Navigating Geopolitical Tensions: The Role of Industrial and Technological Factors on Knowledge Flows Between U.S. and China

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This study investigates how geopolitical tensions impact cross-border knowledge flows between U.S. and Chinese firms, focusing on the mediating role of switching costs and the moderating effects of industrial chain dependency and technological substitutability. Drawing on Resource Dependence Theory (RDT) and the Knowledge-Based View (KBV), we empirically analyze comprehensive secondary datasets, including patent citation data and geopolitical risk indices. Our findings reveal that geopolitical tensions significantly reduce knowledge flow intensity, particularly in industries with high technological substitutability and cost sensitivity. However, industrial chain dependency mitigates these effects, with switching costs partially mediating the relationship. This study contributes to RDT by incorporating geopolitical risks as critical external dependencies and extends KBV by highlighting firms' adaptive strategies in politically volatile environments. These insights offer actionable guidance for firms and policymakers in navigating politically sensitive global value chains.

Keywords: geopolitical tensions, knowledge flow intensity, switching costs, industrial chain dependency, technological substitutability

INTRODUCTION

Geopolitical tensions between the United States and China have intensified over the past decade, fundamentally reshaping global trade, investment, and innovation ecosystems. Since the onset of the U.S.–China trade war in 2018, over $550 billion worth of goods have been subjected to tariffs (Bown, 2019), alongside stringent restrictions on Chinese technology firms such as Huawei and ZTE. The CHIPS and Science Act (2022) further underscored U.S. strategies to reduce dependency on Chinese supply chains, particularly in semiconductors, a pivotal sector for technological advancement (Yeung et al., 2023). Concurrently, China's "dual circulation" strategy emphasizes self-reliance in critical technologies while fostering diversified trade partnerships (Fan et al., 2024).

Central to this geopolitical rivalry is the issue of knowledge flows, which underpin technological innovation and competitive advantage (Grant, 1996). Firms in knowledge-intensive sectors such as semiconductors, pharmaceuticals, and renewable energy rely on global innovation networks to sustain their competitive edge. However, geopolitical risks—ranging from intellectual property (IP) theft and trade restrictions to heightened regulatory uncertainties—have prompted firms to recalibrate their cross-border collaboration strategies (Li et al., 2022; Jin et al., 2024).

While prior research on international business has emphasized the importance of knowledge-sharing (Foss et al., 2010; Grant, 1996), it has largely overlooked the nuanced ways in which geopolitical risks reshape these dynamics. Theoretical frameworks such as Resource Dependence Theory (RDT) and the Knowledge-Based View (KBV) provide valuable insights but require extension to account for the challenges posed by geopolitical uncertainty. RDT posits that firms' strategies are shaped by their dependencies on critical external resources controlled by other organizations or regions (Pfeffer & Salancik, 2015). Under such conditions, firms may adopt strategies such as diversifying partnerships to reduce dependence on high-risk regions or selectively limiting knowledge-sharing activities to safeguard proprietary assets (Hillman et al., 2009; Du et al., 2023). In contrast, KBV emphasizes the centrality of knowledge as a strategic resource, positing that firms continue to engage in knowledge-sharing when it is critical to maintaining their innovation capabilities, even in risky environments (Grant, 1996; Saikia et al., 2024). These complementary perspectives form the theoretical foundation for understanding how firms navigate knowledge-sharing under geopolitical tensions.

This study contributes to the literature in three significant ways. First, it integrates RDT and KBV to propose a novel framework linking geopolitical risks to knowledge flows, mediated by switching costs and moderated by industry-specific characteristics. In doing so, it extends RDT's focus on resource dependency by incorporating geopolitical tensions as a critical environmental factor, while adapting KBV to the unique challenges of managing knowledge flows in a fragmented global economy. Second, leveraging robust datasets—including patent citation records, trade flow data from the Atlas of Economic Complexity, and the Global Geopolitical Risk Index (Caldara & Iacoviello, 2022)—this study provides empirical evidence of how firms manage knowledge flows under geopolitical uncertainty.

