Strategic Trade, Industrial Power, and Geopolitical Rivalry: A Two-Country Differential Game of the U.S.–China Conflict

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Abstract

This paper develops a dynamic two-country differential game model to examine the long-term economic and geopolitical implications of the trade war between the United States and China. Departing from classical comparative advantage theory, the model incorporates national preferences for industrial self-sufficiency, trade balance, and strategic power accumulation. Each country is represented as a national agent optimizing intertemporal welfare based on consumption, production, trade, and geopolitical rivalry. Endogenous capital accumulation, productivity growth through learning-by-doing, and disutility from foreign dependence are central to the analysis. Strategic power is derived from both capital stock and trade surpluses, reflecting their role in underwriting technological leadership and military influence. Through simulations, we demonstrate how persistent trade surpluses allow China to accumulate strategic advantage, while sustained U.S. deficits weaken industrial capacity and global leverage. The framework challenges the orthodoxy of free trade and provides a basis for evaluating nationalist economic strategies and decoupling policies in a multipolar world.

Keywords: Trade war; U.S.–China rivalry; differential game; capital accumulation; strategic power; tariffs; industrial policy; geopolitical economy; learning-by-doing; reindustrialization; dynamic optimization; economic nationalism.

1 Introduction

The return of great power competition between the United States and China is reshaping the foundations of global economic governance. No longer confined to military alliances or ideological blocs, the contemporary U.S.–China rivalry unfolds along interlinked economic, technological, and geopolitical dimensions. At its core lies a deepening divergence in political economy: a liberal-democratic system built on market openness and private innovation versus a party-state model combining authoritarian governance with national industrial planning.

This clash has revived state-centered strategies—industrial policy, trade protection, and technological decoupling—as core instruments of national power. The global economic order, once governed by assumptions of convergence and interdependence, is now being restructured by a new Cold War logic.

This paper builds a formal dynamic framework to study the strategic interaction between the United States and China as they engage in sustained economic and geopolitical rivalry. Moving beyond standard trade theory, we model both nations as forward-looking agents optimizing national objectives that include not just consumption and production, but also capital accumulation, technological upgrading, and strategic power. Our approach integrates historical traditions of economic realism with modern techniques in dynamic optimization and game theory. The key contribution is to develop and solve a two-country differential game that captures how asymmetric development paths, trade surpluses, and national policies feed back into long-term relative power.

The theory of comparative advantage, as formalized by David Ricardo (1817), has long served as the intellectual foundation for the global consensus on free trade. Its central proposition—that all nations benefit by specializing according to relative efficiency and exchanging goods internationally—has been celebrated as both theoretically elegant and empirically robust. Economists such as Paul Samuelson (1948) and Paul Krugman (1993, 1996) have extolled its explanatory power, asserting it as the only proposition in the social sciences that is simultaneously true and non-trivial. Milton Friedman (1980) famously claimed that economists have spoken with "almost one voice" in favor of free trade for over two centuries. The doctrine's influence permeates not only economic pedagogy but also policymaking, as evidenced in the post–Cold War bipartisan push for liberalization through NAFTA, the WTO, and permanent normalized trade with China (Solow, 2000).

Yet this nearly universal consensus has come under increasing scrutiny. The dynamic failures of free trade—chronic trade deficits, deindustrialization, the erosion of innovation capacity, and rising foreign ownership of national assets—have prompted renewed interest in older traditions of political economy that emphasized productive self-reliance, industrial policy, and strategic autonomy. Cass (2023) offers a comprehensive critique of this intellectual orthodoxy, arguing that modern economists have overlooked or ignored the structural assumptions embedded in Ricardo's model: capital immobility, full employment, and the exchange of goods for goods. When these assumptions break down, as they have in a globalized economy with fluid capital markets and chronic underemployment, comparative advantage no longer guarantees mutual benefit. Instead, it often facilitates the hollowing out of domestic industry and long-term economic dependence.

Historically, American economic thought was not built on Ricardian foundations, but on a mercantilist-industrial strategy promoted by statesmen such as Alexander Hamilton, Henry Clay, and Abraham Lincoln. This "American System" treated production as a civic virtue and a strategic necessity, prioritizing manufacturing, innovation, and national independence (Marshall, 1920). Henry Charles Carey, one of Lincoln's key advisors, rejected British free trade as a geopolitical weapon designed to preserve industrial hegemony, and called instead for tariff protection to nurture domestic capability. Even John Maynard Keynes (1982), writing in the interwar period, confessed: "I am no longer a free trader," recognizing that full national specialization left countries dangerously exposed.

Theoretical models that incorporate these insights remain rare. One of the most significant contributions is provided by Zou (1997), who formalized the Vinerian view of mercantilism into a dynamic optimization framework. Zou's model demonstrates how national welfare can be improved by strategically limiting imports and incentivizing domestic production, particularly when there are intertemporal returns to capital accumulation and endogenous growth. Similarly, Rodrik (1997) has emphasized the dangers of globalization-induced dislocation, while McCulloch (1993) has critiqued the unscientific faith in free trade that often masquerades as economic objectivity.

The rise of the United States in the 19th and early 20th centuries, as shown by Hamilton (1791), List (1841), and Irwin (2017), was built on high tariffs, domestic capacity building, and targeted state intervention. From Lincoln's wartime industrial policies to Roosevelt's defense mobilization, national strength emerged through protectionist and developmental strategies. Likewise, China's ascent has relied on mercantilist tools: undervalued exchange rates, joint ventures with forced technology transfer, and massive state subsidies in strategic sectors (Chen & Wu, 2020; Zhou, 2021). As Friedberg (2022, 2025), Mastro (2025), and Gertz (2024) show, these strategies are now being hardened into comprehensive national doctrines—blending economics with national security in a new form of geoeconomic statecraft.

Section 2 situates the present conflict in historical and strategic context. We review how the post–Cold War liberal consensus gave way to growing U.S. concern over trade imbalances, technological dependence, and military vulnerabilities. Drawing on recent scholarship (Brooks and Wohlforth, 2023; Kendall-Taylor and Frantz, 2024; Shirk, 2022), we highlight how both nations now perceive trade and investment flows not merely as economic exchanges but as components of a broader contest for power and autonomy. In this context, strategic decoupling, dual-use technology controls, and industrial reshoring have become policy norms.

Section 3 presents the formal two-country model. We specify utility functions that capture national preferences over consumption, domestic production, trade balance, and strategic capability. Output is determined by endogenous capital accumulation, productivity growth, and policy-influenced distortions such as tariffs. Each country plays a dynamic intertemporal game, internalizing the future consequences of trade exposure and production specialization. Trade surpluses serve as enablers of strategic leverage, while deficits erode autonomy.

Section 4 derives the dynamic Nash equilibrium paths. We solve the Hamilton-Jacobi-Bellman equations governing each country's optimal controls and characterize steady-state outcomes under various structural parameters. The analysis reveals critical thresholds where trade asymmetries begin to translate into irreversible strategic divergence.

Section 5 presents simulation results. Calibrated to realistic parameter values drawn from recent empirical studies (Autor et al., 2023; Lardy, 2024; Hausmann and Hidalgo, 2023), our simulations show how sustained trade imbalances compound over time to reshape productivity, output shares, and relative power. We examine both symmetric and asymmetric scenarios—comparing free trade baselines with protectionist or mercantilist policies—and trace the impact of technology transfer, capital dynamics, and tariff regimes.

Section 6 interprets the strategic and policy implications. We assess the effectiveness of reindustrialization, export controls, and decoupling strategies in restoring national strength. Drawing on policy debates (Cass, 2023; Rudd, 2022; Baldwin, 2024), we evaluate how optimal trade policy must balance short-term economic costs with long-run strategic goals. Our model clarifies when tariffs and subsidies can serve as rational tools in an era of contested globalization.

Section 7 concludes by outlining directions for future research, including the modeling of endogenous conflict risk, multi-country coalitions, and feedbacks between political institutions and trade strategies. As the U.S.–China rivalry shapes the architecture of 21st-century globalization, understanding the dynamic and strategic structure of trade policy is no longer a theoretical luxury—it is a geopolitical imperative.

2 The U.S.–China Cold War: Strategic Rivalry Across Trade, Technology, and Military Domains

The strategic rivalry between the United States and China has evolved into a multifaceted cold war, encompassing trade disputes, technological competition, and military posturing. This section provides an overview of the current state of affairs in these domains.

2.1 Trade War and Economic Decoupling

The contemporary trade war between the United States and China marks a historic rupture in the postwar liberal economic order. What began as a dispute over bilateral trade imbalances has evolved into a structural decoupling of two globally interdependent economic superpowers. The clash now encompasses not only tariffs and trade barriers but also industrial policy, financial capital flows, and national security imperatives. While economic globalization has been the prevailing trend of the past four decades, the U.S.–China conflict signifies the onset of an era defined by fragmentation, realignment of production chains, and the reassertion of state sovereignty over markets.

The genesis of this trade confrontation can be traced to long-standing grievances over China's industrial practices, including state subsidies, forced technology transfers, intellectual property violations, and currency manipulation. The U.S., long committed to multilateralism and free trade, began reversing course during the Trump administration by imposing tariffs on $370 billion worth of Chinese goods. Though the Biden administration initially adopted a more measured tone, it retained most of these tariffs and later reinforced them amid rising geopolitical tensions. The election of a second Trump administration in 2024 reignited aggressive trade measures, which were rhetorically framed not just in economic terms but also as part of a broader civilizational contest between democratic capitalism and authoritarian mercantilism.

Recent developments in 2025 have sharpened this trajectory. In May 2025, a temporary tariff de-escalation agreement was signed in Geneva, in which the U.S. reduced tariffs on Chinese goods from an average of 145% to 30%, while China lowered its duties from 125% to 10%. The accord was widely interpreted as a pragmatic pause rather than a genuine reconciliation, as both sides remained entrenched in their strategic postures. Within weeks, accusations arose from Washington that Beijing had failed to expedite export licenses for critical rare earth elements, thereby undermining the spirit of the agreement. Beijing countered that its policies were globally uniform and non-discriminatory, denying any specific retaliation against the United States.

The collapse of this temporary truce was swift. The U.S. responded by reinstating punitive tariffs and imposing new restrictions on Chinese technology firms, particularly in AI, quantum computing, and telecommunications. The Office of the United States Trade Representative (USTR) cited "systemic distortions created by China's party-state capitalism" as justification. In retaliation, China expanded its unreliable entity list, blacklisted U.S. defense and semiconductor firms, and significantly curtailed its imports of U.S. agricultural and energy products. Notably, China reduced its crude oil purchases from American exporters by more than 90%, signaling a strategic effort to undermine U.S. energy dominance in global markets.

The economic toll of this protracted decoupling has been extensive and asymmetric. On the U.S. side, manufacturing sectors reliant on Chinese inputs—such as electronics, toys, and textiles—have experienced significant cost pressures, resulting in price inflation and supply chain bottlenecks. Despite efforts to "reshore" production, many American firms struggle to find cost-competitive alternatives, particularly in labor-intensive industries. According to a June 2025 Wall Street Journal report, the toy industry in the U.S. now faces higher production costs and thinner margins, with some brands raising retail prices by over 30%.

China, in turn, has doubled down on its "dual circulation" strategy, an economic doctrine unveiled in 2020 that prioritizes domestic self-sufficiency while maintaining select global export channels. Beijing's policy pivot has included massive subsidies to its semiconductor, aerospace, and electric vehicle sectors, as well as tax incentives for firms relocating production out of politically sensitive markets. China's aim is to reduce exposure to external coercion while preserving its leverage over critical global supply chains. Furthermore, Beijing continues to promote yuan-based trade settlements and regional financial arrangements to lessen its reliance on the U.S. dollar.

Financial decoupling is also underway. In 2025, several U.S. state-level pension funds, under political pressure, divested from Chinese equities and launched "China-free" index funds. Vanguard's new ex-China ETF, launched in March 2025, quickly attracted over $12 billion in assets. Meanwhile, China has restricted listings of its high-tech firms on U.S. exchanges and encouraged domestic IPOs on the STAR Market and the Hong Kong Stock Exchange. The bifurcation of capital markets reflects a deeper disarticulation of financial ecosystems, with strategic implications for corporate valuation, currency stability, and global investor behavior.

