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The Impact of Techno-nationalism on International Innovation Investment

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Abstract

Against the backdrop of profound shifts in the global geopolitical landscape, techno-nationalism has emerged as a pivotal variable reshaping the international economic order. This paper explores how the rise of techno-nationalism has fundamentally altered the underlying paradigm of international innovation investment. The research identifies a paradigmatic shift in investment rationales, moving from "efficiency-driven" globalization to a "security-centric" logic, where geopolitical compatibility has superseded cost and market access as the primary determinant of capital flows. By analyzing the policy toolkits of major economies—including the U.S., the E.U., and Japan—this study demonstrates that techno-nationalism, through defensive investment screenings and offensive industrial subsidies, is driving a fragmentation and "Balkanization" of global innovation landscapes. Notably, in strategic sectors such as semiconductors and artificial intelligence, cross-border capital flows have experienced a "deep freeze," while "friend-shoring" and "onshoring" are becoming the dominant investment modalities. While this trend may stimulate domestic R&D in the short term, the long-term consequences include diminished global innovation efficiency and the bifurcation of technical standards. Finally, the paper proposes a "multi-local" strategy for multinational corporations and suggests that sovereign states must seek a dynamic equilibrium between security imperatives and innovation vitality.

Keywords: Techno-nationalism, International Investment, Geopolitics, Supply Chain Security, Investment Strategy

1. Introduction

During the first two decades of the 21st century, the global political and economic landscape was primarily shaped by the logic of neoliberal globalization. The defining feature of this era was "techno-globalism"—the belief that technological innovation should transcend national borders, with capital, talent, and knowledge flowing freely across the globe to maximize efficiency. However, in recent years, with the resurgence of great power geopolitical competition, the exposure of vulnerabilities in global supply chains, and the reshaping of national security definitions by emerging technologies, a trend known as "techno-nationalism" has reclaimed center stage in international relations and international political economy.

The resurgence of techno-nationalism is not a simple repetition of history, but rather a profound reflection of the qualitative shift in the relationship between technology and state power. Unlike traditional trade protectionism, modern techno-nationalism no longer focuses solely on tariffs and market access. Instead, it regards cutting-edge technologies such as semiconductors, artificial intelligence (AI), quantum computing, and biotechnology as core pillars of national survival, security, and competitiveness. Under this logic, the state is no longer a market night watchman but an active intervener, investor, and regulator. This paradigm shift is fundamentally reshaping the logic, flows, and structure of international science and technology innovation investment. This study aims to explore the multidimensional impacts of techno-nationalism on international science and technology investment. By systematically examining the theoretical underpinnings, policy instruments, and practical implementations of techno-nationalism across major global powers, this paper seeks to reveal the multifaceted effects of this trend on international investment in science and technology innovation. It further proposes corresponding strategies for multinational corporations and nations to navigate these challenges.

2. The Rise of Techno-nationalism

2.1 Core Concepts and Policy Instruments

2.1.1 Core Concepts of Techno-nationalism

Academic definitions of techno-nationalism have undergone an evolutionary process. Early definitions, such as Robert Reich's 1987 formulation [1], primarily referred to an ideology linking technological advancement to national security and economic prosperity. However, within the current international relations context, the scope of techno-nationalism has significantly expanded. According to recent research by scholars like Alex Capri [2], modern techno-nationalism can be understood as a strategic worldview that deeply binds technological capability and autonomy to national security, economic prosperity, and social stability. It is not merely a defensive posture but rather a set of principles and policies that actively intervene in markets and shape technological trajectories through state power.

The core of this concept lies in the generalization of the logic of "securitization." Traditional national security focuses on military defense and territorial integrity, whereas techno-nationalism expands the boundaries of security to encompass economic security, cybersecurity, data security, and even supply chain security. As Samuels observes [3], technology is viewed as a source of national security and even a symbol of national identity. Under this lens, technological innovation ceases to be a purely commercial endeavor and instead becomes a zero-sum game in great power rivalry. Competition between nations has shifted from traditional arms races to contests over control of critical technologies—what is termed the "innovation war."

The rise of techno-nationalism represents a rethinking and revision of the theory of "interdependence" in the era of globalization. While liberal institutionalism posits that interdependence fosters peace, the theory of "weaponized interdependence" argues that global economic networks—such as finance, the internet, and supply chains—exhibit asymmetrical center-periphery structures. Nations occupying pivotal hub positions can exploit this asymmetry, transforming interdependence into a coercive instrument of power against adversaries [4]. This theoretical shift provides the legitimacy for technonationalist policies—namely, that nations must reduce reliance on external critical technologies to avoid being "choked off" by rivals.

2.1.2 Policy Instruments

To achieve technological autonomy and security, governments worldwide have deployed a complex suite of policy tools. These encompass both defensive measures aimed at blocking adversaries from acquiring critical technologies—such as foreign investment security reviews, export controls, and technology sanctions—and offensive strategies designed to bolster domestic industries, including large-scale industrial subsidies, localization substitution programs, and the promotion of domestic technical standards.