In addressing the research question—how do geopolitical tensions impact knowledge flows, mediated by switching costs and moderated by industrial chain dependency and technological substitutability?—this study not only fills a critical gap in the literature but also offers a comprehensive framework for understanding how firms sustain innovation amidst increasing geopolitical fragmentation.

THEORETICAL FOUNDATION

Geopolitical Tension

Geopolitical tensions (GPT) have long shaped global economic and political trajectories, originating in power dynamics and competition for strategic dominance (Freedman, 2017). Classical geopolitics, as outlined by Mackinder (1904) and Haushofer (1924), emphasized territorial control as the foundation of geopolitical power. However, in the 21st century, the focus has shifted to economic, technological, and informational domains, reflecting the growing interconnectedness of global value chains and the centrality of knowledge and innovation in modern statecraft (Moisio, 2018). This shift has fundamentally altered the nature of state-to-state rivalries, with economic interdependencies and technological competition now serving as critical arenas of contention (Witt et al., 2023; Luo, 2020).

The evolving relationship between the United States and China exemplifies this paradigm shift. Initially marked by economic complementarity following China's accession to the World Trade Organization (WTO) in 2001, the relationship fostered extensive cross-border investments and knowledge-sharing activities, benefiting both nations (Child & Tse, 2001). U.S. firms leveraged China's cost-efficient manufacturing capabilities, while China gained access to advanced technologies and global markets, driving unprecedented economic growth and innovation (Ji et al., 2020). However, initiatives such as "Made in China 2025" and the Belt and Road Initiative (BRI) signaled China's strategic ambitions to achieve technological self-sufficiency and global leadership, escalating tensions since 2018 (Fan & Chen, 2024; Li et al., 2022). These developments culminated in the U.S.–China trade war, which imposed tariffs on $550 billion worth of goods and introduced stringent restrictions on technology transfers (Bown, 2019).

The U.S. imposition of export controls and restrictions on critical technologies, such as semiconductors, aligns with this pattern, as firms in affected industries increasingly prioritize securing intellectual property over collaboration (Zhao et al., 2023). These findings extend Resource Dependence Theory (RDT), illustrating how geopolitical risks exacerbate resource vulnerabilities, compelling firms to reconfigure their reliance on international networks (Pfeffer & Salancik, 2015). Simultaneously, the Knowledge-Based View (KBV) is reinforced, as the strategic value of knowledge is re-evaluated in light of increased uncertainty (Grant, 1996).

The bilateral dynamics between the U.S. and China exert profound influence over global economic stability, trade flows, and investment patterns. Together, these two nations account for approximately 40% of global GDP and serve as pivotal hubs in global trade and innovation networks (Wang et al., 2020). Partner countries such as Vietnam, Malaysia, and India have adapted to the decoupling trends spurred by the U.S.–China trade conflicts by positioning themselves as alternative hubs for global manufacturing (Luo, 2020; Belderbos et al., 2021).

Conversely, partner countries face considerable challenges in navigating these geopolitical complexities. The European Union (EU), for instance, must balance its trade relationships with China against its alignment with U.S.-led initiatives aimed at curbing Chinese technological influence (Witt et al., 2023). Similarly, African nations involved in China's BRI increasingly encounter risks related to over-reliance on Chinese financing and infrastructure development (Luo & Wang, 2021).

The academic interest in GPT reflects its pervasive implications for global governance, economic stability, and innovation systems. Scholars have emphasized the need to integrate GPT into theories of international business and strategy, particularly as it intersects with phenomena such as technological nationalism and digital transformation (Moisio, 2018; Witt et al., 2023; Peng et al., 2021).