Behind these economic maneuvers lies a deepening geopolitical estrangement. American strategists increasingly view economic entanglement with China as a vector of vulnerability, particularly in sectors related to national security and critical infrastructure. In parallel, China perceives Western decoupling efforts as part of a broader containment strategy. This mutual suspicion drives policy choices that would have once been deemed uneconomic—from redundant supply chains to strategic stockpiles and export bans on dual-use technologies.

2.2 Technological Competition and Export Controls

The technological rivalry between the United States and China has emerged as a central axis of the broader Cold War–like confrontation between the two powers. While the earlier stages of this geopolitical competition were defined primarily by trade imbalances and tariffs, the locus of conflict has shifted to high technology—particularly semiconductors, artificial intelligence (AI), quantum computing, aerospace, and dual-use technologies with both commercial and military applications. The fundamental recognition shared by both sides is that supremacy in cutting-edge technologies is not only an engine of future economic growth but a critical determinant of national security, global influence, and strategic autonomy. Consequently, both the United States and China have embedded technological strategy at the core of their long-term national development plans, and are now locked in a zero-sum competition over control of key innovation ecosystems and supply chains.

The United States, under both Republican and Democratic administrations, has adopted a comprehensive approach to curb China's access to foundational technologies. Beginning with limited export restrictions in the late 2010s, U.S. policy has evolved into a coherent framework of "tech denial" aimed at preserving American strategic advantage. The most consequential move came in October 2022, when the Bureau of Industry and Security (BIS) issued sweeping rules that severely restricted China's access to advanced semiconductor chips, chip-making tools, and supercomputing components. These restrictions were justified on national security grounds, as the U.S. government argued that Chinese entities were repurposing advanced technologies for military modernization, surveillance, and repression. In addition to targeting Chinese firms directly, the Biden administration expanded the Foreign Direct Product Rule (FDPR) to prevent foreign firms—such as TSMC in Taiwan or ASML in the Netherlands—from selling to China any advanced chips or equipment that incorporated U.S. technology, thereby weaponizing America's chokepoint position in the global tech stack.

In response to these escalating restrictions, China has intensified its pursuit of technological self-sufficiency. The Chinese state has doubled down on the goals of the "Made in China 2025" plan and issued national security–oriented industrial policies that emphasize indigenous innovation, domestic substitution, and state-directed investment. In 2023, Beijing launched the third phase of its National Integrated Circuit Industry Investment Fund, capitalized at over 300 billion yuan (approximately $47.5 billion), to accelerate the development of a homegrown semiconductor industry. Concurrently, Chinese firms such as Huawei, SMIC, and Biren have redirected research and development resources into designing AI chips and developing domestic lithography capabilities. While China remains heavily dependent on foreign semiconductor equipment and EDA (electronic design automation) tools, it is rapidly expanding its ability to manufacture older-generation chips at scale and is investing in alternative architectures to bypass Western restrictions.

This technological arms race is not limited to semiconductors. The U.S. has begun regulating exports of quantum computing components, advanced AI models, hypersonic technologies, and critical data infrastructures. In parallel, China has responded with its own export controls, notably placing restrictions on the export of rare earth elements, gallium, and germanium—critical inputs for electronics, clean energy, and defense manufacturing. These tit-for-tat controls underscore the strategic interdependence of the two economies and the fragility of global technological supply chains. Moreover, the U.S. has sought to rally its allies into a coordinated tech denial strategy—sometimes referred to as the "Chip 4" alliance, involving the United States, Japan, South Korea, and Taiwan. This coalition is aimed at reinforcing semiconductor supply chain resilience while limiting China's access to advanced tooling and know-how.

The economic and geopolitical consequences of this technological bifurcation are profound. On one level, the division of global technology ecosystems into U.S.-led and China-led spheres threatens to reduce global efficiency, accelerate inflationary pressures, and stifle cross-border innovation. On another level, the emergence of two distinct standards and architectures—ranging from 5G networks to operating systems and cloud infrastructure—heralds a techno-political Cold War with its own rules and alliances. Many countries in the Global South, Southeast Asia, and the Middle East find themselves caught between these systems, navigating a complex landscape of strategic alignment, technological dependency, and geopolitical coercion.

2.3 Rare Earth Elements and Strategic Resources

The geopolitical confrontation between the United States and the People's Republic of China has increasingly centered on the control and weaponization of strategic resources, particularly rare earth elements (REEs). These 17 chemically similar elements—including neodymium, dysprosium, terbium, and samarium—are indispensable to the manufacturing of high-performance magnets, precision-guided munitions, electric vehicle motors, wind turbines, radar systems, and advanced electronics. As such, REEs have become not just economic inputs, but instruments of national power. In this context, China's dominance in rare earth mining, processing, and export infrastructure constitutes a formidable source of global leverage, and recent moves to restrict exports have turned these materials into geopolitical bargaining chips in the evolving U.S.–China Cold War.

As of 2025, China controls over 60% of global REE mining output and more than 85% of global processing capacity. This near-monopoly is the result of decades of strategic investment, state subsidies, and environmental tolerance, which allowed Chinese firms to undercut international competitors and consolidate control over every stage of the rare earth supply chain. In contrast, the United States—despite once being a leading rare earth producer—allowed its domestic industry to atrophy due to a combination of market liberalism, regulatory costs, and geopolitical complacency. This structural asymmetry now leaves Washington vulnerable to Beijing's coercive potential, especially as the technological competition intensifies across defense and clean energy sectors.

Recent developments have made the strategic implications of this imbalance starkly visible. In April 2025, the Chinese Ministry of Commerce and the Ministry of Industry and Information Technology jointly implemented a new export licensing regime for certain high-value REEs, including dysprosium and terbium, which are essential for thermal-resistant magnets used in military aircraft and missile guidance systems. While the official justification was "national security," many analysts see this as a calibrated response to escalating American export restrictions on semiconductors and military-grade AI components. Under the new regime, Chinese exporters must secure government licenses to sell these rare earths abroad, a process that remains bureaucratically opaque and politically selective. Though a small number of licenses have been granted—primarily to companies in countries with which China seeks diplomatic goodwill—the overall effect has been to curtail Western supply, delay deliveries, and force production slowdowns in downstream industries.

The consequences for the United States have been immediate and alarming. Manufacturers of electric vehicles, solar inverters, and defense systems report significant disruptions. General Motors and Lockheed Martin, for example, have announced production delays due to shortages of REE-based components. In response, the U.S. Department of Defense has invoked the Defense Production Act to accelerate domestic rare earth extraction, while also entering into strategic agreements with mining firms to localize magnet manufacturing. MP Materials, operator of the Mountain Pass mine in California, has received new federal grants to expand its refining capabilities. Similarly, USA Rare Earth is building a large-scale magnet plant in Stillwater, Oklahoma, which is expected to produce enough neodymium-iron-boron (NdFeB) magnets to supply a substantial share of domestic demand. However, these facilities are not yet operational at scale, and even when they are, the U.S. remains dependent on foreign sources for many intermediate processing steps.

Recognizing the long-term vulnerability posed by rare earth dependence, the Biden and Trump administrations—despite their political differences—have both prioritized the reshoring of strategic mineral supply chains. Beyond domestic initiatives, the U.S. has deepened partnerships with allies such as Australia and Canada to develop new rare earth projects. Australian firms like Lynas Rare Earths have begun constructing separation plants in Texas, backed by Pentagon funding. The Quadrilateral Security Dialogue (Quad) has also included REE resilience in its agenda, with India and Japan pledging cooperation on supply diversification. Meanwhile, the European Union has adopted the Critical Raw Materials Act, which aims to reduce the bloc's reliance on China by investing in local and African resource extraction, processing, and recycling.

Still, the effort to challenge China's dominance faces serious obstacles. Rare earth mining is environmentally destructive and politically contentious, making it difficult to secure permits in democratic societies. More importantly, the rare earth supply chain is not just about raw extraction—it is also about know-how, technological refinement, and economies of scale in processing. China's decades-long head start in metallurgical engineering and REE magnet fabrication cannot be easily undone. Western firms, having ceded this ground for so long, now face high startup costs, labor shortages, and steep learning curves.

Furthermore, Beijing is not standing still. In June 2025, China introduced a digital tracking system for all rare earth exports, requiring exporters to provide end-use certificates and transaction histories. While justified as a transparency mechanism, many experts interpret it as a prelude to selective embargoes. Strategic ambiguity in the licensing process allows China to reward allies and punish rivals, thus transforming rare earths into tools of economic statecraft.

2.4 Military Posturing and Strategic Competition

By 2025, the strategic rivalry between the United States and China has solidified into an enduring Cold War–like confrontation, particularly within the military domain. The Indo-Pacific region has emerged as the epicenter of this competition, where both great powers increasingly engage in aggressive signaling, power projection, and military posturing that extend far beyond traditional deterrence. At the heart of this tension is the status of Taiwan, a flashpoint that encapsulates ideological divergence, strategic interests, and symbolic sovereignty. The People's Liberation Army (PLA) has dramatically expanded its military exercises around Taiwan, simulating invasion scenarios, blockade operations, and precision strike missions aimed at neutralizing key defensive and political infrastructure. For example, in April 2025, the PLA deployed its aircraft carrier Shandong, escorted by 21 warships and 71 fighter aircraft, in a week-long exercise that rehearsed a full encirclement of Taiwan and demonstrated sea-air integration capabilities. These maneuvers, increasingly routine in frequency and scale, are widely perceived as credible rehearsals for an eventual military campaign—should diplomatic or coercive means fail to bring about reunification on Beijing's terms. In response, Taiwan's Ministry of National Defense has elevated its readiness level and requested enhanced bilateral cooperation with the U.S. and Japan.

The United States, alarmed by China's growing capabilities and strategic assertiveness, has significantly expanded its military footprint across East Asia. In a coordinated demonstration of power and alliance solidarity, the U.S. Air Force in early 2025 staged its largest-ever "elephant walk" at Kadena Air Base in Okinawa, showcasing over fifty advanced aircraft including F-35A stealth fighters, KC-135 refueling tankers, and MQ-9 Reaper drones. This symbolic but operationally relevant maneuver illustrated America's readiness to defend its regional interests and partners. Additionally, the 2025 Balikatan joint exercises with the Philippines featured the deployment of the Navy Marine Expeditionary Ship Interdiction System (NMESIS), a mobile missile launcher designed for littoral sea-denial missions against potential Chinese naval incursions. The reactivation of key U.S. military installations in the Philippines, such as Subic Bay and Basa Air Base, further underscores Washington's determination to reconstitute Cold War–era perimeter defense networks. These developments represent more than mere deterrence; they are part of a larger Indo-Pacific strategy to counterbalance China's "anti-access/area-denial" (A2/AD) capabilities, especially its extensive deployment of DF-series ballistic and cruise missiles.

The technological dimension of this military competition has accelerated dramatically, particularly in missile systems, space capabilities, and artificial intelligence. China's PLA Rocket Force now boasts the world's largest arsenal of land-based missiles, including the DF-17 hypersonic glide vehicle and DF-21D "carrier killer," posing direct challenges to U.S. forward-deployed forces. Meanwhile, the U.S. Indo-Pacific Command has fast-tracked counter-hypersonic and AI-enabled decision support systems under its Joint All-Domain Command and Control (JADC2) architecture. Both nations are investing heavily in AI-driven targeting, unmanned systems, cyber warfare, and electromagnetic spectrum dominance. China's 2025 Defense White Paper openly identifies "intelligentized warfare" as the future of military operations, prioritizing autonomous swarm drones, robotic logistics, and decision-speed asymmetries as core strategic advantages. For its part, the U.S. Department of Defense has declared AI and quantum superiority as top-tier priorities for defense modernization. These moves reflect not only a race for kinetic superiority but also a contest over which system can command and integrate vast volumes of data faster and more decisively in crisis or conflict.

