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Geopolitics and Innovation: A Systematic Literature Review of Firm Responses to the U.S.–China Trade War

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ABSTRACT

Purpose: This study aims to systematically examine how the U.S.–China trade war has shaped firm-level innovation activities. It identifies key risk factors triggered by geopolitical tensions, analyzes firm-level responses, and evaluates long-term strategic shifts in innovation and industrial strategies.

Methodology: The study employed a systematic literature review (SLR) approach following established guidelines for transparent and replicable synthesis. A structured search across ScienceDirect, JSTOR, and Emerald databases was conducted using Boolean keyword combinations related to the trade war and innovation. A total of sixteen empirical studies were identified and analyzed descriptively, focusing on theoretical mechanisms, empirical findings, and contextual variations.

Findings: The review finds that the trade war introduced substantial trade policy uncertainty (TPU), producing heterogeneous impacts across firms and sectors. Financially constrained and export-dependent firms reduced R&D and experienced declines in patent quality, while larger firms and those with state support increased innovation. Common adaptive responses included geographic diversification of R&D, ESG-driven innovation, and the pursuit of indigenous technologies. TPU thus functions not only as a constraint but also as a conditional driver of "precautionary innovation" aimed at reducing foreign dependence and securing long-term competitiveness.

Unique Contribution to Theory, Policy and Practice: This study provides one of the first systematic syntheses of firm-level innovation responses to the U.S.–China trade war. It contributes to theory by framing trade policy uncertainty as both a deterrent and a stimulus to innovation. For policymakers, it highlights the importance of coordinated industrial policies that enhance resilience and technological self-reliance. For practitioners, it offers insights into how firms can transform external shocks into opportunities for long-term strategic adaptation and innovation-led competitiveness.

Keywords: *U.S.–China Trade War, Firm Innovation, Trade Policy Uncertainty, Systematic Literature Review, Geopolitical Competition*

JEL Codes: *F13, F14, O31, O33, O38*

1. INTRODUCTION

Since 2018, diplomatic relations between the United States (U.S.) and China have been defined by escalating tariffs, investment restrictions, and strategic decoupling. The trade volume between the world's two largest economies has exceeded $700 billion, with deep integration in manufacturing, services, and technology. With China's push for indigenous innovation under Made in China 2025 and Trump's trade policies, the U.S.–China trade war has intensified. Due to trade disputes, both countries have experienced substantial trade volume and profit losses. While the macroeconomic outcomes—such as consumer welfare, inflation, employment, and GDP—have been widely examined, much less attention has been given to firm innovation. Yet uncertainty and barriers to trade directly shape firm innovation and affect long-term growth potential. Because trade conflict is not temporary, identifying its long-term impact is crucial to understanding the economic implications of the trade war.

To address how the trade war affected firm innovation, it is essential to understand how the Trump and Biden administrations responded. Beginning in March 2018, Trump imposed U.S. tariffs on Chinese steel and aluminum, followed by multiple tariff rounds totaling over $360 billion in trade. His administration focused on reducing the U.S. trade deficit through Section 301 tariffs and sanctions on firms such as Huawei and ZTE. While Biden continued tariffs, he was more selective, introducing outbound investment restrictions and enacting the CHIPS and Science Act to re-shore production and reduce reliance on China. These measures led U.S. firms to shift supply chains to Southeast Asia and Chinese firms to increase domestic R&D. A brief history of these developments is summarized in Table 1.

Analyzing the trade war's impact on innovation is challenging because outcomes vary by firm type, industry, technology, and geography. Innovation itself is broadly defined and difficult to measure, often revealing only partial outcomes. To understand its impact meaningfully, it is necessary to ask what innovation incentives the trade war created, what strategic shifts firms adopted, and how effects differ across firm types and industries.

This review employs a systematic literature review approach, analyzing sixteen empirical studies on the trade war's impact on firm innovation. Each study provides distinct empirical contexts and methodologies that together offer comprehensive insights. This review summarizes the history of the trade war, discusses theoretical perspectives linking trade and innovation, explains the methodological approach, synthesizes findings across key themes, and presents policy and research implications.

This study contributes in three ways. First, it fills the gap in understanding firm-level innovation impacts of the trade war by systematically synthesizing empirical findings. Second, it accounts for firm heterogeneity in linking international trade and innovation, addressing limitations of previous theoretical models (e.g., Aghion et al., 2018). Third, it advances the discussion of uncertainty in firm innovation, showing that trade policy uncertainty can sometimes

incentivize "precautionary innovation." This highlights the complex and dual role of uncertainty in shaping firm innovation under the U.S.–China trade war.

Table 1. Brief History of the U.S.-China Trade War

Period	Country	Measures
2017.04	US	Launched "232 investigation" to examine threats posed by steel and aluminum imports to national security.
2017.08	US	Launched "301 investigation" into unfair Chinese trade practices.
2018.03–2019.06	US-China	Three major rounds of tariff announcements and retaliations (see original table).
2020.01	US-China	Signed "Phase One Trade Agreement," with China committing to purchase an additional $200 billion in US goods over two years.
2021.01	US	Biden administration begins. Maintains most of Trump's tariffs and adopts "invest, align, compete" strategy.
2021.03	US	Enacted **American Rescue Plan** to stimulate economy during COVID-19, indirectly supporting domestic producers amid trade disruptions.
2021.11	US	Signed **Infrastructure Investment and Jobs Act** to enhance competitiveness through improved transport and supply chain infrastructure.
2022.08	US	Passed the **CHIPS and Science Act (CSA Act)** allocating $50 billion to boost domestic semiconductor manufacturing and reduce reliance on China.
2022.10	US	Introduced new export controls limiting Chinese access to advanced semiconductors and AI chips, escalating tech decoupling.
2023.01	US	Continued enforcement of tariffs and strategic export bans, with diplomatic attempts at stabilizing trade relations during bilateral summits.
2023.12	US-China	Failed negotiation on tech-sharing protocols and semiconductor access leads to renewed Chinese retaliatory policies targeting US tech firms.
2024.03	US	US Treasury publishes report designating China as a "strategic competitor" in critical industries, not just a trading partner.
2024.07	US	Expanded the "Buy American" mandate, requiring federal agencies to prioritize US-made goods in procurement processes.