Resource Dependence Theory (RDT)

Resource Dependence Theory (RDT), introduced by Pfeffer and Salancik in The External Control of Organizations (1978), revolutionized organizational theory by emphasizing the influence of external dependencies on firm behavior. Building on earlier work on open systems (Katz & Kahn, 1966) and power-dependence dynamics (Emerson, 1964), RDT posits that firms operate within complex interdependencies shaped by their reliance on critical resources controlled by external entities. Such dependencies create power imbalances that influence strategic decisions, including the formation of alliances, mergers, and political engagement aimed at securing resources, mitigating uncertainty, and managing power asymmetries (Pfeffer & Salancik, 1978; Casciaro & Piskorski, 2005; Hillman et al., 2009).

Over four decades, RDT has been applied across diverse organizational and interorganizational contexts. Early applications focused on how firms restructure relationships with suppliers, competitors, and regulators to minimize dependence risks (Pfeffer & Nowak, 1976). Subsequent research integrated RDT with theories of corporate political activity, illustrating how lobbying and regulatory influence help mitigate dependencies on state-controlled resources (Hillman et al., 2009). More recently, RDT has expanded to address global and multi-level institutional contexts, exploring how firms navigate resource dependencies in cross-border environments influenced by trade policies, foreign direct investment (FDI), and geopolitical tensions (Drees & Heugens, 2010; Mellahi et al., 2016; Cuypers et al., 2021).

Switching costs emerge as a critical mediating factor in the RDT framework, explaining why firms may continue to rely on high-risk partnerships even when faced with significant geopolitical uncertainty. Our empirical analysis highlights the economic, operational, and relational barriers that switching costs impose, particularly in industries characterized by high asset specificity and technological interdependence (Williamson, 1981; Nienhüser, 2008). This aligns with prior work on the adaptive strategies firms adopt to manage dependencies while minimizing exposure to external risks (Sheng & Glaister, 2022).

Knowledge-Based View (KBV)

The Knowledge-Based View (KBV) builds on the Resource-Based View (RBV), emphasizing knowledge as a core resource for achieving sustained competitive advantage. Wernerfelt (1984) and Barney (1991) laid the foundation for RBV by highlighting the strategic importance of firm-specific resources.

Extending this framework, Grant (1996) formalized KBV by positioning knowledge as the most strategically significant resource, characterized by its tacitness, non-imitability, and capacity to drive innovation and long-term competitive advantage.

Nonaka and Takeuchi (2007) further developed KBV by introducing the SECI framework, which articulates how organizations create, share, and utilize knowledge through processes of socialization, externalization, combination, and internalization. Kogut and Zander (1992) posited that the primary function of firms is to generate, transfer, and recombine knowledge, distinguishing them from markets. Spender (1996) added depth to this discussion by differentiating explicit and tacit knowledge, emphasizing their interplay in organizational learning and strategic decision-making.

Subsequent studies have refined KBV's theoretical dimensions. Felin and Hesterly (2007) underscored heterogeneity in knowledge as a source of value creation, while Tsoukas (1996) highlighted the distributed nature of organizational knowledge.

Knowledge exhibits unique traits that enhance its strategic value in competitive environments. Unlike physical assets, knowledge is non-rivalrous, meaning it can be shared without depletion, and its value often increases with reuse (Nonaka & Takeuchi, 2007). KBV identifies knowledge integration and application as central to a firm's ability to innovate and sustain competitive advantage (Grant, 1996; Zander & Kogut, 1995). This is particularly evident in knowledge-intensive industries such as biotechnology, semiconductors, and green technologies, where continuous innovation and learning are critical for survival (Zhu et al., 2024; Luo & Tung, 2007).

Felin and Hesterly (2007) argued that high substitutability reduces dependency on specific partners, enabling firms to reconfigure knowledge-sharing arrangements with relative ease. Conversely, in industries reliant on specialized, non-replicable technologies, such as semiconductors, firms face significant risks in transferring or withholding knowledge (Grant, 1996; Zhu et al., 2024). Our regression analyses substantiate these claims, revealing that industries with high technological substitutability, such as consumer electronics, are less affected by geopolitical tensions due to their ability to pivot to alternative suppliers (Charpin et al., 2024).