Despite intermittent diplomatic engagements, including dialogues in Geneva, Singapore, and Jakarta, attempts at strategic risk reduction have yielded little success. At the 2025 Shangri-La Dialogue, U.S. Defense Secretary Pete Hegseth issued a stark warning that any Chinese attempt to seize Taiwan would trigger "devastating consequences," while reaffirming the U.S. commitment to Indo-Pacific allies. China condemned these statements as hostile provocations emblematic of a "Cold War mentality," accusing Washington of militarizing the region and interfering in its internal affairs. The strategic distrust between the two sides remains entrenched, exacerbated by mutual suspicion of intentions, conflicting views on sovereignty, and incompatible visions of global order. Moreover, China's recent live-fire naval exercises in the Tasman Sea—conducted within Australia's Exclusive Economic Zone without prior notification—have alarmed regional states and signaled Beijing's growing willingness to project military power far beyond the First Island Chain.

2.5 Diplomatic Engagements and Strategic Dialogues

Despite the intensifying strategic rivalry between the United States and China, diplomatic channels remain cautiously open, driven by the recognition on both sides that unmanaged confrontation could escalate into economic disruption or even military miscalculation. Since the resurgence of Cold War dynamics, both countries have navigated a volatile mix of confrontation and dialogue. These engagements are not merely ceremonial; they serve as crucial mechanisms to reduce uncertainty, deconflict military operations, negotiate trade terms, and establish red lines in domains ranging from artificial intelligence and rare earth exports to Taiwan and the South China Sea. Yet, the persistent asymmetry in strategic objectives—China's push for regional hegemony versus America's commitment to preserve the liberal international order—continues to cast a long shadow over these dialogues.

A pivotal moment occurred on June 5, 2025, when U.S. President Donald Trump and Chinese President Xi Jinping held a long-anticipated phone call—their first direct communication since Trump's reelection. The call, lasting over 90 minutes, was widely interpreted as a recalibration of bilateral ties following months of tariff hikes, sanctions, and mutual recriminations. According to official White House sources, the discussion touched on multiple contentious issues, including the stalling of rare earth exports from China, military exercises near Taiwan, and the continuation of visa bans for students and researchers. President Trump described the conversation as "very positive," expressing optimism about a new round of negotiations. In turn, President Xi emphasized China's adherence to the Geneva framework and accused the U.S. of violating earlier trade promises through its latest round of technology export bans and security blacklisting of Chinese firms.

This diplomatic thaw set the stage for a new series of high-level trade talks, scheduled to begin on June 9, 2025, in London. The U.S. delegation is expected to include Treasury Secretary Scott Bessent, Commerce Secretary Howard Lutnick, and Trade Representative Jamieson Greer, all prominent economic nationalists from Trump's inner circle. On the Chinese side, Vice Premier He Lifeng is presumed to lead the delegation, though Beijing has remained guarded about the precise composition of its negotiating team. Unlike earlier rounds of dialogue held under the Biden administration, which focused on climate cooperation and public health, the London talks are explicitly centered on trade rebalancing, the resumption of rare earth exports, and the resolution of new tariff regimes. The U.S. currently maintains a 30% tariff on most Chinese imports, while China imposes a 10% tariff on key American goods, including semiconductors, energy equipment, and agricultural products.

A critical issue on the agenda is China's suspension of rare earth exports—a move that has been interpreted in Washington as a form of strategic retaliation. Although Chinese authorities argue that the suspension reflects a broader regulatory overhaul aimed at standardizing global supply chains, U.S. officials see it as a targeted act of economic coercion. Rare earth elements, vital for advanced defense systems, clean energy technologies, and consumer electronics, have become a central pressure point in the new Cold War. Trump's administration has accused China of using these materials as a geopolitical lever, much as it previously wielded its control over global PPE supplies during the early days of COVID-19. In the London talks, the U.S. is expected to demand not only the restoration of rare earth flows but also greater transparency in China's export license process, which American officials say has become "politicized and opaque."

Beyond trade, the two governments are also reviving dormant strategic and military dialogues. On May 27, 2025, U.S. Defense Secretary Charles Flynn and Chinese Defense Minister Dong Jun held their first in-person meeting in Singapore during the Shangri-La Dialogue. While their handshake was symbolic, the agenda was substantive. Discussions covered protocols for naval encounters in the South China Sea, deconfliction procedures for hypersonic weapons testing, and cyber intrusion allegations. Although no breakthroughs were announced, both sides agreed to re-establish the Military Maritime Consultative Agreement (MMCA) mechanism, which had been dormant since 2020. Such military-to-military dialogues are crucial in reducing the risks of unintended escalation, especially as both navies operate in close proximity around Taiwan and the Strait of Malacca.

Educational, cultural, and people-to-people exchanges have also emerged as points of contention and diplomacy. In recent years, visa policies have become tools of reciprocal punishment. Under Trump's return to office, the U.S. has further restricted STEM-related student visas for Chinese nationals, citing national security risks. In retaliation, China has tightened exit permissions for its own scholars and imposed new ideological vetting standards for foreign collaborations. However, during the June 5 phone call, Xi reportedly raised concerns about the impact of these restrictions on long-term bilateral understanding and soft power exchange. Trump, in a surprising shift of tone, signaled willingness to ease some academic barriers, stating that "Chinese students are welcome in America, provided they do not steal secrets." This signals that while security concerns dominate policy, selective reopening remains possible.

These diplomatic interactions should not be mistaken for détente. They instead represent a tactical management of a broader confrontation. Both sides are simultaneously engaging and hedging, seeking to avoid open conflict while continuing to press for advantage in strategic sectors. Diplomacy, in this context, is not a route to resolution but a tool for competitive statecraft—buying time, managing narratives, and projecting resolve. What distinguishes the 2025 round of engagements from prior eras is the collapse of the "constructive engagement" paradigm. No side believes the other will change fundamentally. Thus, each seeks to shape the competitive environment within which their rivalry unfolds.

In this evolving Cold War II landscape, diplomacy will remain essential—but not as a harbinger of reconciliation. Rather, it will serve as a controlled release valve, a means of stabilizing volatility within a fundamentally adversarial system. Whether the London negotiations yield substantive economic breakthroughs remains to be seen, but their very occurrence underscores a shared imperative: to prevent Cold War from becoming Hot War. The coming months will reveal whether tactical pragmatism can restrain ideological divergence—or whether the logic of rivalry will overwhelm the logic of diplomacy.

The escalating rivalry between the United States and China spans economic, technological, and military domains, closely resembling a modern-day Cold War. Subsections 2.1 to 2.5 detailed the unfolding trade war, the severance of technological ties, and the increasing strategic militarization across both nations. The trade war, initiated with tariff escalations and retaliatory duties, evolved into a broader process of economic decoupling as both nations sought to reduce interdependence and regain industrial sovereignty. In tandem, the technology conflict intensified through American export controls on AI chips and semiconductor manufacturing tools, aimed at curbing China's tech-military fusion. Beijing's counters include restrictions on rare minerals critical to high-tech supply chains and major investments in domestic tech ecosystems. These economic confrontations are undergirded by an asymmetric dependence on rare earths and strategic resources—domains where China holds structural advantages—thereby exposing Western vulnerabilities and making trade imbalances more than a macroeconomic concern. Military posturing further reinforces the strategic nature of this conflict, with U.S. Indo-Pacific deployments and Chinese maneuvers near Taiwan signaling heightened risks of confrontation. Despite high-level diplomatic exchanges and summits, the strategic distrust has deepened, rendering diplomacy a tool for managing—not eliminating—rivalry.

3 Two-Country Model Setup

We develop a continuous-time, dynamic model of two strategically interacting countries—the United States and China—each represented as a unified national agent that internalizes economic and geopolitical objectives over an infinite time horizon. The core motivation is to understand how persistent trade asymmetries, industrial divergence, and geopolitical rivalry emerge from endogenous intertemporal dynamics shaped by capital accumulation, trade flows, and government-imposed trade policy instruments such as tariffs. While the optimizing entity in each country is modeled as a representative agent—capturing the aggregate national interest—the structure allows for fixed, exogenously determined tariffs that reflect broader government policy rather than private utility maximization. The model captures the core tensions in the current U.S.–China strategic conflict: industrial concentration versus deindustrialization, trade surplus versus trade deficits, and capital-led strategic empowerment versus structural economic erosion.

Let time $t \in [0, \infty)$ denote the continuous flow of global time, and let $i \in \{U, C\}$ denote the country index, with U standing for the United States and C for China. Each country engages in consumption and trade over time, represented by the time paths $C_i(t)$ for national consumption and $M_{ij}(t)$ for net bilateral imports from the trading partner $j \neq i$. We impose the trade balance identity $M_{ij}(t) = -M_{ji}(t)$, ensuring global accounting consistency: one country's surplus is the other's deficit. These flows influence national welfare, industrial vitality, and the capacity for future strategic power.

The objective of each representative country is to maximize a national welfare functional that captures not only economic satisfaction but also political disutility from dependency and anxiety over strategic asymmetry. The functional is defined as:

$$\max_{\{C_i(t), M_{ij}(t)\}} \int_0^\infty e^{-\rho_i t} \left[u(C_i(t)) - \eta_i M_{ij}(t) + \xi_i \psi(Y_i(t), K_i(t)) - \theta_i Z_j(t) \right] dt.$$

Here, the utility term $u(C_i(t))$ reflects classical economic satisfaction from national consumption. The function is assumed to be strictly increasing and concave, capturing diminishing marginal returns to aggregate consumption. The term $\eta_i M_{ij}(t)$ reflects a penalty for net imports, reflecting the nation's discomfort with excessive reliance on foreign goods. This disutility parameter $\eta_i > 0$ embodies mercantilist, nationalist, or strategic sentiments that view trade dependence as a source of economic and political risk—through hollowing out of industrial bases, technological leakage, or foreign entanglement. The third term, $\xi_i \psi(Y_i(t), K_i(t))$, contributes positively to national welfare by rewarding industrial strength. Here, $Y_i(t)$ represents output and $K_i(t)$ capital stock, and the function $\psi(\cdot)$ could be additive or multiplicative, encoding the idea that a strong industrial economy provides long-term benefits through innovation, employment, and national prestige. The final term, $-\theta_i Z_j(t)$, captures strategic rivalry: the disutility a country experiences from the rising power of its adversary. A high value of $Z_j(t)$—the geopolitical capability of the opposing country—induces concern, fear, and deterrence pressure, as it may translate into military superiority or economic coercion.

The production structure of each country follows a Cobb–Douglas functional form:

$$Y_i(t) = A_i(t) K_i(t)^{\gamma_i} L_i(t)^{1-\gamma_i}, \quad \gamma_i \in (0, 1),$$

with endogenous productivity $A_i(t)$ and effective labor $L_i(t)$ that evolve dynamically over time. Both variables capture long-run knowledge accumulation and skill formation. We assume learning-by-doing in both dimensions:

$$\dot{A}_i(t) = \lambda_i Y_i(t) - \delta_i^A A_i(t), \quad \dot{L}_i(t) = \phi_i Y_i(t) - \delta_i^L L_i(t).$$

These expressions formalize the idea that the more a country produces, the more technical know-how and labor skills it accumulates; conversely, deindustrialization results in technological decay and the atrophy of industrial capabilities. The erosion rates δ_i^A and δ_i^L represent institutional forgetting, loss of expertise, and decoupling from production networks, which are central to the fears of both the U.S. and China in the context of long-term strategic rivalry.

Capital accumulation follows a standard dynamic evolution, modified to include both trade frictions and physical depreciation:

$$\dot{K}i(t) = Y_i(t) - C_i(t) - \chi_i(Mij(t)) - \delta_i^K K_i(t).$$

The depreciation term \delta^K_i K_i(t) reflects the wear and obsolescence of capital stock. More critically, the function $\chi_i(M_{ij})$ captures both the direct and structural costs of trade. Specifically, we model:

$$\chi_i(M_{ij}) = (1 + \tau_i)M_{ij}(t) + \frac{\zeta_i}{2}M_{ij}^2(t),$$

where \tau_i \geq 0 is the tariff rate on imports imposed by government decree. Since we model the nation as a representative agent and not as a planner optimizing over trade policy instruments, tariffs are taken as given and fixed throughout. These tariffs increase the effective domestic cost of imports, reflecting nationalist or protectionist goals such as import substitution or industrial reshoring. The second term, $\frac{\zeta_i}{2}M_{ij}^2$, introduces a convex structural penalty for deepening trade dependence. As imports increase, the cost imposed on the domestic economy rises disproportionately, capturing compounding harms: crowding out of domestic firms, technological obsolescence, supply chain hollowing, and strategic exposure to geopolitical coercion. This term embodies the nonlinear effects of global economic entanglement, which are especially prominent in current discourse on semiconductor supply chains, pharmaceutical dependencies, and rare earth monopolies.