2025.01	US	Trump re-elected and returns to office, shifts tone toward more aggressive trade measures.
2025.02	US	Trump signs Executive Order imposing additional 10% tariff on **all** Chinese imports, citing national security.
2025.03	US	Ends **de minimis** provision for Chinese goods, eliminating duty-free treatment for low-value imports.
2025.04	US	Reinstates **Section 232 tariffs**, raising duties to 25% on all steel and aluminum imports, including from China.
2025.05	China	Responds with 15% retaliatory tariffs on US coal and liquefied natural gas (LNG) exports.
2025.06	US-China	Trade tensions escalate amid global concerns over disrupted supply chains, especially in tech and energy sectors.

2. METHODOLOGY

The purpose of this review is to evaluate the impact of the trade war between the U.S. and China on firm innovation since the inception of the Trump administration's trade policies and China's retaliatory measures in 2018. However, due to the complexity and broad scope of this issue, few studies have assessed its overall impact on firm innovation. This is surprising given the extensive attention to welfare and macroeconomic outcomes such as GDP, employment, and consumer prices (see Caliendo & Parro, 2023). Therefore, rigorous research is needed to understand how the trade war has influenced firm innovation decisions and what this means for strategy and policy.

To address this gap, this study adopts a systematic literature review (SLR) approach. An SLR comprehensively examines existing research to categorize and synthesize findings on a specific topic, integrating fragmented evidence into a coherent overview (Kitchenham & Charters, 2007). It helps identify consistent patterns and offers a more comprehensive understanding than individual studies.

Following conventional guidelines, the review involved three steps: (1) defining inclusion criteria, (2) developing a search and selection strategy, and (3) conducting descriptive analysis of the selected studies (Alderson et al., 2004).

2.1 Inclusion Criteria

The review included only empirical studies—excluding theoretical or conceptual ones—that examined the post hoc impact of the trade war on the innovation activities of U.S. and Chinese firms. No restrictions were placed on innovation type (incremental, radical, product, or service).

Studies were required to contain the keywords “trade war” and “innovation” (or synonyms) in the title or abstract and to be published in peer-reviewed journals or referenced in such works.

2.2 Search Process and Studies Selection

A four-stage process was followed. First, a computerized search using the keywords “U.S.–China trade war” and “innovation” was conducted in ScienceDirect, JSTOR, and Emerald, yielding 19 peer-reviewed articles. To improve coverage, a second search added synonyms such as “trade dispute,” “trade conflict,” “trade relations,” “trade friction,” “R&D,” and “research and development,” resulting in 14 additional papers. In the third stage, abstracts of the 33 papers were screened against the inclusion criteria. Descriptive or theoretical studies were excluded, leaving 15 articles. In the final stage, all selected papers were read in full. Additional relevant studies cited within these papers were also reviewed, bringing the total to 16 empirical articles included in the final synthesis.

Although some relevant works may have been overlooked due to interpretive limitations, the systematic approach greatly reduces selection bias and ensures transparency and replicability in identifying core evidence on firm innovation under the U.S.–China trade war.

2.3 Analysis of Selected Studies

Although the selected studies address similar topics within the U.S.–China trade war context, they vary widely in publication date, methodology, sample, and theoretical focus. Therefore, a meta-analysis—which combines data statistically—was not appropriate. As this review aims to explore and map overall impacts rather than quantify them, a descriptive approach was used. Common themes were identified through repeated reading and categorization to generate meaningful academic and practical insights.

In the first phase, key information from each study, such as sample type, industry, trade-war-related risks (independent variables), and innovation outcomes (dependent variables), was extracted and organized (see Table 2). This step helped identify central themes and classify studies into analytical categories. Trade-war outcomes were prioritized, as they reveal how external risks such as economic uncertainty, tariffs, and technological sanctions shape firm innovation. In the second phase, detailed findings were reviewed, with particular attention to statistically significant results and underlying theoretical mechanisms. Relevant references cited in these studies were also consulted for additional insight. Discussion sections were summarized to derive both scholarly and practical implications.

Through this process, three overarching categories were established: risk factors, firm adaptive responses, and long-term strategic shifts.

3. THE DYNAMICS OF THE TRADE WAR AND FIRM INNOVATION: RISKS, FIRM RESPONSES AND STRATEGIC SHIFT

This section reviews key findings from the literature on the U.S.–China trade war and firm innovation. To capture the evolving nature of firm responses from short-term to long-term changes, the review is organized into three themes: risk factors, firm adaptive responses, and long-term strategic shifts. Findings from the selected studies were synthesized to identify major patterns, differences, and implications for future research and policy.