Foreign investment security reviews serve as the most direct defensive tool against techno-nationalism. Their core logic is to prevent foreign capital from acquiring domestic critical technologies or sensitive data through mergers, acquisitions, or equity investments. Take the U.S. Committee on Foreign Investment in the United States (CFIUS) as an example: its authority underwent historic expansion following the passage of the Foreign Investment Risk Review Modernization Act (FIRRMA) in 2018. FIRRMA expanded the scope of review beyond traditional controlling transactions to include non-controlling investments involving "Critical Technologies," "Critical Infrastructure," and "Sensitive Personal Data"—collectively termed "TID" businesses [5]. This implies that even a minority investment by a foreign venture capital firm in a U.S. startup could trigger national security scrutiny if it involves board observer seats or access to non-public technical information. The latest 2024 data shows a significant increase in CFIUS reviews involving the financial, information, and services sectors, with heightened scrutiny of Chinese investors persisting at elevated levels. Additionally, the EU has established a foreign investment screening framework, while Japan revised its Foreign Exchange and Foreign Trade Act (FEFTA), both significantly lowering review thresholds (e.g., Japan reduced the reporting threshold for equity holdings from 10% to 1%) and expanding the list of regulated industries [6].

Export controls have evolved from traditional non-proliferation mechanisms into a powerful tool for major powers to impose technological blockades. The trend toward weaponizing entity lists is evident, with the U.S. Department of Commerce's Bureau of Industry and Security (BIS) managing the "Entity List" to restrict U.S. companies from exporting technology to specific foreign entities. In recent years, this list has expanded rapidly, adding numerous Chinese companies involved in semiconductors, artificial intelligence, and supercomputing [7]. Additionally, the U.S. has implemented long-arm jurisdiction controls by amending the Foreign Direct Product Rule (FDPR). This rule mandates that any foreign-manufactured product incorporating U.S. technology or software—even in minimal proportions—falls under U.S. export controls. This regulation has been used to sever companies like Huawei from global foundry chip supply channels, profoundly reshaping the global semiconductor supply chain ecosystem [8]. Furthermore, export bans on equipment targeting specific technology nodes—such as logic chips at 14nm and below, and NAND flash memory with 128 layers or more—aim to precisely target competitors' technological iteration capabilities, locking them into mature process nodes [9]. This reflects the trend toward precision in technological sanctions.

Technical sanctions differ from conventional trade restrictions, often combining financial sanctions with comprehensive blockades in specific technological domains. Their aim is to deprive adversaries of the ability to profit from or advance through technology. The U.S. "Non-SDN Chinese Military-Industrial Complex Entities List" (NS-CMIC List) prohibits Americans from investing in technology companies deemed to assist China's military modernization. This not only cuts off these entities' access to dollar financing but also effectively "delegitimizes" them in capital markets. Sanctions imposed by the United States on Russia and Iran explicitly include "technology sanctions" provisions, prohibiting the transfer of refining technologies, quantum computing technologies, and advanced materials technologies. These measures are designed to weaken the long-term industrial foundations of these nations. Such sanctions are typically combined with financial decoupling, employing "Smart Sanctions" mechanisms to precisely target critical technological nodes without imposing comprehensive trade embargoes.

Large-scale industrial subsidies represent one of the primary offensive tools. To reverse the trend of manufacturing outflows and establish technological dominance, governments worldwide have rolled out massive fiscal subsidy programs to guide the reshoring of manufacturing. The U.S. CHIPS and Science Act provides approximately $52.7 billion in direct subsidies and tax credits aimed at incentivizing the return of semiconductor manufacturing to America [10]. However, this legislation is not purely economic stimulus; it includes stringent "guardrails" prohibiting recipient companies from expanding advanced process manufacturing capacity in "countries of concern" over the next decade [11]. This effectively forces multinational corporations to strategically "choose sides." The offensive nature of the U.S. CHIPS Act extends beyond containing China, triggering a global "subsidy race" that compels allies to follow suit to prevent industrial hollowing-out. Examples include the EU's EU Chips Act and South Korea's K-Chips Act. These geopolitically driven subsidy policies are profoundly reshaping the competitive landscape of the global semiconductor industry.

Faced with external blockades, establishing autonomous and controllable supply chains has become a core strategy for nations. Over the past three decades, global supply chains were built around the principles of "efficiency first" and "just-in-time" production, minimizing costs through intricate international division of labor. However, supply chain disruptions triggered by the COVID-19 pandemic, energy shocks stemming from the Russia-Ukraine conflict, and intensifying strategic competition between China and the United States have compelled governments worldwide to shift the focus of supply chain policies toward "security" and "resilience." Establishing "autonomous and controllable" supply chains has become a cornerstone of national security strategies, with core measures including reshoring, friend-shoring, and de-risking. . This shift marks a transition in global economic governance from pursuing Pareto-optimal economic logic to pursuing strategic logic centered on geopolitical security. For instance, the EU's Critical Raw Materials Act (CRMA) sets highly ambitious 2030 quantitative benchmarks for the EU's supply of 34 critical raw materials, including lithium, cobalt, and rare earths [12].

The battle for control over technology standard-setting is pivotal to securing future industrial dominance. In the digital economy era, technical standards are no longer merely technical documents ensuring device interoperability; they have become strategic high ground determining industrial allocation rights, market access privileges, and national security boundaries. Whoever sets the standards holds the power to define the next-generation technology ecosystem and reap "patent royalties" at the apex of the industrial chain. Today, the battle for standard-setting authority has escalated from corporate commercial rivalry to strategic confrontation between nations. Mobile communication standards represent the most fiercely contested arena in geopolitical competition. Within the 3GPP (Third Generation Partnership Project) standard-setting process, Chinese enterprises like Huawei and ZTE have demonstrated formidable influence, triggering deep anxiety among Western nations. In response, the United States has vigorously promoted the Open RAN architecture. By decoupling hardware and software and opening interfaces, it aims to break the integrated hardware-software monopoly held by traditional telecom equipment providers like Huawei, Ericsson, and Nokia. This strategy seeks to allow more American software and chip manufacturers to enter the base station market, thereby circumventing Huawei in the supply chain. In the early stages of 6G research and development, the U.S. government formed exclusive alliances like the "Next G Alliance" with Japan, South Korea, and Europe. These efforts aim to exclude China from the "inner circle" of standard-setting for next-generation core technologies like terahertz communications and integrated air-ground-space systems, striving to reclaim dominance in the 6G era.