Finally, we define national power as a function of capital and trade surplus. A country's ability to influence others—militarily, technologically, diplomatically—depends on accumulated capital stock and liquidity acquired through net exports. We write:

$$Z_i(t) = \omega_i K_i(t) + \nu_i S_i(t), \quad S_i(t) = \max\{M_{ji}(t), 0\}.$$

Here, $Z_i(t)$ represents the total strategic power of country i. The term $\omega_i K_i(t)$ captures the conversion of industrial infrastructure into military and strategic assets: advanced weapons platforms, AI capability, telecommunications infrastructure, and more. The second term, $\nu_i S_i(t)$, arises from the financial strength and global leverage afforded by sustained trade surpluses. For example, China's large export surpluses allow it to accumulate U.S. Treasury bonds, exert influence through foreign investment, and finance projects under the Belt and Road Initiative. The surplus term $S_i(t)$ registers only positive trade balances; a country in deficit derives no such benefit. Thus, the function encodes a fundamental asymmetry: export surpluses contribute to power; import dependence does not.

This model encapsulates the asymmetries at the core of the current Cold War-style confrontation between the U.S. and China. China has deliberately pursued a path of export-led accumulation, capital deepening, and global infrastructure expansion, using its trade surpluses to fund strategic ambitions. The U.S., by contrast, has run persistent trade deficits, suffered deindustrialization in key regions, and become increasingly reliant on foreign production of critical goods. These macroeconomic trajectories generate corresponding divergences in strategic power and political leverage, fueling geopolitical tension. The introduction of tariffs, export controls, and industrial policy measures by both countries can be viewed as efforts to realign the dynamic path of $K_i(t)$, $A_i(t)$, and ultimately $Z_i(t)$, in pursuit of strategic primacy.

4 Dynamic Nash Equilibrium Paths

To analyze the strategic trajectories of the United States and China under the two-country dynamic model described above, we now characterize the Nash equilibrium paths of consumption, trade, capital accumulation, and power. In this setting, each country chooses its control variables—national consumption $C_i(t)$ and net imports $M_{ij}(t)$—to maximize its own intertemporal welfare, taking as given the state variables and the strategies of the rival country. The result is a system of coupled Hamilton–Jacobi–Bellman (HJB) equations, governing optimal behavior in the face of rival responses. Our goal is to derive and interpret these equilibrium paths and identify the strategic consequences of different initial conditions and parameter regimes.

4.1 Value Functions and HJB Equations

In this section, we characterize the dynamic optimization problem of each country within the two-player differential game framework by formulating its corresponding Hamilton–Jacobi–Bellman (HJB) equation. This formulation offers a powerful tool for deriving each country's intertemporal decision rules over consumption and trade policy, while accounting for their evolving capital stocks, production capacity, technological progress, and the strategic behavior of the rival nation.

Let $i \in \{U, C\}$ denote the representative country—corresponding to the United States or China respectively—and $j \neq i$ its rival. Each country chooses its own consumption $C_i(t)$ and bilateral net imports $M_{ij}(t)$ to maximize an infinite-horizon intertemporal objective, subject to its own dynamic constraints and taking the rival's actions as given. The objective function reflects a weighted balance of private utility, mercantilist disutility from trade dependence, national production value, and aversion to the rival's rising strategic power.

The value function of country i, denoted $V_i(K_i, A_i, L_i, Z_j)$, represents the maximum attainable discounted utility from any point in time onward, conditional on current domestic capital K_i, productivity A_i, labor force L_i, and the rival's strategic power Z_j. The dynamic programming principle leads to the following HJB equation:

$$\rho_i V_i = \max_{C_i, M_{ij}} \left\{ u(C_i) - \eta_i M_{ij} + \xi_i \psi(Y_i, K_i) - \theta_i Z_j + V_{K_i} \cdot \dot{K}_i + V_{A_i} \cdot \dot{A}_i + V_{L_i} \cdot \dot{L}_i \right\},$$

where ρ_i is the subjective discount rate, $u(C_i)$ is a strictly concave utility function (typically $u(C_i) = \log C_i$), $\eta_i M_{ij}$ penalizes dependence on net imports, and

$\psi(Y_i, K_i)$ captures the broader value of domestic production and capital stock, including civic pride, innovation, employment, and military application. The term $\theta_i Z_j$ introduces a strategic externality: the rival's rising power reduces the utility of country i, reflecting a zero-sum perception common in great power competition.

This optimization is intertemporally constrained by a set of state dynamics. Specifically, the production function follows a Cobb–Douglas form:

$$Y_i = A_i K_i^{\gamma_i} L_i^{1-\gamma_i},$$

with productivity A_i and labor L_i themselves being state variables that evolve via learning-by-doing:

$$\dot{A}_i = \lambda_i Y_i - \delta_i^A A_i,$$
$$\dot{L}_i = \phi_i Y_i - \delta_i^L L_i.$$

These two equations capture the idea that countries accumulate technological knowledge and labor force experience through continued production, but both decay if domestic industry contracts. A surplus-oriented industrial strategy—like China's post-WTO accession trajectory—induces increasing returns over time through sustained output growth, while import-heavy countries experience industrial decline.

Capital K_i evolves according to a standard net investment equation, adjusted to incorporate trade-related costs and depreciation:

$$\dot{K}i = Y_i - C_i - \chi_i(Mij) - \delta_i^K K_i.$$

Here, the trade cost function $\chi_i(M_{ij})$ includes both financial outflows and strategic costs of dependency. Specifically:

$$\chi_i(M_{ij}) = (1 + \tau_i)M_{ij} + \frac{\zeta_i}{2} M_{ij}^2,$$

where τ_i is the tariff imposed by country i, and ζ_i measures the compounding structural harm caused by trade dependence—such as technological leakage, loss of domestic capacity, and vulnerability in supply chains. The marginal cost of trade rises with volume, as overreliance weakens long-term industrial resilience.

These dynamics imply that countries face a strategic trade-off between short-run consumption and long-run strategic autonomy. On one hand, imports provide immediate access to cheap goods and increase real consumption. On the other hand, they erode capital accumulation via the trade cost function and enhance the rival's strategic position by generating trade surpluses that fund technological or military advancements.

Moreover, strategic power Z_j evolves endogenously in response to the rival's capital and trade surpluses:

$$Z_j(t) = \omega_j K_j(t) + \nu_j \max\{M_{ij}(t), 0\},$$

which means that when country i imports from country j, it directly contributes to the power of its opponent through both economic surplus and capital accumulation. This channel is explicitly incorporated into the HJB formulation: each country must internalize the indirect cost of empowering its adversary, making the game inherently interdependent and anticipatory.

The full HJB formulation thus encodes four layers of economic-geopolitical behavior:

1. Individual utility maximization, favoring present consumption.
2. Mercantilist caution, discouraging reliance on imports.
3. Industrial strategy, promoting production and capital accumulation.
4. Geopolitical rivalry, penalizing the power rise of the rival state.

Crucially, the optimization problem faced by each country is not simply myopic or market-based. It reflects the deep-seated strategic logic of great power competition, where trade, industrial development, and security are all intertwined. This is consistent with the real-world escalation of U.S.–China conflict since 2018: tariffs, export controls, reshoring subsidies, and anti-foreign investment screening are all rationalized as ways to limit long-run strategic dependencies.

In the next subsection, we proceed to derive the first-order conditions for the control variables $C_i(t)$ and $M_{ij}(t)$, and show how these conditions yield nonlinear, state-contingent feedback rules. These optimal controls not only maximize internal objectives but also reflect the anticipation of future conflict trajectories and power divergences. The result is a complex web of dynamic strategic responses—precisely what we observe in today's economic decoupling and technological bifurcation between the United States and China.

4.2 First-Order Conditions and Reaction Functions

To derive the Nash equilibrium paths of the two-country geostrategic differential game, we proceed by characterizing the first-order conditions (FOCs) for each country's control variables: consumption $C_i(t)$ and bilateral net imports $M_{ij}(t)$. These conditions are obtained by differentiating the Hamilton–Jacobi–Bellman (HJB) equation with respect to the controls and solving the resulting static optimization problem, conditional on the dynamic state.

Let $V_i = V_i(K_i, A_i, L_i, Z_j)$ denote the value function of country i, and recall that the HJB equation is:

$$\rho_i V_i = \max_{C_i, M_{ij}} \left\{ u(C_i) - \eta_i M_{ij} + \xi_i \psi(Y_i, K_i) - \theta_i Z_j + V_{K_i} \cdot \dot{K}_i + V_{A_i} \cdot \dot{A}_i + V_{L_i} \cdot \dot{L}_i \right\}.$$

We assume logarithmic utility $u(C_i) = \log C_i$, and recall that the production function and capital dynamics are:

$$Y_i = A_i K_i^{\gamma_i} L_i^{1-\gamma_i}, \quad \dot{K}i = Y_i - C_i - (1+\tau_i)Mij - \frac{\zeta_i}{2} M_{ij}^2 - \delta_i^K K_i.$$

The optimal consumption level C_i is derived from the first-order condition:

$$\frac{\partial}{\partial C_i}\left[\log C_i + V_{K_i}(-C_i)\right] = 0,$$

which yields:

$$C_i = \frac{1}{V_{K_i}}.$$

This shows that optimal consumption is inversely related to the marginal value of capital: the more valuable capital is for future utility, the more incentive the country has to invest rather than consume today. This channel is especially important when facing an aggressive rival—greater capital accumulation today implies more strategic power tomorrow, tilting the incentive away from immediate gratification.

Next, we turn to the more strategic control variable: net imports $M_{ij}(t)$. The FOC with respect to M_{ij} is:

$$\frac{\partial}{\partial M_{ij}}\left[-\eta_i M_{ij} - V_{K_i}\left((1+\tau_i)M_{ij} + \frac{\zeta_i}{2}M_{ij}^2\right) - \theta_i \cdot \frac{dZ_j}{dM_{ij}}\right] = 0.$$

Let us now expand and interpret this condition. The derivative of the rival's strategic power Z_j with respect to imports M_{ij} is:

$$\frac{dZ_j}{dM_{ij}} = \omega_j \frac{dK_j}{dM_{ij}} + \nu_j \cdot \nVdash\{Mij < 0\}.$$

The first term arises because imports from country i add to the income (and thus capital accumulation) of country j, while the second term reflects that $M_{ij} < 0 \Rightarrow M_{ji} > 0$, i.e., a surplus for country j, which boosts their power via the ν_j coefficient.

Substituting back, we obtain:

$$-\eta_i - V_{K_i}(1+\tau_i+\zeta_i M_{ij}) - \theta_i\left(\omega_j \frac{\partial K_j}{\partial M_{ij}} + \nu_j \cdot \nVdash\{Mij < 0\}\right) = 0.$$

Solving this nonlinear equation yields the reaction function:

$$M_{ij}^* = f(K_i, A_i, L_i, Z_j, K_j),$$

which is downward-sloping in the rival's power Z_j and capital K_j, and upward-sloping in the domestic marginal value of capital V_{K_i}. This formalizes an intuitive logic: a country reduces imports as it becomes more concerned about its rival's rising power, or when its own capital is highly valuable. Conversely, trade may expand when geopolitical threat is low and capital accumulation is less urgent.

This expression defines a best response function for each country, conditional on the rival's state. Because both countries internalize each other's response paths via the dependence on Z_j and K_j, the game becomes dynamically interlocked: each side anticipates that its trade decisions empower or weaken its opponent, and adjusts its strategy accordingly.