3.1 Risk Factors of the Trade War

The trade war has influenced firm innovation mainly by altering the structure of international trade and increasing uncertainty in decision-making. Shifts in tariffs and trade barriers have disrupted market access, sales, and firm operations, requiring firms to adapt. At the same time, evolving trade policies have introduced persistent unpredictability—an essential factor shaping firms' strategic behavior under risk.

This section synthesizes literature on firm-level risk factors triggered by the U.S.–China trade war, including heightened trade policy uncertainty (TPU), financial strain, export market volatility, and supply–demand disruptions. Collectively, these risks created an environment of economic instability that forced firms to adjust their innovation activities in distinctive ways.

3.1.1 Trade Policy Uncertainty (TPU) and Perceived External Risk

Liu et al. (2024) analyzed Chinese firms' annual reports to examine how the trade war created trade policy uncertainty (TPU)—the unpredictability arising from sudden changes in trade policy (Handley & Limão, 2022). They found that firms more dependent on the U.S. market faced stronger TPU and greater volatility due to their inability to anticipate tariffs and trade barriers. The degree of uncertainty also varied across industries and over time.

Cao and Hu (2024) further showed that TPU can motivate rather than hinder innovation. Using a difference-in-differences (DID) approach, they found that trade-exposed firms—especially in pollution-intensive sectors—increased green R&D as a strategic adaptation to external shocks. TPU thus acts as a form of "disciplining pressure," encouraging sustainability-oriented innovation under uncertainty.

Similarly, Zhang et al. (2025) used patent data and TPU indices to find that rising TPU spurred innovation in high-tech sectors. Firms responded to global supply-chain uncertainty by investing in indigenous innovation and technological self-reliance (Liu & Ma, 2020). This effect was strongest in industries facing high geopolitical and technological tension.

Overall, these studies suggest that TPU functions not only as a constraint but also as a catalyst for "precautionary innovation." Firms most exposed to trade risks often increase R&D to reduce dependence on foreign inputs and uncertain markets, illustrating the paradoxical role of uncertainty as both a deterrent and a driver of innovation (Czarnitzki & Toole, 2007; Bloom et al., 2016).

Table 2. Key Findings from Reviewed Papers

Author	Publication Year	Sample Region and Year	Sample Firm	Data	Methodology	Risk Factors	Innovation Outcomes	Long-term Strategic Shifts
Lai & Sarkar	2023	Taiwan, 2010–2020	Taiwanese listed firms	Taiwan Economic Journal (TEJ) database	Difference-in-Difference, firm fixed effects	Tariff shocks, US-China trade war	Decreased R&D for US-exposed firms, reallocation to tech-advanced countries	Strategic realignment via outward investment
Liu et al.	2024	China, 2007–2020	Chinese listed firms	CSMAR + firm-level TPU index from annual reports	Panel regression, fixed effects	Trade policy uncertainty	R&D declines significantly with TPU rise	Firms restructure investment and hedging strategies
Liu et al.	2023	China, 2000–2020	Chinese exporting firms	China Customs data + CSMAR + patent data	Triple-difference (DDD), IV	Export profitability decline	Higher innovation among firms maintaining export profitability	Shift to higher-value-added and tech-intensive exports
Cao & Hu	2024	China, 2008–2020	Chinese A-share listed firms	CSMAR + green patent data	DID + firm-level TPU index	Trade policy uncertainty	TPU boosts green innovation, esp. in SOEs and coastal regions	Push toward environmentally sustainable tech
Xu et al.	2024	China, 2005–2020	Chinese manufacturing firms	CSMAR + ESG and patent databases	DID, mediation models	US tariffs, ESG pressures	Tariffs increased ESG-driven innovation	Strategic ESG investment becomes resilience mechanism
Chen et al.	2023	China, 2008–2020	Chinese ICT firms	CSMAR + patent + tariff exposure data	DID, PSM	Tariff shocks, US trade war	Sharp decline in invention patents and innovation efficiency	Innovation relocation or shrinkage in US-exposed sectors

Zheng et al.	2024	China, 2007–2020	Chinese digital tech enterprises	CSMAR + firm-level TPU index + patent data	DID, firm fixed effects	TPU from US-China tensions	TPU reduces innovation in key digital technologies	De-globalization and domestic tech substitution
Zhang et al.	2025	China, 2010–2020	Chinese listed firms	CSMAR + TPU index + patent applications	DID + mediation + heterogeneity analysis	TPU	TPU curbs innovation, esp. in non-SOEs and financially constrained firms	Innovation divergence across ownership and region
Ju et al.	2024	China, 2000–2022	N/A (macro-industrial focus)	Literature + policy timeline	Thematic analysis	Geopolitical competition, state subsidies	Mixed—policy-driven innovation support vs. fragmentation risks	US-China decoupling reshaping industrial strategy
Cheng	2023	China, 2010–2020	Chinese firms (culture-indexed)	CSMAR + firm culture index	DID	Trade shocks moderated by corporate culture	Firms with flexible/innovative culture show better innovation resilience	Internal cultural shifts to reinforce adaptive capacity
Kang et al.	2025	China, 2008–2021	Chinese patent filers	CNPAT + USPTO + customs data	DID, PSM	US export controls	Patent quantity increases but quality declines	Surge in low-impact filings; symbolic innovation
Qiao	2022	USA, 1996–2020	US high-tech firms trading with China	NSB + Comtrade + Compustat	Staggered DID, PSM	Geopolitical shocks	Innovation declines in small, financially constrained firms	Selective innovation resilience; federal aid role
Bengur ia et al.	2022	China, 2017–2020	Chinese listed firms	Annual reports + customs + financials	Text analysis (TPU) + regressions	Tariffs & TPU	2.3% drop in R&D, 11.5% profit decline	Firms diversify exports; smaller firms hit hardest
Zhang et al.	2025	China, 2012–2022	Chinese ICT firms	CSMAR + TFP data	DID	Trade friction	TFP increases via R&D &	Push toward quality growth in ICT sector