2.2 Shifting International Landscape

Under the influence of techno-nationalism, the international political and economic environment has undergone profound structural changes, with global industrial chains, supply chains, and value chains undergoing restructuring. Globalization is no longer a smooth linear process but exhibits distinct characteristics of regional blocs and alignment. Major economies are adjusting their grand strategies to adapt to this new geo-economic reality.

The Biden administration's National Security Strategy explicitly articulates the "Small Yard, High Fence" concept [13]. Systematically articulated by National Security Advisor Jake Sullivan, its core logic is this: For critical core technologies involving national security—such as advanced logic chips, quantum computing, and biotechnology—a limited-scope ("small yard") yet strictly controlled ("high fence") protected zone must be established. Through the most stringent export controls and investment restrictions, the United States must secure absolute leadership in these domains. Meanwhile, normal international economic and trade relations are maintained across the vast commercial landscape beyond the "yard." In practice, however, the boundaries of the 'yard' are continually expanding. Due to the dual-use nature of many emerging technologies and the pervasive penetration of digital transformation across all economic sectors, the "high fence" is creating far greater barriers to commercial investment than anticipated. Simultaneously, the U.S. vigorously promotes "reindustrialization" and "friend-shoring," seeking to shift critical supply chains from geopolitical rivals to allies or friendly nations. This strategy not only reshapes America's industrial structure but also forces global capital to recalibrate between 'efficiency' and "compliance."

In response to the intensifying Sino-American strategic competition, the European Union has proposed a strategy of "de-risking" rather than "decoupling." This approach was explicitly outlined by European Commission President Ursula von der Leyen in the 2023 European Economic Security Strategy, aiming to reduce reliance on critical raw materials and technologies from any single country while avoiding a complete severance of economic and trade ties. The EU's strategy rests on three pillars: Promote, Protect, and Partner. First, promote competitiveness by strengthening Europe's industrial base and innovation capacity through legislation like the Net-Zero Industry Act and Critical Raw Materials Act. Second, protect critical assets using anti-coercion instruments, foreign investment screening, and export controls to defend against economic security risks. Third, it strengthens partnerships by establishing raw materials clubs and digital partnerships with "like-minded" nations. Although internal European disagreements persist over the precise scope of "de-risking"—such as German business circles favoring maintaining market share in China—the overall policy direction has clearly shifted toward defensiveness [14]. This has resulted in stricter compliance reviews for two-way science and technology investment between China and Europe.

Japan was among the first nations to institutionalize economic security. The passage of the Economic Security Promotion Act (ESPA) in 2022 marked Japan's formal establishment of a comprehensive legal framework for economic security [15]. The Act establishes four pillars: strengthening supply chain resilience by designating semiconductors, batteries, rare earths, and other materials as "specified important materials" and providing financial support to diversify sourcing; ensuring critical infrastructure security through a pre-screening system for key equipment imports across 14 sectors including power, communications, and finance to prevent backdoor implantation; fostering public-private technological collaboration by establishing dedicated funds to support R&D in critical technologies like AI and quantum computing while enhancing industry-academia-government cooperation; and implementing a patent non-disclosure system to classify patent applications involving sensitive technologies like nuclear energy and advanced weaponry, thereby preventing technology leakage. Japan's legislation not only impacts the global operations of its domestic companies but also provides a model for institutionalizing techno-nationalism for other nations. It requires businesses to factor geopolitical risks and supply chain disruption risks into their cost considerations when making international investments.

Against the backdrop of competing national strategies being implemented, the organizational logic of international industrial chains is undergoing a paradigm shift from efficiency-driven "Just-in-Time" to security-driven "Just-in-Case." This structural shift is first manifested in the "forking" and "fracturing" of global high-tech value chains, particularly in the semiconductor and telecommunications equipment sectors. These chains are progressively diverging into two parallel and relatively independent ecosystems: one centered on the United States and its allies, and another anchored by China. Simultaneously, capital allocation exhibits pronounced regional clustering, no longer solely pursuing global cost advantages based on comparative advantage principles. Instead, it is shifting toward regional hubs like North America (leveraging the USMCA framework), Europe, Southeast Asia, and India. This aims to hedge geopolitical uncertainties by shortening the physical radius of supply chains. However, this restructuring of industrial chains—where political logic overrides economic logic—while enhancing supply chain resilience, inevitably increases the costs of global factor allocation and innovation collaboration. The International Monetary Fund (IMF) defines this [16] as the price of “geoeconomic fragmentation.”

3. The Multidimensional Impact of Techno-nationalism on International Sci-Tech Investment

Global economic data from late 2024 to early 2025 reveals that international investment patterns are undergoing the most profound structural rupture since the end of the Cold War. The long-dominant “efficiency-first” logic—where capital seeks globally the lowest-cost, largest-market allocation points—is being supplanted by a new “security-driven” paradigm. This shift is not a mere cyclical fluctuation but a long-term trend driven by geopolitical rivalry, the rise of techno-nationalism, and supply chain security anxieties. Under this new paradigm, global foreign direct investment (FDI) flows exhibit pronounced characteristics of bloc formation, regionalization, and inward-looking cycles. Beyond traditional variables like markets, costs, and talent, “geopolitical compatibility” has emerged as a critical factor, resulting in both physical and logical fragmentation of global capital markets.