It is crucial to observe that this reaction function contains nonlinearities and thresholds. For instance, when M_{ij} switches from positive to negative, the rival's surplus $S_j = \max\{M_{ij}, 0\}$ flips, creating a discontinuous shift in the power function Z_j. This may trigger geopolitical phase shifts, such as escalation from trade competition to broader economic decoupling, or vice versa. This is consistent with real-world events: the sharp reversal in U.S. trade posture in 2018 led to cascading policy responses, including tariffs, blacklisting of firms, and a shift from interdependence to techno-strategic competition.

In equilibrium, both countries choose their controls optimally and consistently with each other. The Nash equilibrium consists of a pair of functions $(C_i(t), M_{ij}(t))$ and $(C_j(t), M_{ji}(t))$, along with the state evolution equations, such that:

1. Each country's controls maximize its HJB,
2. State dynamics are respected,
3. Mutual best responses are satisfied at each point in time.

To find this equilibrium, one typically solves the coupled HJB system simultaneously with forward-looking state equations. In practice, numerical dynamic programming or approximation methods (e.g., value function iteration, policy iteration, projection methods) are required. In the next subsection, we discuss stability conditions, parameter sensitivity, and dynamic paths of power divergence, leading us to simulate realistic scenarios of great power competition under alternative policy regimes.

4.3 Stability Conditions and Geopolitical Divergence

Having derived the first-order conditions and reaction functions, we now turn to the stability analysis of the dynamic two-country game. The central concern is whether the intertemporal strategic interaction between the U.S. and China leads to a stable path of capital accumulation, trade flows, and power differentials, or whether the system diverges into unsustainable trajectories—marked by excessive arms races, persistent imbalances, or collapse of strategic coherence.

To investigate this, we first linearize the system around a potential stationary point. Let us denote the vector of state variables for country i by $\mathbf{X}_i(t) = \begin{bmatrix} K_i(t) & A_i(t) & L_i(t) \end{bmatrix}^\top$, and define the dynamic law of motion:

$$\dot{\mathbf{X}}_i(t) = \mathbf{F}_i(\mathbf{X}_i(t), \mathbf{X}j(t), C_i(t), Mij(t)),$$

where $\mathbf{F}_i$ encodes the capital, productivity, and labor accumulation functions as previously defined. Similarly, define the strategic power vector $\mathbf{Z}(t) = \begin{bmatrix} Z_U(t) \\ Z_C(t) \end{bmatrix}$ with:

$$Z_i(t) = \omega_i K_i(t) + \nu_i S_i(t), \quad S_i(t) = \max\{M_{ji}(t), 0\}.$$

A steady state $(\mathbf{X}_U, \mathbf{X}_C, M_{UC}, M_{CU})$ is a tuple such that $\dot{\mathbf{X}}_i = 0$ and both countries are mutually optimizing their consumption and trade given each other's behavior. Linearizing the system around this point yields a Jacobian matrix $\mathcal{J}$ whose eigenvalues determine local stability.

Formally, denote:

$$\dot{\mathbf{X}} = \mathcal{J} \cdot (\mathbf{X} - \mathbf{X}^*) + \text{higher-order terms},$$

where $\mathbf{X} \equiv [\mathbf{X}_U; \mathbf{X}_C]$. Local stability requires all eigenvalues of $\mathcal{J}$ to have strictly negative real parts.

The structure of $\mathcal{J}$ reveals the interdependence of national dynamics:

• The diagonal blocks of $\mathcal{J}$ (i.e., $\partial \dot{\mathbf{X}}_i / \partial \mathbf{X}_i$) capture the domestic feedback loops: how a country's capital, technology, and labor respond to its own levels of output, imports, and investment.

• The off-diagonal blocks (i.e., $\partial \dot{\mathbf{X}}_i / \partial \mathbf{X}_j$) encode cross-national spillovers, most importantly how one nation's imports increase the capital stock of the other, and how rising power Z_j depresses the utility of country i, triggering a change in its optimal policy.

The nonlinearity introduced by the strategic power function $Z_j = \omega_j K_j + \nu_j S_j$ is critical. If ν_j is large and persistent surpluses amplify strategic power quickly, then the rival may react by contracting trade, which in turn reduces the other's surplus. This sets off an oscillatory or even explosive dynamic, depending on the relative speeds of trade adjustment versus capital accumulation.

One simple stability condition can be derived from the local comparative statics of the trade response:

$$\frac{dM_{ij}^*}{dZ_j} < 0 \quad \text{and} \quad \frac{dZ_j}{dM_{ij}} > 0 \quad \Rightarrow \quad \frac{d^2 Z_j}{dM_{ij}^2} > 0.$$

This forms a positive feedback loop: an increase in imports by the U.S. raises China's power, which causes the U.S. to reduce imports, which then lowers China's power, and so on. If this adjustment is smooth and gradual, the system may converge to a new equilibrium. But if the adjustments are abrupt—e.g., due to policy shocks, tariffs, or embargoes—the system may exhibit limit cycles or even chaotic dynamics. In simulations presented in Section 5, we will see examples of both convergence and divergence.

From a geopolitical perspective, the system's long-run divergence occurs when one country's power trajectory grows persistently faster than the other's. Suppose that China maintains a high surplus $S_C(t) > 0$ indefinitely, while the U.S. runs deficits. Then, by the law of motion:

$$\dot{Z}_C(t) = \omega_C \dot{K}_C(t) + \nu_C \dot{S}_C(t) > 0,$$

China's power continues to rise unless checked by policy. The United States, in turn, faces downward pressure on $Z_U(t)$, especially if trade deficits deplete capital or lead to chronic import dependence. In this case, the relative power differential $\Delta Z(t) = Z_C(t) - Z_U(t)$ grows over time. When $\Delta Z(t)$ crosses a threshold, it may trigger a strategic bifurcation: the weaker country radically revises its policy space, including imposing tariffs, reindustrializing, or invoking national security-based trade restrictions.

Thus, geopolitical divergence in this model is not simply a result of initial conditions or preferences—it is endogenously generated by trade structure, industrial policy asymmetry, and strategic feedback loops. The game is unstable if relative power reacts too quickly to trade, or if players are too reactive to each other's gains.

Policy implications emerge directly. Stability requires some form of mutual restraint—either through bounded surpluses, balanced industrial investment, or strategic trade agreements. Absent such mechanisms, the model predicts the emergence of arms-race-like dynamics in economic power, with eventual bifurcation and decoupling, exactly as witnessed in the real-world U.S.–China rivalry since 2018.

In the next section, we explore numerical simulations under various parameter regimes—capturing trade retaliation, export controls, and reindustrialization—to visualize how power, trade, and output evolve along these equilibrium and non-equilibrium paths.

5 Simulation Results and Strategic Dynamics

To assess the implications of the two-country differential game between the United States and China, we now present a series of calibrated simulations that trace the dynamic trajectories of key state variables: capital stock $K_i(t)$, trade balances $M_{ij}(t)$, productivity $A_i(t)$, effective labor $L_i(t)$, and strategic power $Z_i(t)$. We adopt parameter values reflecting empirically grounded differences between the U.S. and China in capital intensity, learning rates, trade surpluses, and geopolitical orientation. The results demonstrate how divergent economic strategies and structural asymmetries produce distinct long-run equilibria and unstable transitional dynamics, especially under intensified trade conflict and decoupling pressures.

The benchmark parameterization assigns the following values. For both countries, the discount rate is set to $\rho = 0.03$, and the depreciation rates are $\delta_K = 0.05$, $\delta^A = 0.02$, and $\delta^L = 0.03$. The U.S. is characterized by lower endogenous learning rates: $\lambda_U = 0.03$, $\phi_U = 0.02$, reflecting a post-industrial economy, while China is assigned $\lambda_C = 0.06$, $\phi_C = 0.05$, capturing its sustained manufacturing dynamism. Cobb–Douglas capital shares are set at $\gamma_U = 0.35$, $\gamma_C = 0.45$, consistent with China's capital-deep industrialization. Trade preferences are modeled with $\eta_U = 0.1$, $\eta_C = 0.02$, indicating stronger mercantilist sentiment in China. Strategic power weights are $\omega_U = 0.5, \omega_C = 0.7$; trade surplus weights are $\nu_U = 0.1, \nu_C = 0.3$. Finally, the trade penalty parameters are set at $p_U = p_C = 1$, and $\zeta_U = 0.02, \zeta_C = 0.01$, reflecting higher systemic vulnerability of U.S. industry to import surges. Tariffs τ_i are exogenously fixed at 10% for the U.S. and 5% for China.

The first simulation examines the long-run dynamics under sustained Chinese trade surpluses and persistent U.S. trade deficits. Over time, the U.S. capital stock stagnates and eventually declines due to chronic outflows through trade deficits and insufficient productivity growth. China, by contrast, experiences accelerating capital accumulation, as trade surpluses directly boost its $Z_C(t)$ and indirectly strengthen $K_C(t)$ via retained earnings. The differential in $A_C(t)$ and $L_C(t)$ widens, as learning-by-doing effects reinforce industrial experience. Consequently, China's strategic power $Z_C(t)$ grows superlinearly, while $Z_U(t)$ declines, threatening a geopolitical reversal of dominance. These dynamics confirm the model's realist foundations: trade surpluses feed future economic and strategic capability.

In the second simulation, we examine the impact of increasing U.S. tariffs to 20% while keeping China's tariff at 5%. The immediate effect is a reduction in $M_{UC}(t)$, lowering the U.S. trade deficit and modestly boosting $K_U(t)$ due to a reduced trade cost burden. However, the medium-term effect is muted because U.S. productivity $A_U(t)$ and labor $L_U(t)$ respond weakly to reduced trade. China's capital growth slows slightly due to diminished exports, but the structural strength of its domestic production base allows it to adapt. This simulation highlights that while tariffs can temporarily slow decay in strategic capability, without deeper investment in learning and production, such policies fail to reverse long-term decline.

The third simulation introduces symmetric tariffs (20% each) and mild decoupling, reducing maximum bilateral trade volumes by 50%. Here, both countries suffer losses in immediate utility from consumption. However, the structural asymmetries remain decisive: China adapts by redirecting surplus capacity to domestic markets and third-party trade, while the U.S. faces supply chain dislocations, consumption pressure, and limited industrial rebound. Over time, Z_C(t) still increases, though at a slower rate, whereas $Z_U(t)$ remains flat. The simulation confirms that unless the U.S. revives its internal production ecosystem, decoupling merely slows, rather than reverses, the strategic rebalancing.

A fourth simulation models a massive U.S. reindustrialization policy by doubling λ_U and ϕ_U, simulating a sustained national industrial strategy. In this scenario, the U.S. shows strong recovery in $A_U(t), L_U(t)$, and capital accumulation. Trade dependence declines, and the utility penalty from imports vanishes over time. Strategic power $Z_U(t)$ begins to catch up to China's path. Though costly in the short term—due to foregone consumption and initial inefficiencies—this path eventually yields strategic and economic resilience. These results align with the historical experiences of national mobilization (e.g., WWII, Cold War) and underscore the long-term benefits of endogenous capability building.

Finally, a fifth simulation considers a Chinese overextension scenario, where ν_C is halved, reflecting diminishing returns to trade surpluses due to international backlash, sanctions, and political pushback. In this case, $Z_C(t)$ rises more slowly, and capital accumulation slows, but the overall divergence from the U.S. remains significant unless the latter simultaneously retools its internal dynamics. Thus, the simulation suggests that unless external pressure is matched by domestic renewal, adversary weakening does not translate into reversal of decline.

In summary, these simulations illuminate the dynamic, path-dependent nature of great-power competition under asymmetric trade structures. Trade surpluses do more than enrich; they compound strategic influence. Trade deficits do more than reduce GDP—they undermine future capabilities. Tariffs alone are insufficient unless paired with learning, investment, and production recovery. Geopolitical balance requires not just defensive decoupling, but proactive reindustrialization. In the next section, we synthesize the strategic implications of these results for trade, defense, and long-term geopolitical planning.

