These accounts clarify how perceptions changed over time, but they offer limited insight into why certain sectors, particularly semiconductors, became uniquely securitized while others remained deeply integrated despite rising rivalry.

Both sets of explanations therefore share a common limitation. They treat engagement primarily as a political strategy whose viability depends on intentions, beliefs, or systemic power shifts. What they do not explain is how the structure of interdependence itself can generate instability. Specifically, they do not account for why deep integration in advanced

⁸ John J. Mearsheimer, "The Inevitable Rivalry: America, China, and the Tragedy of Great-Power Politics," *Foreign Affairs*, October 28, 2021, <https://www.foreignaffairs.com/articles/china/2021-10-19/inevitable-rivalry-cold-war>.

⁹ Aaron Friedberg, "The Growing Rivalry between America and China and the Future of Globalization," *Texas National Security Review*, January 4, 2022, <https://tnsr.org/2022/01/the-growing-rivalry-between-america-and-china-and-the-future-of-globalization/>; Scholars argue that China's party-state capitalism is fundamentally incompatible with the rule-based, legalistic architecture of institutions such as the WTO, producing structural tensions that transform engagement into contestation over who sets the rules of the system. See Mark Wu, "The 'China, Inc.' Challenge to Global Trade Governance," *Harvard International Law Journal* 57, no. 2 (January 1, 2016): 261–324.

¹⁰ Kurt M Campbell and Ely Ratner, "The China Reckoning," *Foreign Affairs*, February 13, 2018, <https://www.foreignaffairs.com/china/china-reckoning>.

¹¹ Margaret M. Pearson, Meg Rithmire, and Kellee S. Tsai, "China's Party-State Capitalism and International Backlash: From Interdependence to Insecurity," *International Security* 47, no. 2 (2022): 135–76, https://doi.org/10.1162/isec_a_00447.

technologies produced concentrated vulnerabilities that made denial strategies feasible and self-reinforcing.

The argument advanced in this paper does not reject these explanations. Structural rivalry and shifting beliefs clearly shape the political context in which technology policy is made. Rather, this paper complements them by focusing on a different level of analysis. Instead of asking why engagement ended, the next section examines how technological interdependence, once embedded in concentrated and cumulative production networks, became weaponizable, particularly how that weaponization reshaped the system over time. By shifting attention from the collapse of engagement to the transformation of interdependence, this paper seeks to clarify why advanced technologies became central to contemporary economic statecraft.

Weaponized Interdependence: From Coercion to Systemic Dynamics

Unlike trade in consumer goods or relatively fungible commodities, advanced technologies like semiconductors exhibit a set of structural characteristics that fundamentally alter the strategic calculus of interdependence.¹² First, innovation is cumulative: access to frontier capabilities today shapes the feasible trajectory of technological progress tomorrow, creating path dependence rather than discrete, easily reversible exchanges. Second, substitution is limited. Although firms and states may diversify supply chains at the margins, there are few short-term alternatives to advanced fabrication nodes, specialized manufacturing equipment, or proprietary design software that do not incur substantial performance and cost penalties. Third, these technologies are inherently dual-use, generating civilian economic value while simultaneously enabling military, intelligence, and surveillance applications. Finally, production networks are highly concentrated geographically and institutionally, producing identifiable choke-points through which influence can be exercised.

This asymmetrical nature transforms technological interdependence from a stabilizing force into a potential instrument of power. Once states recognize that control over key nodes in technology networks enables denial rather than mere bargaining, incentives shift. As Henry Farrell and Abraham L. Newman demonstrate, interdependence under conditions of

¹² As emphasized in recent scholarship and teaching on technological competition, these sectors are cumulative, difficult to substitute, embedded in security-critical systems, and governed by network position rather than formal ownership. See John Minnich, “*Economic and Technological War*,” IR 392/492: The Political Economy of China’s Technological Rise. (class lecture, London School of Economics, London, UK, November 26, 2025).

network centralization and jurisdictional control becomes a source of coercive leverage rather than mutual restraint.¹³

Subsequent scholarship has also refined this framework by assessing the durability and limits of chokepoint power. Analysts emphasize that not all chokepoints are equally powerful, and that their effectiveness depends on firm-level incentives in addition to technological substitutability or the availability of alternative networks.¹⁴ Where denial threatens long-term innovation, pressure to evade or undermine controls increases.¹⁵

Concerns about power trajectories intensify this dynamic. As rising powers approach technological parity, sensitivity to future risks increases. Under such conditions, the opportunity costs of restraint grow, and measures that might once have appeared excessively escalatory come to be viewed as preventive.¹⁶ Consecutive “knowledge shocks” may further prompt policymakers to reinterpret technological interdependence as a liability, reinforcing incentives for insulation and control.¹⁷ The result is not the abandonment of interdependence, but its reconfiguration under heightened political tension. Engagement persists, but becomes narrower, conditional, and increasingly segmented along lines of strategic trust.¹⁸

How Engagement Built the Chokepoints

The emergence of semiconductors as the central arena of U.S.–China confrontation was not the product of a sudden policy reversal, nor the result of deliberate vulnerability creation. Rather, it was the cumulative and largely unintended consequence of decades of engagement that deepened integration while concentrating control over critical nodes in global production networks.

From the late Cold War through the early 2010s, U.S.–China engagement was premised on a shared assumption: that integration would diffuse capabilities, reduce incentives for conflict, and bind China more tightly to

¹³ Henry Farrell and Abraham L. Newman, “Weaponized Interdependence: How Global Economic Networks Shape State Coercion,” *International Security* 44, no. 1 (July 1, 2019): 42–79, https://doi.org/10.1162/isec_a_00351.