3.1 Reconfiguration of Investment Patterns

3.1.1 Geographical “Bloc Formation” in International Sci-Tech Investment Flows

International capital and technology are concentrating within geopolitical alliances, forming distinct technological ecosystems centered on China and the United States. A defining characteristic of this trend is the significant shortening of “geopolitical distance.” Research by the McKinsey Global Institute reveals that since the global financial crisis, the “geopolitical distance” of global greenfield FDI (new investments) has shortened by over 20%. This distance is measured by analyzing the alignment of positions between the investing country and the host country on international affairs, such as UN voting. This indicates that companies increasingly prefer to invest between nations with similar political stances. Approximately 35% of large multinational corporations have reduced the geopolitical distance of their investments, with Japanese, South Korean, and European companies showing the most pronounced shift. They are reallocating investments in advanced manufacturing—particularly in automotive and semiconductors—from geographically or politically distant locations to closer allied markets like Europe and the United States.

The core competitiveness of the U.S.-centered technology ecosystem lies in the deep integration of its “alliance system” and “market ecosystem.” The United States maintains significant advantages in foundational technologies such as artificial intelligence, semiconductor design tools, and operating systems. It leverages long-arm jurisdiction tools like export controls to influence the technological systems of its allies. Simultaneously, the U.S. is systematically integrating allies’ technological expertise—such as Japan and South Korea’s semiconductor manufacturing capabilities and Europe’s fundamental research strengths—into its supply chain through strategies like “friend-shoring.” This forms a transatlantic and Indo-Pacific technological alliance. According to the latest statistics released by the U.S. Bureau of Economic Analysis (BEA) [17], by the end of 2024, the stock of U.S. foreign direct investment increased by $206.3 billion, reaching a total of $6.83 trillion. This growth was highly concentrated in Europe (primarily Luxembourg and Germany) and a few Asia-Pacific ally nations. This reflects a significant strengthening of capital flows among developed economies, forming a relatively closed and self-reinforcing “internal circulation” system. The intensification of this internal cycle and capital concentration exhibits pronounced policy-driven characteristics. In 2024, greenfield investment projects in the U.S. were dominated by investments in semiconductors, artificial intelligence (AI), and related infrastructure, directly benefiting from massive subsidies and tax incentives provided by the CHIPS and Science Act and the Inflation Reduction Act (IRA) [18]. The ecosystem's innovative vitality relies heavily on its decentralized, venture-capital-intensive market-driven structure. Networks comprising the private sector, top universities, and startups rapidly commercialize ideas. Its technical standards and rules—such as AI governance frameworks and semiconductor alliance agreements—are often disseminated externally through a combination of market dominance and political coordination with allies, forming formidable "soft power."

China's technology ecosystem, centered around the nation, exhibits a distinctive feature of deep integration between "state-led strategy" and "massive-scale market application." To overcome critical bottleneck technologies, China is deepening its "new national system," directing resources toward strategic fields through major national science and technology projects. In practice, this manifests as organizational models like "innovation consortia"—led by anchor enterprises that collaborate with universities and research institutes for systematic breakthroughs. Simultaneously, China aims to dismantle internal barriers by cultivating a unified national technology market, optimizing the allocation of innovation factors to build a self-reliant and controllable industrial chain through concerted national efforts. Furthermore, China possesses the world's largest unified digital market, manufacturing system, and user base, providing "scenario traction" for rapid technological iteration and commercialization [19]. From 5G and new energy vehicles to AI applications, this vast domestic market nurtures and validates local technological solutions, fostering relatively self-contained internal technical standards and application ecosystems. The rise of open-source large-model ecosystems like DeepSeek demonstrates China's approach to leveraging market scale and open-source strategies to build technological influence.

Nations situated in the "intermediate zone" between the two major core spheres—China and the United States—are diverging in their strategic choices. Some countries attempt to maintain equilibrium between the two camps to reap dual benefits. Others, particularly medium powers with specific resource or market advantages, proactively form alliances to establish "mini-multilateral" technology coalitions. This approach aims to consolidate their technological sovereignty and pursue becoming "secondary hubs" in specific sectors. The Australia-Canada-India Technology and Innovation Partnership, established in 2025, exemplifies this trend. It aims to combine Australia and Canada's critical mineral resources with India's manufacturing and talent advantages to create an innovation ecosystem bypassing traditional supply chain hubs. Such alliances represent a key manifestation of multipolarity within the technological ecosystem, further refining and solidifying the boundaries of global technological cooperation blocs.

3.1.2 Sectoral Differentiation in International Sci-Tech Investment

The impact of techno-nationalism on investment sectors exhibits distinct dual-track characteristics. In strategic high-tech fields deemed critical to national security and future competitiveness, investments are undergoing deep decoupling and bloc-based alignment. Meanwhile, uncertainty is rising in non-sensitive sectors, though global capital flows in areas like public welfare and clean energy maintain relative resilience and connectivity—albeit facing potential regulatory risks and supply chain disruptions.