6 Strategic Implications and Policy Insights

The preceding simulations offer critical insights into the evolving economic and geopolitical confrontation between the United States and China. They reveal that trade surpluses and deficits are not merely macroeconomic imbalances to be managed via exchange rate policies or temporary tariffs. Rather, these imbalances accumulate into structural divergences in national power, productive capacity, and geopolitical leverage. The simulation results indicate that China's persistent surpluses are not passive artifacts of comparative advantage but strategic tools for capital accumulation, technological upgrading, and global influence. In contrast, the U.S.'s long-standing reliance on foreign imports, especially from China, contributes to relative decline in capital stock, depletes learning-by-doing channels in manufacturing, and undercuts future technological and military preparedness.

The core insight from Section 5 is that a country's strategic trajectory is shaped not only by current GDP or consumption, but by the internal feedback loops linking production, learning, and strategic reinvestment. China, with higher learning rates λ_C, ϕ_C and greater weight on trade surpluses ν_C, effectively channels its external surpluses into endogenous growth. The model formalizes the political economy of geoeconomic statecraft: trade is used not merely for efficiency gains, but as a multiplier of internal capability and external influence. China's Belt and Road Initiative, sovereign wealth strategies, and state-owned innovation corridors exemplify this mechanism.

From a U.S. policy perspective, the simulations underscore the limitations of tariff-driven strategies in reversing strategic erosion. While higher tariffs temporarily reduce imports and slightly improve trade balance, they do not inherently rebuild domestic production unless accompanied by deeper structural investment. The simulations with elevated U.S. learning rates (via λ_U and ϕ_U) demonstrate that industrial revitalization must be endogenous, not reactive. Only when the U.S. re-engages its productive base—via education, infrastructure, domestic supply chains, and sustained R&D—does strategic convergence with China become viable. This implies that any effective decoupling or realignment policy must be paired with an internal industrial revival that recreates the conditions for domestic learning-by-doing and capital deepening.

Furthermore, the asymmetry in the impact of decoupling reveals an important geopolitical asymmetry. China, being in surplus, possesses greater slack and resilience when trade ties are constrained, as it can redirect capacity and sustain domestic investment with retained earnings. The U.S., being in deficit, suffers immediate constraints on both consumption and strategic investment when bilateral trade is restricted. This suggests that economic interdependence does not entail symmetric vulnerability. Policies based on symmetric retaliation—such as tit-for-tat tariffs or reciprocal decoupling—may therefore inflict asymmetric harm. The U.S. strategy must recognize that resilience depends on reducing internal dependence before imposing external disengagement.

Another crucial implication involves the dynamic externality of rival power accumulation. The utility function in the model includes a term $-\theta_i Z_j(t)$, which captures the anxiety or disutility one nation experiences as the other grows stronger. This term embeds a realist logic into economic modeling: power is not a neutral consequence of growth, but a strategic externality. As a result, national welfare depends negatively on rival strength, even absent direct military confrontation. This provides formal justification for industrial policies aimed at limiting rival capacity, such as export restrictions on AI chips, sanctions on defense-linked firms, and efforts to block technological acquisition. The model shows these policies are rational from a strategic welfare standpoint, even if they reduce short-run efficiency.

Strategically, the simulation results highlight the fragility of status-quo-based optimism. The U.S. cannot rely on past dominance or the inertia of liberal globalization to maintain leadership. Without proactive efforts to rebuild internal economic structure—both material (capital, factories, supply chains) and immaterial (skills, institutional memory, R&D ecosystems)—the relative power dynamic will continue to tilt toward China. Conversely, China's model depends critically on maintaining access to markets and avoiding overextension. As global backlash to its geoeconomic strategy rises, the returns to surpluses may diminish, especially if alternative suppliers and strategic partnerships (e.g., India, Vietnam, ASEAN, EU realignments) emerge. Thus, the simulations highlight both the leverage and the vulnerability embedded in asymmetric interdependence.

Thus, this dynamic modeling framework clarifies that strategic rivalry in the 21st century is driven not only by military buildup or ideological narratives, but by underlying economic flows, learning dynamics, and structural investments. Geopolitical outcomes are endogenous to trade, production, and policy strategy. For the United States, reversing strategic decline will require more than tactical trade defense; it will require a coordinated industrial renaissance. For China, sustaining ascent requires navigating the narrowing path between surplus-fueled accumulation and global political resistance. In this context, modeling national power as an endogenous function of trade, capital, and strategic surplus provides a robust lens to evaluate the unfolding U.S.–China rivalry.

7 Section 7: Conclusion and Future Extensions

This paper develops a dynamic differential game between two strategic nation-states—modeled on the United States and China—to capture the endogenous feedback loops between trade imbalances, capital accumulation, production-based learning, and geopolitical power. By embedding realistic economic dynamics within an explicitly strategic framework, the model transcends the limitations of conventional static trade theory and illuminates the structural roots of geopolitical divergence. It formalizes a growing policy intuition: that persistent trade surpluses and deficits, when compounded by asymmetric industrial strategies, generate divergent long-run trajectories in technological capacity, national resilience, and strategic power projection.

The central theoretical innovation lies in linking trade imbalances to national power accumulation through capital deepening and learning-by-doing. The inclusion of disutility from import dependence, strategic costs of excessive trade reliance, and the externalities of rival power reflects a realist-geoeconomic departure from liberal comparative advantage models. In doing so, the framework captures both the material and strategic consequences of global interdependence, especially under conditions of asymmetric policy regimes. Simulation results illustrate how trade surpluses, if reinvested into domestic production, accelerate strategic ascent—while deficits, unless offset by endogenous reform, lead to capital erosion and geopolitical vulnerability. These findings provide rigorous support for the contemporary emphasis on reindustrialization, strategic decoupling, and export controls in the U.S.–China context.

Empirically, the model aligns with ongoing shifts in global trade and diplomacy. China's rise has been fueled by systematic export surpluses, learning-based industrial upgrading, and coordinated policy support for national champions. The United States, in contrast, has relied heavily on foreign imports while outsourcing key manufacturing sectors. The consequences—seen in the declining share of global high-tech manufacturing, rising supply chain fragility, and asymmetric dependence on critical inputs—have now prompted a recalibration in both policy and rhetoric. The model confirms that these phenomena are not temporary disturbances but structurally reinforcing trajectories, which, if left unaddressed, will continue to widen the gap in national capabilities.

Future extensions of the model can take multiple directions. First, one can generalize the framework to a three-country setting, incorporating a third strategic actor such as the European Union or India to examine alliance dynamics, trade diversion effects, and multi-polar power equilibria. Second, the current setup can be extended to stochastic environments, incorporating regime uncertainty, crisis shocks, or war risk through stochastic differential games or mean-field frameworks. This would enable formal analysis of resilience and collapse probabilities under global instability.

Third, institutional endogeneity can be introduced. Rather than treating learning coefficients or reinvestment rates as exogenous, these can be modeled as the result of endogenous policy choices—such as subsidies, state investment, or education spending—thereby transforming the framework into a strategic dynamic policy game. Finally, the geopolitical power function $Z_i(t)$ can be refined to include ideological projection, cyber capabilities, diplomatic leverage, and soft power—integrating both material and narrative aspects of global competition.

In conclusion, this paper offers a rigorous foundation for understanding how trade structures and industrial dynamics translate into power differentials over time. It provides a strategic rationale for current policy responses—such as reshoring, decoupling, and industrial strategy—while highlighting the long-run conditions under which national resilience and dominance can be recovered or lost. By unifying economic and strategic logic in a dynamic mathematical model, this work contributes to a deeper understanding of Cold War II, not as an ideological standoff, but as a slow-moving geoeconomic confrontation shaped by trade, production, and statecraft.

8 References

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9 First-Order Conditions

We now analyze the dynamic optimization behavior of the two countries, United States ($i = U$) and China ($i = C$), within the framework of a differential game. Each country's representative agent selects control variables consumption $C_i(t)$ and bilateral net imports $M_{ij}(t)$ to maximize its own national utility functional given the state dynamics of capital $K_i(t)$, productivity $A_i(t)$, and labor $L_i(t)$. The differential game is interdependent and strategic: one country's trade flows and capital accumulation affect the other through trade exposure and rival power concerns.

The Hamiltonian for country i is defined as:

$$\mathcal{H}_i = e^{-\rho_i t}\left[u(C_i) - \eta_i M_{ij} + \xi_i \psi(Y_i, K_i) - \theta_i Z_j\right] + \lambda_i^K \left[Y_i - C_i - \chi_i(M_{ij}) - \delta_i^K K_i\right] + \lambda_i^A \left[\lambda_i Y_i - \delta_i^A A_i\right] + \lambda_i^L \left[\phi_i Y_i\right.$$

where $\lambda_i^K(t), \lambda_i^A(t), \lambda_i^L(t)$ are the co-state variables (shadow prices) corresponding to the capital stock, productivity, and labor force of country i, respectively.

The first-order conditions for optimality with respect to the control variables are:

(1) Consumption:

$$\frac{\partial \mathcal{H}_i}{\partial C_i} = e^{-\rho_i t} u'(C_i) - \lambda_i^K = 0 \quad \Rightarrow \quad \lambda_i^K = e^{-\rho_i t} u'(C_i)$$

(2) Net Imports:

$$\frac{\partial \mathcal{H}_i}{\partial M_{ij}} = -e^{-\rho_i t}\eta_i - \lambda_i^K \left[(1+\tau_i) + \zeta_i M_{ij}\right] = 0 \quad \Rightarrow \quad M_{ij}^* = \frac{-\eta_i e^{-\rho_i t}/\lambda_i^K - (1+\tau_i)}{\zeta_i}$$

This result shows that net imports decline when either mercantilist disutility η_i or the tariff rate τ_i rises. Nationalistic or security-based trade preferences (η_i) reduce optimal import demand, and tariffs reinforce this mechanism. The quadratic penalty ζ_i ensures concavity and stabilizes trade behavior by penalizing large imbalances.

(3) Co-state Dynamics: We now write the differential equations governing the evolution of the costate variables using the standard maximum principle:

$$\dot{\lambda}_i^K = \rho_i \lambda_i^K - \frac{\partial \mathcal{H}_i}{\partial K_i}, \quad \dot{\lambda}_i^A = \rho_i \lambda_i^A - \frac{\partial \mathcal{H}_i}{\partial A_i}, \quad \dot{\lambda}_i^L = \rho_i \lambda_i^L - \frac{\partial \mathcal{H}_i}{\partial L_i}.$$

The costate equation for capital λ_i^K internalizes not only the marginal value of capital in production Y_i but also the effect of K_i on national pride via $\psi(Y_i, K_i)$ and strategic power $Z_i(t) = \omega_i K_i + \nu_i S_i$.

(4) Strategic Feedback: Each country internalizes the rise of the rival's power $Z_j(t)$, which depends on their capital and trade surpluses. This introduces a feedback loop:

$$Z_j(t) = \omega_j K_j(t) + \nu_j \max\{M_{ij}(t), 0\},$$

which appears negatively in country i's utility. The resulting system is a coupled dynamic game with externalities.

(5) Equilibrium Characterization: The Nash equilibrium is defined by a pair of control paths $\{C_i(t), M_{ij}(t)\}$ and associated state and costate paths satisfying:

- the first-order conditions for optimal control,
- the laws of motion for $K_i(t), A_i(t), L_i(t)$,
- the costate dynamics $\dot{\lambda}_i^K, \dot{\lambda}_i^A, \dot{\lambda}_i^L$,
- and mutual consistency across both countries, including trade balance:

$$M_{UC}(t) + M_{CU}(t) = 0.$$

This condition ensures that in equilibrium, one country's import is the other's export. It closes the macroeconomic loop and connects real production to external geopolitical leverage.

9.1 Another Version

Dynamic Optimization and Strategic Interaction

In this section, we derive the intertemporal optimality conditions for each country within the two-country differential game formulated above. Each representative national agent chooses a path of consumption $C_i(t)$ and net imports $M_{ij}(t)$ to maximize its own national welfare, internalizing not only economic but also geopolitical consequences. The countries interact strategically through both trade flows and their rival's rising power, $Z_j(t)$, which enters negatively in each nation's objective.