							management efficiency	
Kong et al.	2024	China, 2014–2021	Chinese A-share firms	CSMAR + customs + patent data	Staggered DID	US tariffs & Chinese retaliation	Average 23% patent drop, esp. in non-SOEs	Manager ability & CSR mitigate negative shocks
Jiang et al.	2023	China, 2017–2019	Chinese exporters	Monthly customs data	DID + IV	US tariffs	Export drops 16.5% (quantity), diversion to large nearby economies	Shift to R&D-intensive, high-capital industries

3.1.2 Financial and Operational Pressure

Benguria et al. (2022) show that the impact of trade policy uncertainty (TPU) depends on firms' financial strength. Using Chinese customs and balance sheet data, they found that highly leveraged or low-liquidity firms experienced sharper declines in exports and profitability under tariff shocks. Financially constrained firms were less able to absorb these shocks, limiting their capacity to sustain innovation or long-term investment (Gulen & Ion, 2016).

Cheng (2023) examined how corporate culture moderates firm responses to TPU. Firms with cooperative, long-term-oriented cultures maintained R&D investment despite tariff pressures, while those focused on short-term goals reduced spending. Organizational culture thus acted as a buffer against operational stress, showing that TPU's effects are shaped by internal firm characteristics (Hofstede & Hofstede, 2001).

Qiao (2022) analyzed how TPU affected pricing power and profitability. Exporters with low markups and high U.S. market dependence suffered severe profit declines, unable to adjust prices without eroding margins. Sudden tariff shocks thus intensified operational strain by constraining firms' strategic flexibility (Kapustina et al., 2020).

Collectively, these studies reveal that TPU's effects are heterogeneous, mediated by firms' financial and organizational capacities. It exacerbates vulnerabilities among firms with weak liquidity, low pricing power, or limited flexibility. Conversely, firms with resilient financial structures or adaptive cultures sustain innovation more effectively under uncertainty.

3.1.3 Export Disruption and Market Reallocation Frictions

Jiang et al. (2023) analyzed how Chinese exporters responded to trade policy uncertainty (TPU) after losing U.S. market access. Firms redirected exports to regions such as the EU and ASEAN, but these efforts only partially offset lost volumes. The authors attribute this to market realignment frictions arising from non-tariff barriers, product incompatibility, and sector-specific constraints. Similarly, Ju et al. (2024) identified contractual rigidities, product standard mismatches, and weak

branding as key barriers to market diversification. Together, these studies highlight structural obstacles that limit firms' ability to reallocate exports during trade conflicts.

In contrast, Liu et al. (2023) found that pre-trade-war export diversification mitigated these disruptions. Firms with broader export portfolios maintained profitability and sustained R&D investment despite TPU shocks. This flexibility served as a strategic buffer, consistent with prior evidence that diversified firms show greater resilience to uncertainty (Kramarz et al., 2020; Macedoni & Xu, 2018).

Overall, TPU disrupts exports unevenly, reducing profits available for innovation. Firms with limited global reach face severe losses, while those with diversified markets and adaptive capabilities maintain stability. TPU thus penalizes rigidity but rewards firms with strategic flexibility and established international networks.

3.1.4 Sector-Specific Risk Exposure

The literature highlights that the effects of trade policy uncertainty (TPU) vary widely across sectors. Kong et al. (2024) found that tariffs targeting specific Chinese manufacturing industries reduced output and employment, but large or state-supported firms often increased innovation by leveraging subsidies and economies of scale. This underscores that innovation responses depend on sector characteristics, firm size, and institutional support.

Similarly, Zhang et al. (2025) examined China's ICT sector and found that TPU unexpectedly raised total factor productivity (TFP) through process upgrades and substitution of foreign technology. In technology-intensive sectors, competitive pressure and the need for self-reliance can transform TPU into a catalyst for innovation (Du et al., 2020; Carvalho et al., 2019).

Ju et al. (2024) extended the analysis using a general equilibrium model capturing tariffs, subsidies, and retaliation effects. They showed that in innovation-intensive sectors with low input substitutability, TPU causes persistent inefficiencies and resource misallocation, especially where industrial upgrading depends on imported intermediates (Lashkaripour & Lugovskyy, 2023).

Overall, the impact of TPU on innovation is shaped by sectoral structure and policy context. While advanced manufacturing and ICT sectors may turn uncertainty into opportunity, innovation-intensive industries with complex global value chains face greater risks of productivity loss and misallocation.

3.2 Innovation Outcomes and Firm Responses

While trade policy uncertainty (TPU) introduces volatility, its effect on innovation is not uniformly negative. Evidence shows a conditional dynamic shaped by firm adaptability and external support. This section focuses on how firms adjust innovation quantity, quality, and strategy under TPU, highlighting both deterrent and stimulus effects.

3.2.1 Trade Policy as a Stimulus or Deterrent to Innovation

Facing rising TPU, some firms respond by innovating rather than retrenching. Liu et al. (2024) developed a firm-level TPU index and found a positive link between TPU and R&D investment, especially among firms reliant on foreign technology. When imported technologies become uncertain, firms substitute with internal innovation, turning TPU into a driver of domestic capability-building.