In "chokepoint" sectors deemed critical to national security—such as semiconductors, artificial intelligence (AI), quantum computing, and biotechnology—international investment is undergoing sharp contraction and bloc formation. Capital flows no longer follow the principle of comparative advantage but instead align with national security imperatives. In 2024, global semiconductor FDI exhibited "stable volume but falling prices." While project numbers declined by only 2.8%, total capital investment plummeted by 50% to $55.2 billion [20]. This sharp fluctuation reveals a fundamental shift in semiconductor investment logic: massive capital is shifting from cross-border M&A and global expansion to domestic capacity building driven by government subsidies. The U.S. CHIPS Act and the EU CHIPS Act attracted giants like TSMC, Intel, and Samsung to build advanced process fabs in their respective regions, diverting cross-border capital that might otherwise have flowed to Asia—particularly China. Furthermore, the U.S. Foreign Investment Review Final Rule, effective early 2025, explicitly prohibits or restricts American capital from investing in China's semiconductor, quantum information, and AI sectors [21]. This move further severs the capital ties between these two global innovation hubs in core technologies. The impact extends beyond capital flows, blocking the accompanying technology transfers and management expertise exports.

Investment in the AI sector exhibits extreme polarization and regional fragmentation. On one hand, global AI-related venture capital (VC) reached a record high in 2024, surpassing $100 billion and accounting for one-third of total global VC funding. On the other hand, this boom is concentrated primarily in the United States (e.g., massive funding rounds for OpenAI, Anthropic, and xAI) and within China (e.g., Moonshot AI, DeepSeek), while cross-border AI investments have significantly declined [22]. Particularly, stringent scrutiny of U.S. investments in Chinese AI has led USD funds to largely withdraw from financing rounds for early-stage Chinese AI startups. China's AI industry has been forced to rely entirely on RMB funds and government-guided funds, creating two parallel and incompatible capital-technology ecosystems. This fragmentation extends beyond capital to computational infrastructure (e.g., the Nvidia chip embargo) and the isolation of model training data.

In contrast, clean energy and certain traditional industries demonstrated strong resilience. In 2024, renewable energy maintained its position as the top global FDI recipient, attracting $270.1 billion in investments—accounting for 27% of the total investment in the world's top ten industries [23]. Despite escalating trade barriers—such as anti-subsidy investigations by Europe and the U.S. targeting Chinese photovoltaic modules and electric vehicles—shared global decarbonization goals maintained cross-border capital flows in this sector. Notably, this resilience stemmed from companies proactively adjusting investment strategies. Chinese new energy enterprises like CATL and BYD adopted a "detour strategy" by establishing factories in Hungary, Mexico, and Southeast Asia to circumvent direct trade barriers in Europe and the US. While this investment model maintained capital flow continuity, it also made global supply chains more circuitous and costly.

3.2 Evolution of Investment Models and Risk Paradigms

Under the influence of techno-nationalism, the operational model of international science and technology investment has undergone a fundamental shift. Investors no longer focus solely on financial returns (IRR) and total addressable market (TAM), but have incorporated "geopolitical risk" into their core decision-making models—even as a veto-power screening criterion. Investment patterns have transitioned from global integration toward "friend-shoring" and "onshore production," with geopolitical due diligence becoming standard practice for venture capital (VC).

In recent years, "friend-shoring" has evolved from a political slogan into concrete operational guidelines and institutionalized arrangements for corporate investment. By 2024, many multinational corporations explicitly prioritize "political alignment" as a key criterion in location decisions. Research from the University of Michigan indicates that [24] U.S. corporate supply chain "decoupling" is not occurring across the board, but is concentrated in sectors capable of shifting to politically allied nations. Decoupling only materializes when alternative suppliers are located in economically viable countries aligned with U.S. geopolitical interests. This pattern is particularly pronounced in the semiconductor industry. Through bilateral agreements, the U.S. and Japan have strengthened "friend-shoring" cooperation in semiconductor and electronic component supply chains. The Japanese government offers substantial incentives to encourage companies to relocate manufacturing bases from China to allied nations like Southeast Asia, reducing reliance on any single country. This strategy effectively builds an exclusive technological investment alliance, raising barriers for non-allied nations to enter high-tech supply chains and shifting the global supply chain network from "flattening" toward "grouping."

Traditional commercial due diligence (financial, legal, business) is no longer sufficient to navigate today's complex landscape. Since 2024, "Geopolitical Due Diligence" has become standard practice in cross-border mergers and acquisitions (M&A) and venture capital (VC) investments, reaching unprecedented depth and breadth. Investment institutions have begun systematically examining whether target companies are involved in military, surveillance, human rights, or dual-use technology issues related to “countries of concern.” For instance, the U.S. House of Representatives’ investigation into Sequoia Capital’s spin-off and its Chinese arm (Sequoia China/HongShan) portfolio has compelled the entire VC industry to incorporate national security screening mechanisms into investment decisions [25]. This scrutiny extends not only to direct investment targets but also penetrates their supply chains and end-users. While the EU’s Corporate Sustainability Due Diligence Directive (CSDDD) focuses on human rights and environmental issues, its implementation often deems operations in geopolitically conflicted regions (e.g., Ukraine, Middle East) as high-risk, compelling stricter compliance reviews. For M&A involving sensitive technologies, buyers must not only assess financial risks but also simulate business continuity under extreme geopolitical scenarios (e.g., escalating sanctions, asset freezes) [26]. Consequently, investors now design exit mechanisms triggered by geopolitical conditions from the initial investment stage. Examples include incorporating expanded “force majeure” clauses or dedicated “sanctions clauses” into investment agreements, stipulating that investors may demand mandatory buybacks or asset divestitures if the target company’s country faces specific sanctions or export controls. This defensive investment structuring reflects heightened market anxiety over geopolitical uncertainties.