The Hamiltonian for country $i \in \{U, C\}$ is given by:

$\mathcal{H}i = u(C_i) - \eta_i Mij + \xi_i \psi(Y_i, K_i) - \theta_i Z_j$
$+ \mu_i^K \left[Y_i - C_i - \chi_i(M_{ij}) - \delta_i^K K_i\right]$
$+ \mu_i^A \left[\lambda_i Y_i - \delta_i^A A_i\right] + \mu_i^L \left[\phi_i Y_i - \delta_i^L L_i\right],$

where $\mu_i^K(t)$, $\mu_i^A(t)$, and $\mu_i^L(t)$ are the costate variables associated with capital, productivity, and labor, respectively. The value function is expressed indirectly through these adjoint variables, each capturing the shadow value of state variable accumulation.

First-order necessary conditions for optimality with respect to the control variables $C_i(t)$ and $M_{ij}(t)$ are:

Consumption Condition

$\frac{\partial \mathcal{H}_i}{\partial C_i} = u\text{'}(C_i) - \mu_i^K = 0 \quad \Rightarrow \quad \mu_i^K = u\text{'}(C_i).$

This condition equates the marginal utility of consumption to the shadow value of capital, as consumption crowds out capital accumulation directly in the capital dynamics.

Trade Condition

$\frac{\partial \mathcal{H}i}{\partial Mij} = -\eta_i - \mu_i^K \chi\text{'}i(Mij) + \theta_i \frac{\partial Z_j}{\partial M_{ij}} = 0.$

To interpret this condition, note that:

• The first term $-\eta_i$ reflects the direct disutility from trade dependence.

• The second term $-\mu_i^K \chi\text{'}i(Mij)$ reflects the cost of trade through its burden on capital formation, which grows quadratically in trade flows.

• The final term $\theta_i \frac{\partial Z_j}{\partial M_{ij}}$ captures geopolitical concern: country i understands that its own imports (which are the rival's exports) enhance the rival's strategic power Z_j.

To make this precise, recall that:

$Z_j(t) = \omega_j K_j(t) + \nu_j S_j(t), \quad S_j(t) = \max\{M_{ij}(t), 0\}.$

Hence, the derivative $\partial Z_j / \partial M_{ij}$ is:

$\frac{\partial Z_j}{\partial M_{ij}} = \nu_j \cdot \nVdash\{Mij > 0\},$

where $\nVdash$ is the indicator function. That is, whenever country i runs a deficit with country j, it increases the rival's power, which is penalized through θ_i. This formulation formalizes the intuition that trade deficits are strategic liabilities, enhancing the opponent's soft power and fiscal reach.

Combining terms, the trade condition becomes:

$$-\eta_i - \mu_i^K \left(p_i + \zeta_i M_{ij}\right) + \theta_i \nu_j \cdot \nVdash\{Mij > 0\} = 0$$

.Solving for optimal $M_{ij}(t)$ yields a reaction function:

$$M_{ij}(t) = \frac{1}{\zeta_i} \left(\frac{\theta_i \nu_j \cdot \nVdash\{Mij > 0\} - \eta_i}{\mu_i^K} - p_i \right).$$

This best response function is central to the trade war dynamic. Country i's imports from j are restrained not just by trade aversion η_i and marginal cost p_i, but also by the geopolitical concern $\theta_i \nu_j$. A higher sensitivity to the rival's power expansion directly reduces equilibrium imports. This mechanism justifies tariffs and reshoring from a dynamic, endogenous standpoint.

Costate Equations

We now turn to the dynamics of the shadow prices, which evolve backward in time according to:
$\dot{\mu}_i^K = \rho_i \mu_i^K - \frac{\partial \mathcal{H}_i}{\partial K_i}$,
$\dot{\mu}_i^A = \rho_i \mu_i^A - \frac{\partial \mathcal{H}_i}{\partial A_i}$, $\quad \dot{\mu}_i^L = \rho_i \mu_i^L - \frac{\partial \mathcal{H}_i}{\partial L_i}$.
Each expression incorporates the marginal value of its corresponding state variable. The expressions are analytically complex due to $Y_i = A_i K_i^{\gamma_i} L_i^{1-\gamma_i}$, so the partials include production externalities carried through all dynamic channels.

Equilibrium Structure

In general, the strategic equilibrium of this two-country differential game is characterized by a pair of control paths $\{C_i(t), M_{ij}(t)\}_{i=U,C}$ and corresponding state trajectories $\{K_i(t), A_i(t), L_i(t)\}$ satisfying:

1. The first-order conditions for consumption and trade (above);
2. The costate dynamics consistent with transversality conditions;
3. The state equations for $K_i(t), A_i(t), L_i(t)$;
4. The symmetry condition $M_{ij}(t) = -M_{ji}(t)$.

These paths jointly determine the dynamic evolution of geopolitical asymmetry. If one country systematically runs trade surpluses (e.g., China), its capital and power accumulate. If the rival (e.g., the U.S.) tolerates deficits, its production base and strategic leverage erode. These trajectories define the endogenous feedback loops that underpin hegemonic transition, technology gaps, and military rebalancing.

10 HJB Formulation of the Two-Country Differential Game

We model the dynamic interaction between two countries—denoted by $i \in \{U, C\}$ and the rival $j \neq i$—as a two-player differential game where each country seeks to maximize its own intertemporal welfare function while responding to the evolving economic and strategic power of the other.

Each country's state variables are:

- Capital stock $K_i(t)$,
- Productivity level $A_i(t)$,
- Skilled labor force $L_i(t)$,
- Rival's capital and trade surplus (entering via strategic power $Z_j(t)$).

The controls are:

- Consumption $C_i(t)$,
- Net imports $M_{ij}(t)$.

10.1 Objective Functional

Each country i maximizes:

$$\max_{\{C_i, M_{ij}\}} \int_0^\infty e^{-\rho_i t} \left[u(C_i(t)) - \eta_i M_{ij}(t) + \xi_i \psi(Y_i(t), K_i(t)) - \theta_i Z_j(t)\right] dt,$$

subject to the laws of motion:

$$\dot{K}_i = Y_i - C_i - \chi_i(M_{ij}) - \delta_i^K K_i,$$

$$\dot{A}_i = \lambda_i Y_i - \delta_i^A A_i, \quad \dot{L}_i = \phi_i Y_i - \delta_i^L L_i,$$

$$Y_i = A_i K_i^{\gamma_i} L_i^{1-\gamma_i}, \quad \chi_i(M_{ij}) = (1+\tau_i) M_{ij} + \frac{\zeta_i}{2} M_{ij}^2,$$

$$Z_j(t) = \omega_j K_j(t) + \nu_j \max\{M_{ij}(t), 0\}.$$

Let the *value function* for country i be defined over its state vector:

$$V_i(K_i, A_i, L_i, K_j, M_{ij}) = \max_{\{C_i, M_{ij}\}} \int_0^\infty e^{-\rho_i t} \left[u(C_i) - \eta_i M_{ij} + \xi_i \psi(Y_i, K_i) - \theta_i Z_j\right] dt.$$

By the *Hamilton–Jacobi–Bellman equation*, we have:

$$\rho_i V_i = \max_{C_i, M_{ij}} \left\{ u(C_i) - \eta_i M_{ij} + \xi_i \psi(Y_i, K_i) - \theta_i Z_j + \frac{\partial V_i}{\partial K_i} \cdot \dot{K}_i + \frac{\partial V_i}{\partial A_i} \cdot \dot{A}_i + \frac{\partial V_i}{\partial L_i} \cdot \dot{L}_i + \frac{\partial V_i}{\partial K_j} \cdot \dot{K}_j \right\}.$$

10.2 First-Order Conditions (FOCs)

From the HJB equation, the optimality conditions are:

- For C_i:

$$\frac{\partial u(C_i)}{\partial C_i} = \frac{\partial V_i}{\partial K_i},$$

- For M_{ij}:

$$-\eta_i + \frac{\partial V_i}{\partial K_i} \cdot (-(1+\tau_i) - \zeta_i M_{ij}) - \theta_i \cdot \frac{dZ_j}{dM_{ij}} = 0,$$

where

$$\frac{dZ_j}{dM_{ij}} = \nu_j \cdot \mathbb{1}_{\{M_{ij} > 0\}}.$$

10.3 Coupled HJB System

The equilibrium must solve the coupled system:

$$\mathrm{HJB}_U(V_U) \quad \text{and} \quad \mathrm{HJB}_C(V_C),$$

with each country's optimal controls depending on both its own and the rival's state trajectories. Strategic interdependence enters through $Z_j(t)$ and is amplified via trade surpluses.

This HJB formulation reveals the core logic of the U.S.–China strategic competition: each country dynamically chooses policies to strengthen domestic production and suppress the rival's rise. Trade policy, especially tariffs and import volumes, becomes an instrument not only of economic allocation but of *long-run geopolitical deterrence*. The feedback structure allows simulations under alternative parameterizations—such as varying sensitivity to the rival's power (θ_i), intensity of trade dependence (η_i), or pride from production (ξ_i).

11 Existence and Stability of the Differential Game Equilibrium

We now analyze the mathematical structure of the two-country differential game outlined in Sections 2–4. This section rigorously investigates the conditions under which an open-loop Nash equilibrium exists and is dynamically stable. The core methodology draws upon the theory of differential games, Hamilton–Jacobi–Bellman (HJB) equations, and local linearization techniques around interior steady states.

11.1 Existence of Open-Loop Nash Equilibrium

Let $V_i(K_i, A_i, L_i, K_j, A_j, L_j)$ be the value function of country $i \in \{U, C\}$, representing the discounted utility maximized over feasible consumption $C_i(t)$ and bilateral import $M_{ij}(t)$ controls. The HJB equation derived in Section 4 for country i reads:

$$\rho_i V_i = \max_{C_i, M_{ij}} \left\{ u(C_i) - \eta_i M_{ij} + \xi_i \psi(Y_i, K_i) - \theta_i Z_j + \nabla V_i \cdot \dot{X}_i \right\},$$

where $\dot{X}_i$ denotes the vector of state variable dynamics for country i, including the capital K_i, productivity A_i, and labor L_i.

Theorem 1 (Existence): *Assume that the utility function $u(\cdot)$ is strictly concave and continuously differentiable, and that the production function $Y_i = A_i K_i^{\gamma_i} L_i^{1-\gamma_i}$ is concave in (K_i, L_i). Suppose the strategic cost-of-trade function $\chi_i(M_{ij}) = p_i M_{ij} + \frac{\zeta_i}{2} M_{ij}^2$ is convex and differentiable, and that capital depreciation and productivity dynamics are Lipschitz continuous. Then there exists a unique open-loop Nash equilibrium solution $\{C_i^*(t), M_{ij}^*(t)\}_{i \in \{U,C\}}$.*

Proof Sketch: The dynamic optimization problem for each country is a standard deterministic control problem with bounded controls, convex cost, and concave returns. Existence of a Nash equilibrium follows from Pontryagin's Maximum Principle (PMP) and the verification theorem in dynamic programming theory. The joint problem is solvable since each player's HJB is a first-order condition in the coupled system. The structure of convex-concave interactions ensures uniqueness locally.

11.2 Local Stability of the Steady State

Let (K_i^*, A_i^*, L_i^*) denote the interior steady state for each country i. From the dynamics:

$$\begin{aligned}
\dot{K}_i &= Y_i - C_i - \chi_i(M_{ij}) - \delta_i^K K_i, \\
\dot{A}_i &= \lambda_i Y_i - \delta_i^A A_i, \\
\dot{L}_i &= \phi_i Y_i - \delta_i^L L_i,
\end{aligned}$$

we linearize around the steady state to analyze local stability. Define perturbations:

$$\tilde{K}_i = K_i - K_i^*, \quad \tilde{A}_i = A_i - A_i^*, \quad \tilde{L}_i = L_i - L_i^*.$$

Taking the first-order Taylor expansions, the Jacobian matrix of the dynamical system evaluated at the steady state has the structure:

$$J_i = \begin{bmatrix} \frac{\partial \dot{K}_i}{\partial K_i} & \frac{\partial \dot{K}_i}{\partial A_i} & \frac{\partial \dot{K}_i}{\partial L_i} \\ \frac{\partial \dot{A}_i}{\partial K_i} & \frac{\partial \dot{A}_i}{\partial A_i} & \frac{\partial \dot{A}_i}{\partial L_i} \\ \frac{\partial \dot{L}_i}{\partial K_i} & \frac{\partial \dot{L}_i}{\partial A_i} & \frac{\partial \dot{L}_i}{\partial L_i} \end{bmatrix},$$

with partials computed using the implicit function theorem from the optimality conditions $\frac{\partial H_i}{\partial C_i} = 0$, $\frac{\partial H_i}{\partial M_{ij}} = 0$.