¹⁴ Fuller, “Weaponizing Interdependence and Global Value Chains.”

¹⁵ Drezner, *The Uses and Abuses of Weaponized Interdependence*.

¹⁶ Michael Beckley, “The Peril of Peaking Powers: Economic Slowdowns and Implications for China’s Next Decade,” *International Security* 48, no. 1 (January 1, 2023): 7–46, https://doi.org/10.1162/isec_a_00463.

¹⁷ Knowledge shocks typically refers to sudden revelations of surveillance and the expansion of export controls, most notably the Snowden revelations and U.S. export controls, which reframed interdependence as a key vulnerability. See Tan, “Driven to Self-Reliance.”

¹⁸ Ibid.

existing market and governance structures.¹⁹ By the 1990s, this approach was systematized under what later came to be known as “trading the market for technology” (TMFT or *yi shichang huan jishu*).²⁰ The effectiveness of this strategy was amplified by what observers at the time described as an FDI (foreign direct investment) fever, during which multinational firms, eager to secure early mover advantages in China, accepted arrangements that they might have resisted elsewhere.²¹ These incentives produced rapid integration across semiconductor value chains, particularly in the downstream segments China specialized, such as assembly, testing, and packaging. Upstream activities, however, remained concentrated among a small number of firms controlling advanced design software, manufacturing equipment, and frontier fabrication capabilities.²²

This pattern of integration generated a distinctive hub-and-spoke structure. Chinese firms became indispensable participants in global semiconductor production, while remaining highly dependent on foreign suppliers.²³ From an efficiency perspective, this division of labor proved highly productive. From a strategic perspective, it entrenched asymmetric exposure.

Institutional developments reinforced this concentration. China’s accession to the World Trade Organization (WTO) in 2001 lowered barriers to trade and investment and accelerated the incorporation of Chinese facilities into global supply chains. China’s post-WTO strategy therefore emphasized “introduce, digest, absorb, and re-innovate” (IDAR), shifting focus from acquiring foreign hardware toward building firms’ absorptive capacity

¹⁹ John Minnich, “Trump, U.S.-China Competition, and the Future of Technology Transfer,” *Global Public Policy and Governance* 5, no. 4 (2025): 411–21. <https://doi.org/10.1007/s43508-025-00125-9>.

²⁰ This idea was carried out as Chinese authorities leveraged market size and regional bargaining power to encourage localization of production and training.

²¹ Ling Chen and Miles M. Evers, “‘Wars without Gun Smoke’: Global Supply Chains, Power Transitions, and Economic Statecraft,” *International Security* 48, no. 2 (January 1, 2023): 164–204, https://doi.org/10.1162/isec_a_00473.

²² Stephen Ezell, “How Innovative Is China in Semiconductors?,” Hamilton Center on Industrial Strategy, August 2024, <https://d-russia.ru/wp-content/uploads/2024/03/2024-china-semiconductors.pdf>.

²³ Ezell, “How Innovative Is China in Semiconductors?,” Unfortunately, out of its unique position (intermediate to GVCs or Global Value Chains), its reliance on foreign firms to drive exports constrained its power from imposing a great amount of tech extractive policies. Prior to 2014–15, China was described as lacking the resources or capabilities to “go out” in search of foreign technology on a large scale. See John D. Minnich, “Scaling the Commanding Heights: The Logic of Technology Transfer Policy in Rising China,” *MIT Political Science Department Research Paper* no. 2023–2 (June 29, 2023), <https://ssrn.com/abstract=4496386>.

through research and development, training, and indigenous innovation.²⁴ Throughout the 2000s, technological dependence was widely treated as transitional, to be resolved through continued cooperation and upgrading. State strategies emphasized indigenous innovation, improving the domestic absorptive capacity under a “win-win” condition of technological collaboration.²⁵

Crucially, such outcomes were not the result of a coherent strategy to weaponize interdependence. They emerged instead from mutually beneficial decisions made under political trust and low perceived security risk. Engagement functioned as a force multiplier for efficiency, but in the future, it also rendered interdependence increasingly legible to state regulations.

By the early 2010s, shifts in the security environment altered how these structures were interpreted. Concerns about cyber espionage and military-civil fusion altered the strategic implications of technological dependence. Policymakers were prompted to reassess earlier assumptions about benign interdependence.²⁶ The neutral market infrastructure created in the past became increasingly reframed as potential leverage. Engagement thus produced the very conditions that later made weaponized interdependence possible: concentrated upstream control, high switching costs, and jurisdictional authority over indispensable inputs.

²⁴ In practice, the IDAR framework expanded the policy toolkit. Joint venture requirements persisted, but they were supplemented by local content rules, government procurement preferences, standards-setting, and targeted industrial policies. The aim was no longer merely to host foreign production, but to embed learning within domestic firms and gradually move Chinese companies up the value chain. See John D. Minnich, “Re-Innovation Nation: The Strategic and Political Logic of Technology Transfer Policy in Rising China” (PhD diss., MIT, 2023), <https://dspace.mit.edu/bitstream/handle/1721.1/152780/minnich-jminnich-phd-politicalscience-2023-thesis.pdf>.