Cao and Hu (2024) also found that TPU can promote green innovation. Using panel data and a difference-in-differences (DID) model, they showed that pollution-intensive firms increased green R&D as a hedge against policy and regulatory risks. Exposure to stricter environmental markets, such as the EU, further reinforced this shift toward sustainable innovation.

Zhang et al. (2025) provided additional evidence that TPU stimulates innovation in high-tech sectors. Firms increased patent filings as a strategic response to restricted U.S. technology access, though the effect was strongest among large or subsidized firms. Institutional support and resource buffers were therefore crucial in transforming uncertainty into innovation gains.

Ju et al. (2024) examined TPU's macro-level effects and found that while tariffs alone reduce productivity, targeted industrial subsidies can offset these losses by redirecting innovation toward priority sectors. This shows that innovation outcomes are policy-mediated: reactive protectionism suppresses innovation, whereas coordinated industrial policy sustains it (Lashkaripour & Lugovskyy, 2023).

In summary, TPU's impact depends on firms' absorptive capacity, resource access, and policy environment. Firms with foreign technology dependence tend to substitute with domestic R&D (Liu et al., 2024), those in pollution-intensive industries pursue green innovation (Cao & Hu, 2024), and high-tech or state-supported firms maintain R&D momentum (Zhang et al., 2025). Together, these findings reveal that uncertainty can deter or stimulate innovation depending on firm structure and policy coordination.

3.2.2 Declines in Innovation Quality and Capacity

While firm innovation activity may rise under trade policy uncertainty (TPU), several studies show a decline in innovation quality. Chen et al. (2023) found that Chinese ICT firms heavily reliant on U.S. technologies experienced sharp drops in high-value invention patents and a shift toward low-impact utility patents. This suggests that TPU discourages advanced R&D and redirects firms toward short-term, lower-risk outputs.

Kang et al. (2025) observed a similar pattern following U.S. export controls on semiconductors. Although patent filings increased, most were utility-type patents, reflecting "innovation for signaling" (Li et al., 2022)—visible but shallow efforts to display activity under pressure. Combined with technological sanctions, TPU may thus distort innovation strategies and weaken long-term technological capability (Bloom et al., 2016).

Cheng (2023) showed that corporate culture mediates this effect. Firms with short-term profit goals cut R&D during trade shocks, while those with innovation-oriented cultures sustained investment. Thus, TPU's impact on quality depends on internal values as much as external constraints (Hofstede & Hofstede, 2001).

In summary, the increasing quantity of innovation does not necessarily indicate progress. TPU can drive symbolic or low-quality innovation, particularly in financially or technologically constrained firms. Only those with strong innovation cultures and a long-term orientation can maintain genuine technological advancement during periods of uncertainty.

3.2.3 Exporters' Strategic Adjustments in R&D

Under rising trade policy uncertainty (TPU), exporters did not simply reduce or increase innovation—they reallocated and restructured it. Lai and Sarkar (2023) found that Taiwanese multinationals maintained overall R&D spending during the U.S.–China trade war but redirected investment and outward FDI from China to advanced economies such as Singapore, the U.S., and Germany. This reflects a spatial reconfiguration of innovation to manage geopolitical risk and maintain continuity in global value chains.

Liu et al. (2023) showed that export diversification before the trade war strengthened firms' innovation resilience. Using interaction models of market diversity and tariff exposure, they found that diversified exporters increased R&D spending during TPU. Flexible market positioning enabled firms to treat uncertainty as an optimization challenge rather than a constraint (Boehm et al., 2020).

Sectoral context also matters. Zhang et al. (2025) found that Chinese ICT firms used TPU-driven restrictions as a catalyst for digital transformation and AI integration, a "forced transformation" toward technological self-reliance (Wei, Lian, & Wu, 2019). Similarly, Zheng et al. (2024) observed that highly exposed firms increased patenting in strategic technologies such as AI, quantum information, and industrial Internet, particularly among financially flexible, low-leverage firms. These adaptive innovations mitigated the trade war's negative effects on market performance (Chen, Zhang, & Miao, 2023).

Overall, exporters' R&D strategies under TPU vary by prior internationalization, sector, and resources. Firms with diversified markets or technological depth—such as ICT leaders—reconfigured innovation toward resilience and independence. In contrast, less diversified firms faced greater difficulty adapting to global disruptions.

3.3 Long-Term Strategic Shifts

This section focuses on how firms began to restructure their innovation, investment, and supply chain strategies in response to the sustained uncertainty of the US–China trade war. These long-term adjustments extend beyond short-run innovation responses and encompass geographic

diversification, industrial upgrading, domestic substitution, and the emergence of industrial policy coordination. Eight papers in this review address in depth these enduring strategic responses.

3.3.1 National Innovation Strategy and Industrial Policy Responses

Trade policy uncertainty (TPU) during the U.S.–China trade war spurred not only firm-level adaptation but also national shifts in innovation strategy. Ju et al. (2024) used a dynamic general equilibrium model to show that the conflict marked a transition from cost-based to innovation-based competition. While unilateral tariffs distorted resource allocation and reduced efficiency, targeted industrial subsidies mitigated these losses by redirecting innovation capacity. The study emphasizes that coordinated global subsidies would yield greater welfare and efficiency than retaliatory protectionism.