Against this backdrop, the risk paradigm for international technology investment has evolved, with political risk supplanting commercial risk as the primary consideration. Corporate compliance costs have surged, and global innovation networks have fractured. Historically, multinational corporations based investment decisions primarily on commercial metrics such as return on investment (ROI), market size, and labor costs. However, in the era of techno-nationalism, political license has become a preemptive veto factor. In extreme cases, companies may be forced to withdraw even when market demand exists due to deteriorating political conditions. A prime example is Chinese battery manufacturer SVOLT Energy Technology’s decision in 2024-2025 to terminate its European operations and cancel plans for a German factory. Despite Europe’s substantial demand for electric vehicle batteries, geopolitical uncertainties, threats of EU anti-subsidy investigations, and the political risks stemming from protracted approval processes exceeded the company’s tolerance threshold. Moreover, squeezed by both geopolitical pressures and techno-nationalism, compliance costs for companies are no longer marginal operational expenses. Instead, they have evolved into substantial burdens that devour profits and stifle innovation. This surge in costs is comprehensive, encompassing data compliance, supply chain traceability, export control licensing applications, and legal fees incurred when navigating conflicting regulations across multiple jurisdictions.

3.3 Far-Reaching Consequences for the Global Innovation Ecosystem

The restructuring of investment patterns driven by techno-nationalism has profoundly altered the operational logic of the global innovation ecosystem. The fragmentation of scientific research, rising innovation costs, and opposing technical standards now define the prevailing innovation landscape. While these shifts may temporarily stimulate domestic R&D investment in specific nations, they will ultimately lead to diminished innovation efficiency, fragmented technical standards, and obstructed collaboration in the global public sphere.

The scientific decoupling driven by techno-nationalism hinders knowledge flow and research collaboration, undermining innovation efficiency. For decades, Sino-American scientific cooperation has served as a vital engine for global scientific progress, particularly in life sciences, materials science, and physics. However, multiple authoritative datasets from 2024 indicate this collaboration is rapidly shrinking, resulting in de facto “scientific decoupling.” According to the latest data from Clarivate and Nature Index, the number of Sino-American co-authored papers continued to decline significantly in 2024, with drops exceeding 20% in sensitive fields like engineering, physics, and computer science [27]. This “decoupling” severs one of the most critical bilateral connections in the global scientific network, slowing the dissemination of cutting-edge knowledge. The chilling effect of the U.S. "China Initiative" and increasingly stringent visa reviews have prompted a large number of Chinese scientists to leave the United States and return to China. Data indicates that [28] this talent repatriation has negatively impacted U.S. research output in materials science and AI, while simultaneously accelerating China's self-sufficiency in talent within these fields. Cross-border data restrictions in biomedicine have become the greatest obstacle to collaboration. Influenced by China's Regulations on the Management of Human Genetic Resources and the proposed U.S. Biosecure Act, multinational clinical trials and genomics research face significant compliance risks. This has reduced the synergistic efficiency of global drug development and extended the cycle for new drug research and development[29].

Techno-nationalism compels nations to pursue "autonomy and control" over core technologies, directly leading to redundant resource allocation and diminished innovation efficiency worldwide. Through measures like the U.S. CHIPS Act subsidizing domestic manufacturing, nations are essentially rebuilding industrial chain segments that could previously be efficiently sourced through global trade. This "reinventing the wheel" behavior significantly diverts R&D resources that could otherwise be directed toward exploring new technologies. IMF research estimates that such geo-economic fragmentation could result in up to a 7% loss in global GDP, with the primary long-term cost stemming from the impeded diffusion of knowledge caused by technological decoupling [30]. In highly complex industries like semiconductors, decoupling may force sanctioned parties to adopt suboptimal domestic alternatives, thereby reducing final product yield and performance. IMF models predict that a complete severance of semiconductor trade between the OECD and China could degrade China's input quality by approximately 5%, directly undermining the competitiveness of downstream electronic products [31].

The current global technology governance architecture is undergoing a structural paradigm shift from "interdependence" to "technological apartheid." This geopolitically driven fragmentation is systematically dismantling the unified global technology standards established after World War II [32]. This dualistic technological ecosystem manifests as particularly intense institutional competition at the digital infrastructure level. In the 6G communications domain, the United States and its allies are vigorously promoting the Open RAN architecture. This aims to weaken China's monopoly advantage in traditional integrated hardware by opening interfaces and decoupling software from hardware. This divergence in technological approaches risks a fundamental rupture in global communication networks at both the physical and protocol layers, potentially leading to the emergence of incompatible "split networks." [33] Simultaneously, global AI governance rules are fragmenting into two parallel and competing normative systems: one represented by the U.S. Department of State's Political Declaration on the Responsible Military Use of Artificial Intelligence and Autonomous Technologies, emphasizing military ethics and alliance cooperation grounded in Western liberal values [34]; the other embodied by China's Global Initiative on AI Governance, advocating a UN-centered governance model that prioritizes national sovereignty and representation of developing nations. Moreover, as the boundaries of "data security" become infinitely broadened, intelligent connected vehicles (ICVs) have become the new frontline in trade barriers. The U.S. Department of Commerce's ban on China's Vehicle Connectivity System (VCS) not only effectively erects a "digital iron curtain" blocking technology flows but also extends the fragmentation of industrial chains from the cloud to end devices [35]. Authoritative quantitative research from the International Monetary Fund (IMF) warns that if this deepening "geo-economic fragmentation" evolves into complete technological decoupling, it will sever the cross-border spillover effects of global knowledge and innovation, potentially causing long-term damage to global GDP ranging from 7% to 12% [36]. This would not only mean the evaporation of trillions of dollars in economic welfare but also force countries in the Global South into an "either-or" technological dilemma, exacerbating the permanent entrenchment of the global digital divide.