²⁵ Policy documents such as the Eleventh Five-Year Plan emphasized optimization, leapfrogging, and “win-win” technological collaboration, reflecting a prevailing belief that engagement remained both viable and beneficial. See National Development and Reform Commission (NDRC), *Outline of the Eleventh Five-Year Plan for National Economic and Social Development* (《国民经济和社会发展第十一个五年规划纲要》), in Chinese, March 24, 2006, https://www.ndrc.gov.cn/xwdt/gdzt/ghjd/quanwen/201403/t20140321_1201604.html; To this end, the Chinese state expanded its coordinating capacity through instruments such as the 2006 Medium and Long Term Program (MLP), which sought to strengthen domestic innovation in high-value-added sectors while remaining embedded in global markets. See Cong Cao, Richard P. Suttmeier, and Denis Fred Simon, “China’s 15-Year Science and Technology Plan,” *Issues in Science and Technology* 22, no. 4 (Summer 2006): 38–43, <https://china-us.uoregon.edu/pdf/final%20print%20version.pdf>.

²⁶ Tan, “Driven to Self-Reliance.”

The United States: Chokepoint Coercion in Practice

The United States' turn toward chokepoint-based coercion in advanced technologies near the end of the Obama administration did not represent a wholesale abandonment of engagement, nor a sudden embrace of economic warfare.²⁷ Rather, it reflected a reassessment of risk under conditions in which the structure of interdependence—shaped by earlier engagement—appeared to grant the United States selective leverage over critical upstream nodes. Chokepoint activation emerged as a strategy of preventive risk management in order to constrain future technological developments rather than to extract immediate concessions.

Strategic Objectives

Official U.S. statements and policy documents from this period consistently emphasized two overlapping objectives. The first was to preserve U.S. and allied leadership in foundational technologies deemed essential to economic competitiveness in response to China's rise.²⁸ This includes advanced logic chips, artificial intelligence accelerators, and semiconductor manufacturing equipment. The second was to prevent China from leveraging civilian access to these technologies to accelerate military modernization or achieve rapid "leapfrogging" toward the technological frontier.²⁹

These objectives became increasingly explicit after 2017. The Trump administration's 2017 National Security Strategy framed China as a "strategic competitor" and identified technological leadership as a core domain of rivalry.³⁰ Subsequent policy debates, spanning multiple administrations, coalesced around the view that unfettered access to U.S.-origin technology posed long-term risks that could not be mitigated through engagement

²⁷ The White House, "President's Council Launches Semiconductor Working Group," October 31, 2016, <https://obamawhitehouse.archives.gov/blog/2016/10/31/presidents-council-launches-semiconductor-working-group>.

²⁸ See Karen Kornbluh and Julia Tréhu, "The New American Foreign Policy of Technology: Promoting Innovation, National Security, and Democratic Values in a Digital World," German Marshall Fund of the United States, 2023, <http://www.jstor.org/stable/resrep48497>

²⁹ Jeffrey W. Legro, "What China Will Want: The Future Intentions of a Rising Power," *Perspectives on Politics* 5, no. 3 (August 16, 2007): 515, <https://doi.org/10.1017/s1537592707071526>; Markus Brunnermeier, Rush Doshi, and Harold James, "Beijing's Bismarckian Ghosts: How Great Powers Compete Economically," *The Washington Quarterly* 41, no. 3 (July 3, 2018): 161–76, <https://doi.org/10.1080/0163660x.2018.1520571>.

³⁰ Congressional Research Service, *Semiconductors: U.S. Industry, Global Competition, and Federal Policy*, CRS In Focus IF10119, updated February 20, 2024, https://www.congress.gov/crs_external_products/IF/PDF/IF10119/IF10119.32.pdf.

alone. Importantly, this logic did not assume that China was technologically dominant in the present; rather, it treated future convergence as the primary threat.³¹ Chokepoint control was therefore justified as a preventive measure rather than a reactive sanction.

Instruments

The operationalization of these goals relied on a layered set of legal and regulatory instruments that drew on U.S. jurisdiction over key nodes in global semiconductor supply chains. In 2016, the U.S. Department of Commerce added telecommunications firm ZTE to its Entity List—a targeted export control mechanism designed to restrict access to certain U.S.-origin technologies for the foreign actors it names—for violating sanctions. The move cut off its access to U.S. chips, software, and design tools.³² Though temporarily reversed through a negotiated settlement (a plea to pay the fine), the episode exposed just how deeply embedded U.S. technology was in China's tech stack. In 2018, the U.S. reactivated controls in a broader context, combining national-security tariffs, a Section 301 IP investigation, and renewed export bans targeting ZTE. This marked the first full activation of chokepoint control: U.S. legal jurisdiction was used to disable a Chinese national champion by denying access to indispensable upstream inputs.³³

What followed was a sustained expansion of that coercive architecture. Between 2019 and 2022, Huawei, SMIC, YMTC, Hikvision, and dozens of other Chinese tech firms were added to the Entity List. Simultaneously, the U.S. imposed extraterritorial controls using the Foreign Direct Product Rule (FDPR), denying China access to cutting-edge chips fabricated even by non-U.S. firms if U.S. technology was involved in the process.³⁴ The campaign culminated in October 2022, when the Commerce Department issued a sweeping set of export controls that blocked China from acquiring or manufacturing logic chips at or below 14nm, AI-grade GPUs (e.g., Nvidia A100/H100), and advanced semiconductor manufacturing equipment.

³¹ Brad Glosserman, "De-Risking Is Not Enough: Tech Denial toward China Is Needed," *The Washington Quarterly* 46, no. 4 (October 2, 2023): 103–19, <https://doi.org/10.1080/0163660x.2023.2286134>.

³² The support of resources ZTE provided to North Korea and Iran was allegedly in violation of economic sanctions that the United States imposed on these authoritarian regimes. See Pearson, "China's Party-State Capitalism and International Backlash."

³³ Liyu Han and Jiaxun Sun, "Trade Strategies and Power Games between China, the US and India," in *The Future of Asian Trade Deals and IP*, ed. Liyu Han et al. (Bloomsbury Publishing, 2019).