Firms also aligned their strategies with evolving national priorities. Xu et al. (2024) found that many firms, under geopolitical and reputational pressure, adopted environmental, social, and governance (ESG) reforms as part of a broader innovation and legitimacy agenda. These initiatives—ranging from sustainable branding to governance changes—helped firms re-access Western markets and capital under trade restrictions, demonstrating how innovation strategy extends beyond technology to include reputation and policy alignment (Porter & Kramer, 2011).

Together, these studies show that TPU reshaped competitiveness through industrial policy and non-market capabilities. Sector-targeted subsidies enhanced innovation resilience (Ju et al., 2024), while ESG-oriented strategies restored legitimacy and market access (Xu et al., 2024). Protectionism thus shifted innovation from purely technological domains to strategic, institutional, and reputational adaptation—key for sustaining long-term competitiveness under geopolitical uncertainty.

3.3.2 Supply Chain Sovereignty and Input Substitution

Trade policy uncertainty (TPU) from the U.S.–China trade war pushed firms—especially in technology-intensive sectors—to pursue supply chain independence. Kang et al. (2025) found that U.S. export controls on semiconductors and ICT inputs led to a surge in patent filings, much of which consisted of low-value utility patents. This suggests that innovation activity increased in quantity but declined in quality, reflecting pressure-driven substitution rather than sustainable advancement. Without coordinated long-term planning, supply chain sovereignty may therefore remain incomplete.

Liu et al. (2024) similarly found that firms facing higher uncertainty engaged in defensive R&D to replace foreign technologies, aligning with China's broader push for "indigenous innovation" (Handley & Limão, 2017). TPU thus triggered strategically directed innovation aimed at localizing critical inputs, though the long-term outcomes remain uncertain.

Using a general equilibrium model, Ju et al. (2024) examined the broader effects of global value chain (GVC) decoupling. They found that while firms reduced reliance on foreign inputs

and relocated R&D domestically, this led to inefficiencies such as lower total factor productivity and reduced international knowledge spillovers (Amiti et al., 2019; Fajgelbaum et al., 2020). Their findings underscore a key tradeoff: pursuing supply chain sovereignty can enhance short-term resilience but often reduces global innovation efficiency (Bown, 2020; Lashkaripour & Lugovskyy, 2023).

3.3.3 From Tactical Innovation to Systemic Transformation

Beyond short-term reactions, the U.S.–China trade war has prompted a shift from tactical to systemic innovation transformation, particularly among firms capable of reorienting their business models. Kong et al. (2024) found that Chinese manufacturers facing steep tariffs redirected R&D toward high-value areas such as robotics and smart manufacturing. However, only firms with strong R&D foundations and policy support successfully pivoted, highlighting the importance of institutional capacity and absorptive capability for long-term competitiveness.

Zhang et al. (2025) and Zheng et al. (2024) reported similar dynamics in digital and AI sectors, where loss of U.S. technology access accelerated digital realignment. Zhang et al. (2025) described this as "innovation through adversity," while Zheng et al. (2024) showed that high-tech, low-leverage firms expanded patenting in frontier domains like AI, quantum computing, and the metaverse—signaling a strategic reconfiguration toward technological autonomy.

Together, these studies show that the trade war evolved from disruption to a catalyst for structural transformation. Firms leveraged TPU to upgrade from low-margin production to high-tech, self-reliant innovation (Amiti et al., 2019; Fajgelbaum et al., 2020). This transition reflects a broader paradigm shift where resilience, autonomy, and security complement efficiency as core innovation objectives (Handley & Limão, 2017; Bloom et al., 2016). Firms now pursue precautionary innovation—investing in domestic substitutes, green technology, and digital upgrades—driven as much by geopolitical contingencies as by market incentives (Cao & Hu, 2024; Xu et al., 2024).

From a policy perspective, coordinated industrial support and international collaboration are more effective than unilateral tariffs, which fragment innovation ecosystems. As technological decoupling deepens, global governance must adapt to address R&D investment, scientific collaboration, and supply-chain interoperability. Future policy should balance national security with global innovation interdependence to prevent zero-sum outcomes.

4. DISCUSSION

This systematic review reveals that the US-China trade war significantly disrupted firms' R&D and innovation activities, generally causing increased patent filings but reduced innovation quality due to prioritization of quantity over substantive technological progress (Kang et al., 2025). Financial constraints and trade uncertainty notably reduced innovation output, especially for smaller and financially constrained firms (Zhang et al., 2025; Qiao, 2022). Specialized innovation domains, including green technologies, were particularly vulnerable (Cao & Hu, 2024).

In response, firms strategically increased R&D investments, diversified export markets, and shifted toward technological self-reliance as long-term defenses against geopolitical shocks (Liu et al., 2024; Zhang et al., 2024). Strengthening corporate culture and ESG practices emerged as critical internal strategies for resilience, alongside the global reallocation of production and innovation to mitigate trade risks (Cheng, 2023; Lai & Sarkar, 2023; Xu et al., 2024).

These findings provide profound implications for theoretical frameworks widely discussed in the literature, notably real options theory. While traditional real options theory predicts that firms delay investments when faced with uncertainty, empirical evidence from this review illustrates that heightened trade uncertainty can paradoxically drive proactive innovation strategies aimed at self-reliance and risk mitigation (Liu et al., 2023; Liu et al., 2024). The "escape-competition" hypothesis is also supported, as firms facing intense competitive pressures from tariffs and geopolitical tensions intensified innovation efforts to maintain competitiveness (Zhang et al., 2024). Furthermore, signaling theory closely aligns with the findings of this review, explaining that strategic ESG enhancement as firms sought to differentiate themselves in disrupted global markets (Xu et al., 2024).