4. Response Strategies and Future Outlook

As techno-nationalism intensifies and the global innovation landscape undergoes regional realignment, traditional "borderless" globalization strategies have become unsustainable. Confronted by an era defined by "security first," both multinational corporations and state actors must forge a new dynamic equilibrium between 'connectivity' and "isolation."

4.1 Corporate Strategic Choices

For multinational corporations, geopolitics has evolved from an external environmental variable into a core endogenous factor. To sustain operations in a fractured global market, companies are undergoing profound strategic restructuring. The core logic shifts from pursuing the ultimate efficiency of a single global supply chain to building a "multi-local" architecture capable of isolating geopolitical shocks. This involves establishing relatively independent operational systems in different regions that align with local policies.

The "multi-local" strategy has become the standard paradigm for multinational tech giants navigating geopolitical fractures. This approach requires companies to establish relatively independent operational systems across distinct geopolitical blocs, achieving physical or logical separation of technology stacks, data architectures, and governance structures—effectively forming a "federalized" corporate model. Given increasingly stringent national regulations on data sovereignty and cybersecurity, enterprises must build mutually independent IT infrastructures. For instance, Volkswagen's "In China, for China" strategy established a highly autonomous local R&D center (VCTC), achieving a localized closed-loop from chip design to software development to circumvent cross-border data compliance risks [37]. This isolation is particularly pronounced in finance and investment. Sequoia Capital completely spun off its China operations and restructured them as "Sequoia China," not only to navigate U.S. investment reviews on China but also to achieve risk isolation between dollar and renminbi capital on the fundraising side. This "brand federalism" allows regional entities to maximize retention of the global brand's reputational capital while complying with local regulatory requirements.

In risk management, enterprises should strengthen supply chain resilience by building diversified supply chains and preparing backup chains, while integrating geopolitical risk assessments into core decision-making processes. Against the backdrop of rising tech nationalism and intensifying geopolitical friction, one of the core risks facing international science and technology innovation investments is the vulnerability and susceptibility to disruption of highly globalized and interdependent supply chain systems. A singular, overly concentrated supply chain structure can lead to production disruptions, technology supply cuts, and massive investment losses if key nodes face export controls, entity list sanctions, or political intervention. Therefore, strengthening supply chain resilience must be central to corporate risk management strategies. This serves not only as a buffer against short-term shocks but also as a strategic foundation for ensuring long-term technological competitiveness and investment security. Enterprises must implement multi-dimensional supply chain diversification strategies encompassing geography, suppliers, and technology pathways, moving beyond traditional geographic dispersion. In layout planning, companies should systematically assess geopolitical risk factors across production stages, strategically relocating or backing up high-sensitivity R&D segments and core component manufacturing to allies or neutral regions with strong political trust and stable legal environments. For critical "chokepoint" technologies and components, actively cultivate and certify secondary and tertiary suppliers. Shift away from the cost-first model that prioritized extreme efficiency through single-supplier reliance, accepting a degree of redundancy costs in exchange for supply chain security. Where feasible, pursue parallel R&D and investment in future key technology pathways. Additionally, establish "digital twin" models and dynamic monitoring capabilities for supply chains to visualize risks and enable proactive management. Integrate geopolitical risk assessments into core corporate decision-making processes, embedding them as integral components of strategic planning.

Despite the looming barriers, enterprises still have room to maintain international cooperation in non-sensitive sectors and fundamental research. In basic scientific research, climate change technical standards, and non-dual-use consumer-grade applications, multinational corporations should actively explore "depoliticized" cooperation models. Such collaborations, rooted in shared intellectual pursuits, universal market needs, or pressing global issues, demonstrate remarkable resilience beyond geopolitical tensions. For instance, in healthcare, despite biosecurity review pressures, cross-border clinical trial data sharing and joint R&D for global health challenges like cancer treatment continue through compliant "firewall" mechanisms, showcasing the humanitarian resilience of innovative partnerships [38]. Transnational research initiatives addressing global challenges like energy transition and climate change—such as collaborations under the Mission Innovation framework—continue to pool the strengths of the world's leading scientific institutions. These partnerships are typically built on shared scientific questions and complementary technical expertise, yielding open and inclusive outcomes that effectively circumvent scrutiny under sensitive techno-nationalism.

4.2 National Policy Balancing

For nations, techno-nationalism is a double-edged sword. While protectionist policies may bolster domestic industries in the short term, prolonged overprotection and decoupling will lead to technological isolation, skyrocketing innovation costs, and the collapse of global public goods provision.

Nations must establish dynamic feedback mechanisms to balance national security safeguards with economic development. Overly broad security framing—elevating all economic issues to national security concerns—not only deters international capital but also severs domestic innovation ecosystems from global cutting-edge knowledge, resulting in wasteful duplication of efforts. Policymakers should define clear security boundaries to prevent restrictions from uncontrollably encroaching on civilian commercial sectors. Therefore, the ultimate goal of national policy is not to make a static, either-or choice between "security" and "development." Instead, it is to construct a policy framework that seeks a dynamic equilibrium between "security" and 'development' under the dual gravitational pull of geopolitics and global markets. The core lies in shifting from the adversarial logic of "comprehensive decoupling" to the risk governance logic of "targeted controls," while actively preserving limited yet essential spaces for global cooperation.