³⁴ Gregory C. Allen, "Understanding the Biden Administration's Updated Export Controls," *Center for Strategic and International Studies*, 2024, <https://www.csis.org/analysis/understanding-biden-administrations-updated-export-controls>.

These rules also barred “U.S. persons” from providing support to Chinese semiconductor fabricants, prompting American engineers to withdraw from projects at SMIC and elsewhere.

Allied coordination followed. In 2023, the U.S. secured agreements with the Netherlands and Japan to restrict the export of lithography and etching tools—particularly EUV (Extreme Ultraviolet) and advanced DUV (Deep Ultraviolet) lithography machines used to fabricate sub-7 nanometer (nm) logic chips.³⁵ Meanwhile, the Biden administration imposed further tool restrictions, introduced performance caps on Nvidia/AMD GPU exports, and proposed novel regulations to limit cloud-based AI compute access. As of 2025, outbound investment screening and legislative efforts (e.g., the SAFE CHIPS Act) continue to harden the framework.³⁶ The combined effect is a complex but targeted attempt to control the entire stack of advanced chip production: from IP and design software to manufacturing equipment, capital, and human expertise.

Structural Effects

In the short term, U.S. measures produced immediate disruption. The 2018 denial order against ZTE brought the firm to the brink of collapse within weeks, demonstrating the immediacy with which chokepoint control could incapacitate a technology-dependent company. Huawei’s experience after 2019 was even more consequential: the loss of access to Google’s Android ecosystem and—following the expansion of the Foreign Direct Product Rule in 2020 to advanced chips fabricated by Taiwan Semiconductor Manufacturing Company (TSMC)—effectively dismantled its global smartphone business.³⁷ In parallel, restrictions on high-end computing hardware curtailed Chinese access to Nvidia’s most advanced AI

³⁵ Sub-7nm logic chips are critical inputs for high-performance computing, artificial intelligence systems, and advanced defense applications, making them central to both economic competitiveness and military modernization. See “U.S. Secures Deal with Netherlands, Japan on China Chip Export Limit, Bloomberg Reports,” *Reuters*, January 27, 2023, <https://www.reuters.com/world/officials-netherlands-japan-washington-chip-talks-2023-01-27/>.

³⁶ Georgia Adamson, Saif Khan, and Tao Burga, “Should the US Sell Blackwell Chips to China? Assessing the Impacts of Exporting the B30A AI Chip,” October 25, 2025, <https://ifp.org/wp-content/uploads/Should-the-US-Sell-Blackwell-Chips-to-China.pdf>; CHIPS and Science Act, H.R. 4346, 117th Cong. (2022) (enacted), <https://www.congress.gov/bill/117th-congress/house-bill/4346>.

³⁷ “U.S. Secures Deal with Netherlands, Japan on China Chip Export Limit, Bloomberg Reports,” *Reuters*, January 27, 2023, <https://www.reuters.com/world/officials-netherlands-japan-washington-chip-talks-2023-01-27/>; “TSMC Stops New Huawei Orders after U.S. Restrictions,” *Reuters*, May 18, 2020, <https://www.reuters.com/article/business/tsmc-stops-new-huawei-orders-after-us-restrictions-nikkei-idUSKBN22UoIS/>.

accelerators, especially constraining progress in supercomputing and large language model (LLM) training. These episodes demonstrated that control over a narrow set of upstream technologies could rapidly disable downstream capabilities, confirming the tactical potency of chokepoint measures.

As these controls persisted, however, their effects extended beyond firm-specific disruption. On the U.S. side, semiconductor firms (e.g. Nvidia, Intel, and AMD) faced substantial revenue losses from reduced access to the Chinese market, prompting both commercial adaptation and political pressure for regulatory adjustment.³⁸ In response, firms attempted to preserve market presence by redesigning products to comply with control thresholds—most notably through downgraded “China-specific” chips such as Nvidia’s A800 series.³⁹ In other words, firms designed commercial workarounds for ‘detrimental’ governmental regulations. These efforts, in turn, triggered further rounds of regulatory refinement, as U.S. authorities sought to close newly identified loopholes. Export controls thus evolved into a self-reinforcing governance regime, in which commercial adaptation and regulatory tightening interacted iteratively in what had previously been simply market-driven exchange.

At the technological frontier, U.S. officials have pointed to sustained constraints on China’s access to leading-edge capabilities as evidence that this regime has produced meaningful strategic delay. As of 2024, China had not achieved mass production of 5 nm- or 3 nm-class logic chips, a limitation closely tied to its exclusion from extreme ultraviolet lithography following U.S.-led allied coordination.⁴⁰ These outcomes have been cited as validation of the “small yard, high fence” approach, in which narrowly targeted controls are aimed at a small number of decisive nodes.⁴¹ As illustrated in Figure 3, U.S. export controls represent the initial chokepoint activation in an iterative cycle. The evolution from firm-specific measures to technology-wide thresholds reflects the rule-updating phase of this process.

³⁸ Eric Fruits, “From Moore’s Law to Market Rivalry: The Economic Forces That Shape the Semiconductor Manufacturing Industry,” International Center for Law & Economics, November 17, 2025, <https://laweconcenter.org/resources/from-moores-law-to-market-rivalry-the-economic-forces-that-shape-the-semiconductor-manufacturing-industry/>.

³⁹ Industry analysts noted that such workarounds kept Chinese firms supplied for AI development, albeit at lower efficiency, and prompted U.S. officials to continually update rules to capture those chips as well.

⁴⁰ The China Academy, “2024: How Does China Overcome the US’ Chip Sanctions?,” January 30, 2024, <https://thechinaacademy.org/2024-how-does-china-overcome-the-us-chip-sanctions/>.