The findings suggest several avenues for future research. First, the role and effectiveness of state-driven innovations under large uncertainty can further be investigated. Many developed and developing countries, such as South Korea and China, have a successful history of state-driven innovation. These countries achieved significant innovation competitiveness in many industries by taking the risk associated with innovation projects and making proactive investments in key technology areas. While this state-driven innovation has many successful stories, the findings of this review leave us with a question of whether state-driven investment in uncertain innovation can always lead to positive results.

Second, examining the long-term sustainability and competitive viability of state-driven innovation under persistent geopolitical tensions could provide valuable insights. Future studies might also analyze cross-country comparisons beyond the US-China context to determine whether similar strategic shifts occur elsewhere under trade uncertainty. Additionally, research focusing on sector-specific vulnerabilities, especially in green technologies, could inform strategies to maintain innovation capability in prolonged geopolitical disruptions.

Policymakers must recognize that protectionist trade policies, while intended to preserve domestic economic interests, can inadvertently encourage resource misallocation and diminish innovation quality. Therefore, targeted policies promoting genuine technological breakthroughs rather than sheer patent volume are essential. Additionally, government initiatives should provide targeted financial support to smaller and specialized innovation-driven firms, which remain highly vulnerable during trade shocks. Promoting internal organizational capabilities, such as corporate culture and ESG practices, can also enhance firm resilience. Finally, encouraging strategic diversification in global markets and supply chains can mitigate risks, ensuring more robust economic adaptability in increasingly volatile international environments.

As with any systematic review, there is potential for publication bias. Studies that often report statistically significant findings or show negative effects of barriers are often likely to get published and cited. This can mislead the overarching literature to under-represent cases where trade shocks were neutral or had mixed impacts on innovation. Thus, future studies may put more emphasis on the mixed effects of the uncertainty brought by the trade way. These can include how export diversification boosts innovation, or what firm or industry resilience factors can mitigate the negative effects of tariff uncertainty on firm innovation.

The lack of directly comparable data across different sectors and countries is a limitation of this review. Also, generalizing findings beyond the US-China context is challenging because policy exposure, industry and supply chain structures, and data availability vary. In particular, the papers reviewed here mostly discuss Chinese cases, which provide limited implications for the U.S. context. Thus, future research should explore in detail how this trade uncertainty and rise in tariffs can influence different sectors and countries for rich theoretical as well as policy implications.

Lastly, it is worth noting that innovation outcomes, particularly measurable ones such as patent applications or sales, often experience a delay from early spending. These long-run trajectories may not be fully captured in many of the reviewed studies, as the reviewed papers often analyze short to mid-term effects of trade shocks. Thus, longitudinal designs should be adopted in future research. The enduring effects of trade disruption on firm innovation outcomes and potentially national and global innovation ecosystems can be better assessed.

6. CONCLUSION

Innovation is a complex process. To create value from ideas and inventions, it is required to coordinate diverse actors and environmental factors that may influence the process. While some of those actors and factors are predictable or controllable, many others may arise outside innovators' control and expectations. The trade war between the U.S. and China epitomizes such a significant challenge that can transform the entire landscape of firm innovation. Although this case has significant implications for firm strategies and economic policies, academic and policy efforts to analyze the phenomenon are limited, which may result in a substantial loss of knowledge and hinder policy advancement. To fill this gap, the trade war should be analyzed not only from a traditional perspective, including welfare, inflation, or employment, but also from an innovation and industrial perspective, which grounds the very beginning of the trade war. This review concludes by encouraging academic and policy efforts that focus on the survival and growth of firms in this turbulent global environment.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The author hereby declares that generative AI technologies have been used during the editing of this manuscript. For example, Grammarly was used for grammar and spell checking, as well as suggestions for improving sentence structure.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

REFERENCES

Amiti, M., Redding, S. J., & Weinstein, D. (2019). The impact of the 2018 trade war on U.S. prices and welfare. *Journal of Economic Perspectives*, 33(4), 187–210. https://doi.org/10.1257/jep.33.4.187

Benguria, F., Choi, J., Swenson, D. L., & Xu, M. J. (2022). Anxiety or pain? The impact of tariffs and uncertainty on Chinese firms in the trade war. *Journal of International Economics*, 137, 103608. https://doi.org/10.1016/j.jinteco.2022.103608

Bloom, N., Draca, M., & Van Reenen, J. (2016). Trade induced technical change? The impact of Chinese imports on innovation, IT, and productivity. *Review of Economic Studies*, 83(1), 87–117. https://doi.org/10.1093/restud/rdv039

Bloom, N., Sadun, R., & Van Reenen, J. (2016). Management as a technology? *American Economic Review*, 106(5), 141–145.

Boehm, C. E., Flaaen, A., & Pandalai-Nayar, N. (2020). Input linkages and the transmission of shocks: Firm-level evidence from the 2018–2019 tariffs. *Review of Economics and Statistics*, 102(5), 791–804. https://doi.org/10.1162/rest_a_00882

Bown, C. P. (2020). The 2018–2019 trade war and U.S. tariffs. Peterson Institute for International Economics Working Paper.

Cao, Y., & Hu, J. (2024). Can trade policy uncertainty drive green innovation? Empirical evidence from China. *Journal of Cleaner Production*, 414, 137650. https://doi.org/10.1016/j.jclepro.2023.137650

Carvalho, V., Azevedo, L., & Massuquetti, A. (2019). Trade wars and global welfare losses. *Economic Modelling*, 80, 251–263.