First, the state must establish clear, transparent, and predictable policy boundaries for the concept of "national security" to prevent its unrestricted erosion of commercial and scientific activities. This promotes precise control and avoids broad decoupling and disruption of supply chains. Drawing on the "small courtyard, high walls" strategy, this involves clearly defining a limited number of 'untouchable' core technology domains directly related to national survival and military advantage ("small courtyard") and constructing robust defenses ("high walls") within these areas. For the vast commercial technology domains beyond these "walls," an open approach should prevail. Policy implementation could adopt a "negative list" management model, dynamically updating lists to specify regulated technologies, entities, and activities. This provides stable market expectations and avoids widespread panic caused by the "generalization of security concerns." Control measures should shift from end-use-based restrictions toward those grounded in technical performance metrics and capability thresholds. For instance, regulations on chip manufacturing equipment could be defined by process node and precision parameters rather than blanket bans on enterprises from specific countries. Such objective standards enhance operational feasibility and foster greater international understanding.

Furthermore, while precisely managing risks, nations must adopt more proactive and sophisticated strategies to ensure their industrial and innovation systems remain deeply embedded within and beneficial to the global ecosystem. In response to decoupling pressures from other nations, differentiated opening policies can be implemented across various sectors. For instance, in upstream core technology domains where restrictions are stringent, resources should be concentrated to achieve independent breakthroughs. Conversely, in application layers, market segments, and data resources—areas where competitive advantages exist—proactive expansion of openness should attract global capital and talent. Simultaneously, pursuing "precision recoupling" with third-party nations can build new, diversified technological cooperation networks, preventing isolation from singular technological trajectories. International technical standards form the core of rule hegemony. Nations should encourage enterprises and research institutions to actively participate in—or even lead—the work of international standards organizations, transforming their technological solutions and industrial practices into globally accepted standards. In areas such as climate change, public health, natural disaster early warning, and fundamental scientific research, countries still share urgent common interests. The nation should effectively leverage multilateral platforms like the United Nations, World Health Organization, and International Telecommunication Union to proactively set cooperative agendas and initiate international large-scale scientific projects in these "low-politics" yet high-value domains. This approach not only maintains essential channels for scientific exchange and eases overall confrontational tensions but also projects a responsible international image while creating opportunities for domestic scientists to integrate into global networks.

Striking a balance between security and development is not a one-time endeavor but a dynamic process requiring continuous monitoring and adjustment. Countries should establish institutionalized policy evaluation mechanisms. Key technology control policies and industrial subsidy policies should undergo regular comprehensive cost-benefit analyses, encompassing dimensions such as the actual impact on domestic innovation speed, the effect on overall industrial chain costs, the influence on international talent attraction, and the implications for alliances and partnerships. When the marginal security gains from protective policies fall significantly below their economic and innovation costs, adjustments should be considered. Concurrently, policy formulation should incorporate broad consultation with diverse stakeholders—including industry, academia, and think tanks—to establish a collaborative mechanism guided by government, led by enterprises, and supported by research. This approach prevents policies from becoming detached from reality.

5. Conclusion

Techno-nationalism has fundamentally and irreversibly reconfigured the underlying logic of international innovation investment, catalyzing its metamorphosis from a purely economic endeavor into a critical frontier of geopolitical rivalry. For decades, international innovation investment operated under a globalization paradigm centered on efficiency and cost optimization, where capital sought the ideal combination of technological factors and market opportunities worldwide. However, the ascendancy of techno-nationalism has forced a paradigmatic shift toward "security-first" and "compliance-centric" rationales. Consequently, geopolitical alignment has ascended from a secondary consideration in investment appraisals to a non-negotiable prerequisite for transactional viability. This transition signifies that international innovation investment is no longer merely a cross-border economic activity but has become an extension of national security statecraft and a primary arena for great-power competition.

In the foreseeable future, international innovation investment will navigate the persistent tension between "security imperatives" and "openness," gravitating toward a "new normal" characterized by fragmentation, regionalization, and deep politicization. Geographically, capital and technology flows are increasingly bifurcated along geopolitical lines, where "friend-shoring" and "onshoring" are supplanting traditional globalized configurations. Sectorally, cross-border M&As and capital mobility in strategic frontiers—such as semiconductors, artificial intelligence, and quantum computing—will face enduring constraints, fostering the emergence of technological enclaves or exclusive ecosystems. The global investment landscape will perpetually oscillate between the pursuit of innovation premiums derived from openness and the demand for containment necessitated by national security.

While techno-nationalism entails significant negative externalities—including diminished global innovation efficiency, redundant construction, and inflated supply chain costs—it has become an inescapable reality for both corporate and state actors. For multinational corporations (MNCs), adopting "multi-local" strategies, fortifying supply chain resilience, and institutionalizing geopolitical risk compliance are imperative for maintaining global competitiveness. For sovereign states, the resilience of governance will be tested by the challenge of maintaining a dynamic equilibrium between defensive securitization and technological vitality. The key to averting a total collapse of the global technological ecosystem lies in precision-targeted regulation rather than indiscriminate decoupling, alongside the preservation of collaborative spaces in non-sensitive domains. In conclusion, the golden age of unfettered international innovation investment has concluded, giving way to a more fragmented and politicized landscape. In this new era, strategic primacy in the global technological race will belong to those who can most effectively balance security and growth within an increasingly complex geopolitical network.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author Contributions

The author conducted all research and wrote the manuscript.

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