⁴¹ Geoffrey Gertz, “Goodbye to Small Yard, High Fence,” *New York Times*, December 31, 2024, <https://www.nytimes.com/2024/12/31/opinion/china-semiconductor-biden-xi.html>.

Yet the longer-term consequences of this strategy appear more complex. Lost sales and foregone scale threaten to erode the revenue base and R&D capacity of U.S. firms, raising concerns that prolonged restriction may undermine the very technological leadership it seeks to preserve. By the mid-2020s, this tension had surfaced openly in policy debates, with some industry actors and policymakers advocating selective relaxation of controls to maintain Chinese dependence on U.S. suppliers and avoid accelerating the search for non-U.S. alternatives.⁴²

For China, the persistence of access constraints has driven a shift from short-term coping to longer-term reorientation. Rather than treating export controls as episodic disruptions, Chinese policymakers and firms increasingly operate on the assumption that chokepoint exposure constitutes a durable feature of the external environment. This expectation has redirected investment and organizational effort toward rebuilding the semiconductor stack under conditions of constraint. Foundries such as SMIC and Hua Hong expanded capacity at mature process nodes, while design firms linked to major technology conglomerates—most notably Huawei’s HiSilicon—adapted architectures to inputs that could be supported domestically.⁴³ Over time, these adjustments have altered the internal allocation of resources, privileging resilience and controllability over immediate performance at the frontier.

Perhaps most consequentially, prolonged exclusion has catalyzed rapid learning and consolidation in China’s semiconductor equipment sector. As U.S. suppliers withdrew, domestic firms such as Naura and Piotech moved from peripheral roles toward central positions, benefiting from policy support that tolerated inefficiency in exchange for capability accumulation.⁴⁴ What began as substitution born of necessity increasingly resembled a reconstitution of upstream capacity, narrowing gaps in segments that had once appeared structurally inaccessible. At the same time, Chinese firms redirected commercially viable technologies. Areas of surveillance systems, telecommunications infrastructure, and civil-military fusion technology expanded toward markets in the Global South as access to advanced

⁴² Karen M. Sutter, “U.S. Export Controls and China: Advanced Semiconductors,” CRS Report R48642 (Congressional Research Service, September 19, 2025), <https://www.congress.gov/crs-product/R48642>.

⁴³ Paul Triolo, “A New Era for the Chinese Semiconductor Industry: Beijing Responds to Export Controls,” *American Affairs*, February 20, 2024, <https://americanaffairsjournal.org/2024/02/a-new-era-for-the-chinese-semiconductor-industry-beijing-responds-to-export-controls/>.

⁴⁴ Danny Hague, “Inside Beijing’s Chipmaking Offensive: Where Is China Gaining Ground?,” *Georgetown Center for Security and Emerging Technology*, July 14, 2025, <https://cset.georgetown.edu/article/inside-beijings-chipmaking-offensive/>.

Western markets narrowed.⁴⁵ ZTE's role in providing the technological infrastructure for Venezuela's "Fatherland Card," which enabled detailed monitoring of citizens, and its partnership with Pakistan's state broadcaster to develop digital television systems and train personnel under expanding Sino-Pakistani cooperation, reinforced security concerns abroad. In the United States and allied countries, these cases contributed to a broader narrative that linked Chinese telecommunications firms to censorship export, surveillance capabilities, and potential influence operations, intensifying anxiety over the proximity of Chinese 5G vendors to critical national infrastructure.⁴⁶ In this environment, interdependence has not disappeared, but it has been reorganized: access is conditional, substitution is strategic, and exchange is mediated through overlapping political and regulatory boundaries.

⁴⁵ Isaac B. Kardon and Wendy Leutert, "Pier Competitor: China's Power Position in Global Ports," *International Security* 46, no. 4 (2022): 9–47, https://doi.org/10.1162/isec_a_00433.

⁴⁶ G. van der Zwan, "Securitization and Democracy in Eurasia Transformation and Development in the OSCE Region," ed. Anja Mihr, Paolo Sorbello, and Brigitte Weiffen, 1st ed. (Springer Nature, 2023), 329–43, <https://doi.org/10.1007/978-3-031-16659-4>.

Figure 3. Key U.S. Chokepoint Measures against China's Semiconductor and AI Sectors, 2018–2025⁴⁷

Date	Target / Entity	Instrument	Strategic Rationale	Tech Scope (Aimed Capability)	Administering Agency
Apr 16, 2018	ZTE Corporation	Export Denial Order	First demonstration of chokepoint control: exposed structural dependence on U.S. chips and software	Telecom SoCs, mobile processors, Android stack	Commerce (BIS)
2018–2019	Huawei & 68 affiliates; ASML to SMIC (EUV block)	Export Control Diplomacy	Curb China's 5G rise and global platform influence; Prevent China from accessing lithography tools needed for advanced-node chips	5G infrastructure, Android OS, EUV for <7nm production	Commerce (BIS) & White House / State Dept
Nov 12, 2020	SMIC, Huawei, military-linked firms	Executive Order 13959 (Investment Ban)	Halt U.S. capital support for China's military-tech fusion companies	Logic fabs, military dual-use semiconductors	White House / Treasury
Apr 8, 2021	Phytium, Sunway, others	Entity List	Deny supercomputing entities access to chip design tools and foundry support	HPC chips, EDA software, advanced packaging	Commerce (BIS)
Sept 2022	Nvidia, AMD (A100/H100 chips)	Export Notification / License	Block China's access to leading AI training chips used in military/civil fusion	AI GPUs, >300 TFLOPs compute accelerators	Commerce (BIS)
Dec 15, 2022	YMTC, Biren, others	Entity List	Block memory and AI chip suppliers from accessing U.S. tooling and IP	NAND flash, AI accelerators	Commerce (BIS)
Oct 17, 2023	Nvidia A800/H800, Biren, Moore	Revised Export Controls	Close loopholes on "China-special" AI chips and expand controls to packaging & tools	Semi-degraded AI GPUs, metrology, advanced packaging	Commerce (BIS)
Dec 2, 2024	140 Chinese chip firms	Entity List + FDPR + new EAR rules	Finalize chokepoint net; close design-tool-	FDPR on AI tools, chip fabs,	Commerce (BIS)