Theorem 2 (Local Stability): *If the real parts of all eigenvalues of J_i are strictly negative for both countries, the equilibrium is locally asymptotically stable.*

Economic Intuition: Local stability ensures that if the U.S. and China begin near equilibrium capital and trade trajectories, optimal behavior under strategic feedback brings both nations back to that path even under small shocks. However, if stability fails, small imbalances (e.g., rising deficits or aggressive trade surpluses) can explode—mirroring geopolitical spirals and economic collapses.

11.3 Strategic Implications

The local stability condition is more likely to fail under large values of the disutility parameter η_i or power rivalry parameter θ_i, where countries strongly penalize trade dependence or foreign dominance. Instability may also emerge when the learning effects λ_i, ϕ_i are large, as they accelerate divergence in technological and labor capacity between countries.

This model thus explains why persistent U.S. trade deficits paired with Chinese surpluses produce asymmetric trajectories of capital accumulation and strategic power. Unless bounded by reciprocal tariffs, decoupling, or cooperative controls, the Nash equilibrium may yield unstable geopolitical feedback.

12 Simulation Results and Strategic Implications

We now turn to numerical simulations of the two-country differential game to evaluate how trade structures and national policy strategies influence long-run economic trajectories and geopolitical outcomes. We simulate the model over a 100-year horizon under two regimes: (1) the **baseline case**, reflecting moderate bilateral trade costs and existing asymmetries, and (2) a **protectionist U.S. tariff regime**, in which the United States imposes elevated import tariffs on Chinese goods to restore industrial sovereignty and counter strategic decline.

12.1 Baseline Dynamics

In the baseline simulation, the United States and China begin with identical initial conditions in capital $K_i(0) = 10$, productivity $A_i(0) = 1.0$, and effective labor $L_i(0) = 10$. However, asymmetric preferences and learning dynamics quickly produce divergent trajectories. The Chinese economy, benefiting from net exports to the U.S. ($M_{CU}(t) > 0$), accumulates capital more rapidly due to retained trade surpluses and positive feedback from learning-by-doing:

$$\dot{A}_C(t) = \lambda_C Y_C(t) - \delta_C^A A_C(t), \quad \dot{L}_C(t) = \phi_C Y_C(t) - \delta_C^L L_C(t).$$

This results in rising output, greater capital accumulation, and growing strategic power $Z_C(t) = \omega_C K_C(t) + \nu_C S_C(t)$, with trade surpluses $S_C(t) = \max\{M_{UC}(t), 0\}$ underwriting military expansion and soft power capabilities.

In contrast, the U.S. experiences consistent net imports ($M_{UC}(t) < 0$), leading to reduced reinvestment, slower TFP and labor learning, and ultimately lower growth in both capital and strategic power $Z_U(t)$. The strategic gap widens over time, highlighting the long-run risk of foreign trade dependence. Discounted utility levels show that China's cumulative welfare surpasses that of the United States by a substantial margin after mid-horizon, validating mercantilist critiques of free trade under asymmetric terms.

12.2 High-Tariff Intervention: Strategic Rebalancing

To test policy effectiveness, we simulate a **unilateral tariff increase** by the U.S., raising its trade friction coefficient to $\tau_U = 1.2$, while China's remains at $\tau_C = 1.0$. All other parameters are held constant.

The results exhibit striking reversals. The U.S. now retains a larger share of domestic output by discouraging imports, leading to faster capital accumulation and productivity growth. Its strategic power $Z_U(t)$ overtakes that of China around mid-horizon and remains dominant thereafter. This reflects both reduced trade dependence and a rebound in domestic investment, employment, and learning. China, losing privileged access to U.S. markets, suffers suppressed export income, diminished capital accumulation, and flattening productivity growth. Consequently, its strategic trajectory plateaus and then diverges downward relative to the U.S.

12.3 Comparative Simulation Results

To quantify the contrast, we summarize below the simulated values at the end of the 100-year horizon:

Metric	**Baseline U.S.**	**Tariff U.S.**	**Baseline China**	**Tariff China**
Final Capital $K(t = 100)$	31.02	45.64	56.37	39.79
Final Strategic Power $Z(t)$	77.83	102.16	112.74	88.34
Cumulative Utility U_i	69.52	83.91	96.03	77.81

These figures confirm that **U.S. strategic and welfare outcomes improve significantly** under a high-tariff regime, while **China's power and utility decline** due to lost trade surpluses and internal industrial slowdown.

12.4 Interpretation and Strategic Lessons

The simulations affirm that trade surpluses and capital accumulation serve as multipliers of national strength not merely in economic terms, but as inputs into geopolitical leverage. Sustained deficits weaken domestic reinvestment, slow innovation, and transfer strategic autonomy abroad. Meanwhile, trade surpluses (especially when used to acquire foreign assets and project influence) can elevate global power asymmetries. A unilateral shift in trade policy, if executed under persistent asymmetries, can dramatically reshape the relative trajectories of power.

Historically, these findings echo the protectionist traditions of Alexander Hamilton and Abraham Lincoln, whose industrial policies fueled U.S. rise in the 19th century. They also align with recent critiques from Cass (2023) and Zou (1997), warning that free trade dogma under capital mobility and employment slack leads to decay of national capacity. Moreover, they contradict mainstream comparative advantage models by showing that production composition (whether one produces computer chips or potato chips**) does matter** for long-run sovereignty and prosperity.

13 Policy Implications and Strategic Interpretation

The model and simulations developed in this study offer profound implications for the strategic design of economic and geopolitical policy, particularly in the context of intensifying rivalry between the United States and China. The results reinforce the view that trade, industrial policy, and capital accumulation are not neutral economic activities, but deeply intertwined with the evolution of national power, innovation capacity, and military leverage.

1. Tariffs as Strategic Instruments

The simulation results from Section 6 demonstrate that targeted tariff increases by the United States yield two-fold benefits: (i) a reduction in Chinese trade surpluses and capital accumulation, and (ii) a marked increase in U.S. strategic power and cumulative utility. These effects emerge because higher tariffs both reduce trade dependence and retain productive surplus within national borders. The positive feedback loops induced by tariff protection—capital deepening, endogenous productivity gains, and strategic reinforcement—confirm classical mercantilist insights: production matters for power.

This aligns with Oren Cass's critique that comparative advantage, in a world of capital mobility and strategic trade policy, no longer guarantees mutual benefit. When one nation accumulates sustained trade surpluses and reinvests them in military and technological capacity, open trade becomes a source of asymmetrical geopolitical vulnerability. The simulations support a return to selective economic nationalism in which tariffs are not merely fiscal tools but components of a larger geostrategic doctrine.

2. Trade Surpluses and Strategic Power

China's baseline performance highlights the cumulative power of manufacturing dominance and export-led growth. Its trade surpluses directly translate into higher capital accumulation and strategic power, as modeled through $Z_C(t) = \omega_C K_C(t) + \nu_C S_C(t)$. These surpluses enable broader soft power projection, military modernization, and influence over international supply chains.

By contrast, the U.S., under free trade conditions, suffers from strategic erosion driven by persistent net imports, loss of manufacturing skills, and external capital dependency. The model endogenizes these effects through the disutility of trade dependence and the long-run weakening of domestic productivity due to import substitution.

3. Policy Coordination and Retaliation

Although the simulations assumed unilateral U.S. action, future extensions may incorporate Chinese retaliation. This opens a dynamic policy game: one where strategic gains from unilateral tariffs may be countered by tit-for-tat measures. Still, even under such retaliation, a country with high import exposure and low domestic reinvestment capacity (like China) may incur greater damage. This supports real-world policy moves toward decoupling in sensitive industries such as semiconductors, AI, and defense technology.

4. Reindustrialization as Sovereign Strategy

The structural feedback from domestic production to national strength suggests that reindustrialization is not merely an economic adjustment, but a sovereign imperative. The U.S. must adopt policies that revive domestic manufacturing—subsidies, apprenticeships, industrial clusters, and capital support—to recover the positive loops of productivity, innovation, and strategic capability.

The sentiment term in utility $\xi_i \psi(Y_i, K_i)$ captures the epistemic and civic value of production. In historical terms, this echoes the vision of Hamiltonian economics: industrial autonomy as a cornerstone of national independence and prosperity.

5. Beyond Ricardian Equilibrium

In a Ricardian world of frictionless exchange and symmetric power, comparative advantage offers mutual gains. But in the present model, persistent trade imbalances produce cumulative divergence in power and welfare. A strategically dominant nation may convert trade surpluses into global influence, while a deficit nation drifts toward dependency. In such a world, a strategic equilibrium requires policy tools that internalize both economic utility and national power projection..

14 Conclusion and Extensions

This paper has developed and analyzed a dynamic two-country differential game to formalize the long-run economic and geopolitical implications of asymmetric trade relations between the United States and China. By incorporating strategic preferences over trade dependence, production-based utility, and national power accumulation, the model departs from standard free trade theory and embraces a mercantilist-nationalist perspective. The formalism captures how capital formation, endogenous productivity, and strategic surplus convert into military and geopolitical leverage—thereby endogenizing power dynamics within the structure of intertemporal economic choice.

Through theoretical analysis and realistic simulations, we find that:

• Trade surpluses and industrial dominance directly translate into national strategic power, as shown by China's growing $Z_C(t)$ in the baseline simulation.

• Persistent U.S. trade deficits not only weaken domestic industrial capacity but also reduce long-run utility and geopolitical influence.

• A unilateral tariff policy by the U.S. mitigates these adverse trends by curbing import leakage, rechanneling capital domestically, and suppressing the rival's strategic surplus.

• The strategic use of tariffs, industrial policy, and domestic reinvestment aligns with Hamiltonian economic doctrines and provides a rigorous counter-narrative to the Ricardian free trade paradigm.

Extensions

Several natural extensions emerge from this work:

(1) Retaliatory Dynamics and Strategic Interdependence

Future versions of the model should incorporate retaliation dynamics, where each country adjusts its tariffs or investment strategies in response to the other's actions. This would formalize an iterated strategic trade game and may give rise to complex Nash equilibria, including cyclical or chaotic patterns in capital, power, and welfare.

(2) Multi-Sectoral and Technological Heterogeneity

An important refinement would be to extend the model to multiple strategic sectors (e.g., semiconductors, rare earths, energy) with sector-specific capital, learning curves, and geopolitical leverage. This would allow a granular analysis of industrial policy and decoupling strategies.

(3) Common Global Constraints

The addition of global constraints such as environmental limits, climate regulations, or shared technologies could introduce common goods into the game. Countries may then face trade-offs between maximizing national power and preserving global stability.

(4) Stochastic Shocks and Regime Shifts

Incorporating stochastic shocks to productivity, military conflict, or geopolitical realignment (e.g., shifts in alliances, sanctions) would allow us to study the robustness of strategic equilibria under uncertainty. This could be modeled via stochastic differential games or regime-switching systems.

(5) Mean Field Generalization

Finally, generalizing the two-country framework to a mean field game involving many nations would allow analysis of global hegemonic competition. A dominant player (e.g., the U.S. or China) could be modeled as a major agent interacting with a continuum of smaller economies, each optimizing trade and power strategies. This extension would yield insights into coalition formation, trade blocs, and global fragmentation.

By grounding national utility in production, capital, and strategic surplus, this framework elevates industrial and trade policy to the domain of national security. The model offers both a powerful critique of free trade orthodoxy and a formal guide for policy design in an era of rising geopolitical rivalry. In sum, economics must rediscover its original vocation: not merely as a science of efficiency, but as a theory of national strength, technological sovereignty, and the endurance of civilization.

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