Chen, J., Zhang, H., & Miao, L. (2023). The negative effects of the U.S.–China trade war on innovation: Evidence from the Chinese ICT industry. *Technovation*, 120, 102700. https://doi.org/10.1016/j.technovation.2023.102700

Cheng, S. (2023). Corporate culture and firm resilience in China: Evidence from the Sino-U.S. trade war. *Pacific-Basin Finance Journal*, 79, 102039. https://doi.org/10.1016/j.pacfin.2023.102039

Czarnitzki, D., & Toole, A. (2007). Business R&D and the interplay of R&D subsidies and product market uncertainty. *Review of Industrial Organization*, 31(3), 169–181.

Demir, F., & Ersan, O. (2017). Economic policy uncertainty and firm-level investment. *Journal of Economic Behavior & Organization*, 139, 338–356.

Du, J., Lu, Y., & Tao, Z. (2020). Tariffs, trade wars, and firm performance: Evidence from China. *Journal of Comparative Economics*, 48(4), 958–978.*

Fajgelbaum, P. D., Goldberg, P. K., Kennedy, P. J., & Khandelwal, A. K. (2020). The return to protectionism. *Quarterly Journal of Economics*, 135(1), 1–55.

Gulen, H., & Ion, M. (2016). Policy uncertainty and corporate investment. *Review of Financial Studies*, 29(3), 523–564.

Handley, K., & Limão, N. (2017). Policy uncertainty, trade, and welfare: Theory and evidence for China and the United States. *American Economic Review*, 107(9), 2731–2783.

Handley, K., & Limão, N. (2022). Trade policy uncertainty and its effects. *Annual Review of Economics*, 14, 57–80.

Hofstede, G., & Hofstede, G. J. (2001). Culture's consequences: Comparing values, behaviors, institutions and organizations across nations. Sage.

Huang, Y., Jia, H., & Ge, Y. (2024). Trade war and innovation upgrading: Evidence from China's ICT sector. *Technovation*, 129, 102713.

Jiang, L., Lu, Y., Song, H., & Zhang, G. (2023). Responses of exporters to trade protectionism: Inferences from the U.S.–China trade war. *Journal of International Economics*, 140, 103687.

Ju, X., Ma, H., & Wang, Y. (2024). Trade wars and industrial policy competitions: Understanding the U.S.–China economic conflicts. *World Economy*, 47(5), 1201–1234.

Kang, Y., Ma, X., Xie, M., & Zhong, N. (2025). Innovation's false spring: U.S. export controls and Chinese patent quality. *Journal of International Money and Finance*, 150, 103229.

Kapustina, L., et al. (2020). Global trade wars: Economic effects and strategic responses. *Journal of Economic Issues*, 54(3), 742–762.

Kong, D., Liu, C., Narayan, P. K., & Sharma, S. S. (2024). The U.S.–China trade war and corporate innovation: Evidence from China. *Financial Management*, 53(3), 501–541.

Kramarz, F., Martin, J., & Mejean, I. (2020). Volatility in the small and in the large: The lack of diversification in international trade. *Journal of International Economics*, 122, 103276.

Lashkaripour, A., & Lugovskyy, V. (2023). Scale economies, industrial policy, and trade. *Journal of Political Economy*, 131(2), 389–436.

Li, L. S. Z., Liu, H., & Yuan, R. (2022). Export restrictions and firm innovation strategies: Evidence from China. *World Economy*, 45(7), 1952–1978.

Liu, Q., & Ma, Y. (2020). Trade policy uncertainty and innovation: Evidence from China's WTO accession. *Journal of International Economics*, 127, 103383.

Liu, Q., Xu, X., & Zhang, G. (2023). Export profitability and firm R&D: Evidence on China's export diversification under the trade war. *Journal of International Economics*, 144, 103755.

Liu, Q., Xu, X., Zhang, G., & Zhao, W. (2024). The effect of trade policy uncertainty on R&D investment: Evidence from Chinese listed firms. *Journal of Comparative Economics*, 52(1), 45–67.

Macedoni, L., & Xu, M. (2018). Trade elasticity and firm diversification. *Journal of International Economics*, 115, 175–191.

Porter, M. E. (1992). Competitive advantage. Free Press.

Porter, M. E., & Kramer, M. R. (2011). Creating shared value. *Harvard Business Review*, 89(1–2), 62–77.

Qiao, Y. (2022). Geopolitical hostility and corporate innovation: Evidence from U.S. high-tech firms in trade sectors with China. *Economics & Politics*, 36(3), 517–556.

Wei, S., Lian, J., & Wu, H. (2019). Trade frictions and structural upgrading of Chinese manufacturing: Evidence from patent data. *China Economic Review*, 57, 101335.

Xu, H., Lee, C., & Zhang, Y. (2024). Navigating international competition with ESG: Insights from the U.S.–China trade war. *Journal of Business Ethics*, 189(3), 755–776.

Zhang, L., Zhang, J., & Shi, Q. (2025). The positive impact of Sino-U.S. trade friction on total factor productivity: Evidence from Chinese ICT firms. *Journal of International Trade & Economic Development*, 34(1), 1–26.

Zhang, Y., Wu, H., & Zhou, L. (2025). Trade policy uncertainty and corporate innovation: Evidence from the U.S.–China trade war. *China Economic Review*, 82, 102135.

Zheng, Z., Fang, H., & Li, P. (2024). U.S.–China trade war and key digital technology innovation of Chinese enterprises. *Technovation*, 124, 102711.