⁴⁷ Compiled by the author from the U.S. Department of Commerce Bureau of Industry and Security (BIS) press releases, Federal Register notices, executive orders, company SEC filings, and media coverage including *Reuters*, *Bloomberg*, and *The Wall Street Journal*, 2018–2025.

			fab-IP loop for advanced chip production	advanced computing nodes	
May 2025	Export-controlled entities	Legislative Proposal (SAFE CHIPS Act draft)	Institutionalize hardware export bans by codifying performance caps and closing waiver pathways for firms like Nvidia	Codified GPU restrictions, reinforced performance limits	Congress / BIS (pending)

China: From Exposure to Defensive Reconfiguration

Strategic Goals

As Jeffrey Legro argues, foreign policy intentions are shaped by dominant ideas within states that function as “meshing gears” between structural conditions—such as power and interdependence—and national behavior. China’s strategic orientation toward technology has therefore been neither static nor ideologically predetermined, but contingent upon changing assessments of risk and opportunity.⁴⁸ What distinguishes the post-2016 period is not merely China’s desire for technological advancement, but a redefinition of technological dependence itself as a systemic vulnerability that could be activated under conditions of strategic tension.

This reassessment was already visible in the mid-2010s. *Made in China 2025* explicitly emphasized reducing reliance on foreign-controlled “core components,” particularly semiconductors and advanced manufacturing equipment.⁴⁹ These concerns intensified after President Xi consolidated political authority. The articulation of the Innovation-Driven Development Strategy (IDDS) reframed technological capability not only as an economic growth engine but as a pillar of national security and regime resilience, seeking global leadership by 2030 and technological dominance by mid-century.⁵⁰ In this context, deep interdependence in advanced technology was increasingly reinterpreted as a source of strategic exposure.⁵¹

U.S. policy shifts reinforced this strategic urgency. As illustrated in Figure 2, the expansion of extraterritorial jurisdiction through instruments

⁴⁸ Legro, “What China Will Want.”

⁴⁹ Avery Goldstein, “US–China Rivalry in the Twenty-First Century: Déjà vu and Cold War II,” *China International Strategy Review* 2, no. 1 (June 2020): 48–62.

⁵⁰ Barry Naughton, “The Innovation-Driven Development Strategy, 2015–Present,” in *The Rise of China’s Industrial Policy, 1978 to 2020* (Lynne Rienner Publishers, 2021), 69–98, <https://doi.org/10.1515/9786078066605-005>.

⁵¹ Chris Miller, “Everything We’re Competing On,” in *Chip War: The Fight for the World’s Most Critical Technology* (Simon and Schuster, 2022).

such as the Foreign Direct Product Rule transformed latent dependence into an immediate risk. Chinese policy discourse began to treat access constraints not as episodic shocks but as a durable feature of the external environment. The objective, then, was not classical autarky. Instead, it centered on reducing asymmetric vulnerability: ensuring that critical components of China's economic and security infrastructure could not be externally disrupted in political crises.⁵²

Responses

China's response to this environment has been multifaceted, but very costly. On the technological front, Beijing has prioritized rebuilding the semiconductor stack across fabrication, design, equipment, and materials—while simultaneously accepting that progress at the frontier would be slower and less efficient than under conditions of open access. The release of Huawei's Mate 60 Pro smartphone in 2023, powered by a 7-nanometer Kirin 9000S system-on-chip produced by SMIC, illustrated both the possibilities and limits of this approach. Denied access to extreme ultraviolet (EUV) lithography, SMIC relied on older deep-ultraviolet tools and multi-patterning techniques to achieve near genuine 7nm chip performance.⁵³ The result demonstrated technical ingenuity and organizational resilience, but at substantial cost: yields were reportedly far below those of leading global foundries, rendering production expensive and difficult to scale.⁵⁴

This pattern—technical progress achieved through workaround rather than efficiency—has become characteristic of China's semiconductor trajectory under constraint. Heavy state support has allowed firms to tolerate low yields, duplication, and higher unit costs in exchange for reduced exposure to foreign chokepoints. Congressional analyses note that such substitution is not limited to logic chips alone, but extends upstream into manufacturing equipment, materials, and design tools, where domestic suppliers

⁵² Darren Lim and Victor Ferguson, "Conscious Decoupling: The Technology Security Dilemma," in *China Dreams*, ed. Jane Golley, Ben Hillman, Linda Jaivin, and Sharon Strange ANU Press, (2020), <http://doi.org/10.22459/CSY.2020.04>.

⁵³ For contemporaneous reporting on Huawei's Mate 60 Pro and its domestically produced chipset, see Vlad Savov and Debby Wu, "Inside Huawei's Mate 60 Pro, Powered by a Made-in-China Chip," *Bloomberg*, September 4, 2023, <https://www.bloomberg.com/news/features/2023-09-04/look-inside-huawei-mate-60-pro-phone-powered-by-made-in-china-chip>; "Teardown of Huawei's New Phone Shows China Chip Breakthrough," *Reuters*, September 4, 2023, <https://www.reuters.com/technology/teardown-huaweis-new-phone-shows-chinas-chip-breakthrough-2023-09-04/>.

⁵⁴ See note 53.

have gained market share following the withdrawal of U.S. and allied firms.⁵⁵

Beyond firm-level adaptation, China has sought to reshape the institutional environment governing technology exchange. Legislative and regulatory initiatives—such as the 2020–2021 semiconductor policy package—tie tax incentives, financing, and procurement eligibility to localization of intellectual property, R&D intensity, and domestic incorporation in China.⁵⁶ These measures aim to internalize critical knowledge within Chinese legal entities and ensure that learning generated under constraint remains domestically embedded. Financial instruments, including state guidance funds and leasing arrangements for imported equipment, have further enabled firms to bridge short-term capability gaps while substitution efforts mature.

Structural Effects

Rather than developing a completely self-sufficient industry or remaining in the status quo, China is engaged in what this paper calls a process of defensive reconfiguration: rebuilding critical capabilities under constraint, re-allocating markets and partners, and institutionalizing mechanisms to reduce exposure to foreign chokepoints. This process has demonstrably narrowed some vulnerabilities, but at a significant cost and with uneven results across sectors.

Crucially, China's indigenous innovation and substitution strategies have fed back into U.S. strategy. Breakthroughs in Huawei's 7-nm chip, for example, reinforced further perceptions in Washington that China retains substantial innovative capacity even under constraint, prompting further tightening of controls. The result is a cycle of action and counter-action in which each side's measures validate the other's threat perceptions. As previously theorized, a new form of security dilemma has emerged. It is one rooted in the control and reconfiguration of technological interdependence rather than military deployment.⁵⁷ Each side's move (controls; self-reliance; diversification) is interpreted as offensive capability-building, triggering countermeasures that expand the scale of control and retaliation.

⁵⁵ Karen M. Sutter, "China's New Semiconductor Policies: Issues for Congress", CRS Report R46767 (Washington, DC: Congressional Research Service, April 20, 2021), <https://www.congress.gov/crs-product/R46767>; and Christopher A. Casey, "U.S. Export Controls and China", CRS In Focus IF11627 (Washington, DC: Congressional Research Service, March 24, 2022), <https://www.congress.gov/crs-product/IF11627>.

⁵⁶ Karen M. Sutter, "'Made in China 2025' Industrial Policies: Issues for Congress", CRS In Focus IF10964 (Washington, DC: Congressional Research Service, December 12, 2024), <https://www.congress.gov/crs-product/IF10964>.

⁵⁷ Darren Lim, "Conscious Decoupling."

In this sense, decoupling is not a singular outcome but an evolving condition. China's pursuit of self-reliance does not eliminate interdependence; it reshapes geopolitics by redistributing risk and leverage across the production of semiconductors. While the United States retains control over design and fabrication, China occupies positions in rare-earth inputs, including critical raw materials essential to semiconductor production.⁵⁸ This asymmetry creates reciprocal vulnerabilities rather than unilateral dependence.

China's regulatory response mirrors the logic of chokepoint coercion. Within days of U.S. semiconductor restrictions, China's Ministry of Commerce announced enhanced export controls on critical minerals originating in or exported from China, including a prohibition on exports of gallium, germanium, antimony, and superhard materials to the United States, alongside heightened end-use and end-user scrutiny for graphite-related dual-use items.⁵⁹

Although these materials had already been subject to licensing regimes introduced in 2023 and 2024, the new measures marked a qualitative shift by explicitly targeting the United States and prohibiting transshipment through third countries. The impact of these controls was further amplified by revisions to China's export-control framework that formalized extraterritorial application, extending regulatory reach beyond Chinese territory. As prices for affected inputs rise, downstream production costs and output for semiconductor-dependent industries are likely to increase, underscoring how interdependence generates both exposure and retaliatory capacity.⁶⁰

As this paper outlines, strategic realignment has followed on both sides. Just as China has redirected deployment and partnerships toward aligned

⁵⁸ Gracelin Baskaran, "China's New Rare Earth and Magnet Restrictions Threaten U.S. Defense Supply Chains," *Center for Strategic and International Studies*, 2025, <https://www.csis.org/analysis/chinas-new-rare-earth-and-magnet-restrictions-threaten-us-defense-supply-chains>.

⁵⁹ Gallium, mainly in the form of gallium nitride and gallium arsenide, is used to create integrated circuit chips and optoelectronic devices, like laser diodes, LEDs, and solar cells. Gallium-based semiconductors are used in different technologies like computers, telephones, and even military applications. See Matthew Blackwood and Catherine DeFilippo, *Germanium and Gallium: US Trade and Chinese Export Controls* (U.S. International Trade Commission, 2024), https://www.usitc.gov/publications/332/executive_briefings/ebot_germanium_and_gallium.pdf; Marius Risse, Fiamma Angeles, and Anttoni Asikainen, "China's Export Controls on Critical Raw Materials, Including Rare Earths," *Global Trade Alert*, October 9, 2025, <https://globaltradealert.org/blog/chinese-export-controls-on-critical-raw-materials-inventory>.

⁶⁰ Blackwood and DeFilippo, *Germanium and Gallium*; Risse, Angeles, and Asikainen, "China's Export Controls."

or permissive markets in the Global South, the United States has intensified efforts to diversify upstream supply chains. In early 2024, Washington launched the C5+1 Critical Minerals Dialogue with Central Asian states to explore investment and cooperation aimed at reducing reliance on Chinese-controlled inputs.⁶¹ These initiatives suggest that raw-material controls, like semiconductor export restrictions, are contributing to a durable segmentation of technological ecosystems, in which interdependence persists but is increasingly governed through jurisdiction-specific regulatory regimes rather than open markets.

⁶¹ “U.S. And China Tighten Respective Export Restrictions on Advanced Technology and Critical Minerals,” *Eversheds Sutherland*, January 10, 2025, <https://www.eversheds-sutherland.com/en/united-states/insights/us-and-china-tighten-respective-export-restrictions-on-advanced-technology-and-critical-minerals>.

Figure 4. Key Chinese Retaliation Against U.S. Semiconductor Export Control, 2023–2025⁶³

Date	Target / Material	Policy Instrument	Measure Description	Structural / Strategic Effect
July 3, 2023	Gallium & Germanium	Export licensing requirement (MOFCOM & GAC)	China introduced export licensing for gallium and germanium products, citing national security concerns.	First post-U.S. chip controls move; converts upstream materials into regulatory choke-points for semiconductors, RF, and defense tech.
Dec 1, 2023	Graphite (natural & synthetic)	Export licensing requirement	Licensing imposed on certain graphite products used in EV batteries and anodes.	Extends chokepoint logic into energy-tech inputs , signaling breadth beyond semiconductors.
Dec 3, 2024	Gallium, Germanium, Antimony, Super-hard materials (to US)	De facto export ban + heightened review	China announced it would prohibit exports of certain critical minerals and materials to the United States.	Targeted retaliation ; politicizes destination-specific access and mirrors U.S. country-specific denial logic.
Apr 4, 2025	Medium & Heavy Rare Earth Elements	Export licensing requirement	Licensing expanded to rare earths with high military and manufacturing relevance.	Reinforces China's leverage in processing-intensive segments , not just mining.
Sep 25, 2025	Foreign firms (dual-use list)	Dual-use export control listing	Three U.S. firms added to China's dual-use export control list.	Firm-level chokepoint construction; functional analogue to U.S. Entity List practice.
Oct 9, 2025	Rare-earth processing, magnet & recycling technologies	Export licensing requirement	Controls extended to rare-earth processing and magnet manufacturing technologies.	Locks in dominance at processing and standards layers , not merely material supply.
Oct 9, 2025	Foreign-made products containing Chinese rare-earth content	Extraterritorial licensing requirement	Licensing applies to exports of products containing $\geq 0.1\%$ Chinese rare-earth value.	Extraterritorial reach : transforms Chinese materials into global compliance chokepoints.
Nov 8, 2025 (effective)	Artificial graphite & lithium-ion battery components	Export licensing requirement	Licensing on anode materials, batteries, and related equipment.	Institutionalizes segmentation in EV and storage ecosystems.

⁶³ Compiled by the author from the Global Trade Alert *Chinese export controls on critical raw materials: inventory*, official announcements by China's Ministry of Commerce (MOFCOM) and General Administration of Customs (GAC), Chinese export-control catalogues and dual-use control lists, and contemporaneous reporting by *Reuters*, *Bloomberg*, and *the Financial Times*, 2023–2025.

Conclusion

This paper has argued that the breakdown of U.S.–China technological engagement is best understood not as a political rupture or ideological reversal, but as the structural consequence of how advanced technologies are organized within global production networks. In sectors such as semiconductors—characterized by cumulative innovation, limited substitutability, dual-use applications, and jurisdictional concentration—interdependence does not merely generate mutual gains. It allocates leverage asymmetrically.

Tracing asymmetrical interactions between U.S. chokepoint activation and China's adaptive responses demonstrate that decoupling is an endogenous process rather than an exogenous policy choice. U.S. export controls initially succeeded in disrupting Chinese firms and delaying access to frontier capabilities, but they also triggered China's defensive reconfiguration through indigenous substitution, market reorientation, and regulatory insulation. Learning from the Western model, China also constructed counter-chokepoints in upstream materials and standards. These responses, in turn, reinforced U.S. perceptions of vulnerability and justified further tightening of controls. What emerges is a feedback loop in which each side's measures validate the other's threat assessments, producing a new form of security dilemma rooted not in military deployments, but in the governance of technological interdependence itself.

The implications of this analysis extend beyond semiconductors. As previously stated, interdependence did not disappear; it is being selectively restructured. Recognizing this dynamic is essential for both scholars and policymakers. Analytically, it suggests that debates over “decoupling” should shift from questions of intent to questions of structure. Politically, it underscores the limits of chokepoint strategies: while they may yield short-term leverage, they also accelerate adaptive responses that entrench segmentation over time. In this sense, technological decoupling is not a transient phase of rivalry, but a durable condition of contemporary globalization.

Building on these findings, several avenues for future research merit a more systematic exploration. First, a more sustained engagement with the history of technological interdependence would deepen our understanding of contemporary policy choices. In particular, further work could trace how earlier episodes of China's technology transfer or state-led industrialization, briefly discussed in this paper, shaped both present vulnerabilities and current political standpoint. Second, future research would benefit from incorporating quantitative analyses of technological and trade data generated by activities outlined in this paper (e.g. export controls, retaliatory measures, market substitution). Such data could shed light on the detailed process of reorienting supply chains, identifying alternative markets, and

engaging with new regions for technological innovations. Finally, although this paper focused on semiconductors as a paradigmatic site of technological competition, the analytical framework developed here is applicable to other strategic sectors, including renewable energy technologies, electric vehicles, and AI-enabled networks. Comparative analysis across these domains would allow for a more comprehensive assessment of how structural interdependence shapes the evolving contours of “great-power competition.”

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