Hypotheses

Geopolitical tensions (GPT) have emerged as a critical factor influencing global value chains and knowledge-sharing practices, significantly shaping the dynamics of cross-border collaborations. Knowledge flow, encompassing the transfer of both explicit and tacit knowledge, is central to fostering innovation and achieving competitive advantage in interconnected economies (Nonaka & von Krogh, 2009; Teece, 2020). However, these flows are inherently contingent upon trust, reciprocity, and stable institutional environments—all of which are profoundly disrupted by geopolitical tensions (Foss et al., 2010; Shapiro et al., 2021).

The negative relationship between GPT and knowledge flow intensity can be understood through the lenses of Transaction Cost Theory (TCT) and the Knowledge-Based View (KBV). TCT posits that firms strive to minimize transaction costs, including those arising from uncertainty and opportunistic behavior (Williamson, 1985). Geopolitical tensions exacerbate these costs by heightening regulatory ambiguity, increasing compliance burdens, and undermining the enforceability of cross-border agreements (Tay et al., 2021; Bussy & Zheng, 2023). For example, U.S. export controls during the trade war created significant complexities for firms engaging in high-risk collaborations, particularly in the semiconductor and AI sectors (Prashantham et al., 2018).

In contrast, KBV emphasizes the strategic significance of knowledge as a critical asset that drives innovation and competitive advantage (Grant, 1996; Nonaka & Takeuchi, 1995). Tacit knowledge, in particular, relies heavily on interpersonal trust and prolonged interaction for effective transfer (Von Hippel, 1994). Geopolitical tensions undermine this trust, eroding the relational foundations necessary for productive knowledge-sharing. In response, firms often reduce engagement in high-risk collaborations or restrict knowledge exchange to less sensitive domains (Puranam et al., 2006; Luo et al., 2021). Our findings confirm that firms adopt risk-averse strategies in response to geopolitical uncertainty, such as prioritizing collaborations in low-risk domains or focusing on localized innovation.

Building on insights from TCT and KBV, we identify three mechanisms through which GPT impacts knowledge flow intensity. First, geopolitical tensions introduce regulatory ambiguities, compliance burdens, and risks of opportunistic behavior, raising the cost of cross-border collaborations (Juergensen et al., 2024).

Geopolitical tensions foster perceptions of opportunism and adversarial intent, eroding the relational foundations of knowledge-sharing (Kretschmer & Khashabi, 2020). This dynamic is particularly salient in U.S.–China relations, where concerns over IP misappropriation have led U.S. firms to restrict the scope and intensity of knowledge flows (Jones, 1999). Third, industries with high IP sensitivity, such as biotechnology, renewable energy, and advanced manufacturing, are particularly vulnerable to disruptions in knowledge flow. In these sectors, geopolitical tensions often lead to a reconfiguration of collaborative practices, with firms prioritizing partnerships with aligned countries or focusing on localized innovation (Li et al., 2024). Based on these insights, we hypothesize:

H1: *Geopolitical tensions between the United States and China significantly reduce knowledge flow intensity between U.S. firms and their Chinese partners.*

Geopolitical tensions (GPT) have profound implications for cross-border knowledge flows, particularly in industries characterized by high cost sensitivity and technological substitutability. These moderating factors, deeply rooted in the theoretical traditions of Resource Dependence Theory (RDT) and the Knowledge-Based View (KBV), elucidate how firms strategically adjust their knowledge-sharing practices in response to external uncertainties.

Industries with high cost sensitivity prioritize operational cost efficiency over long-term strategic commitments, making them particularly susceptible to the disruptions caused by geopolitical tensions. RDT posits that firms embedded within broader external environments are highly dependent on critical resources, and cost-sensitive industries often rely on external suppliers for essential inputs (Pfeffer & Salancik, 1978). Geopolitical risks exacerbate these dependencies by introducing regulatory and operational uncertainties, limiting firms' flexibility to diversify their supply chains (Hillman et al., 2009). As a result, firms in cost-sensitive industries face dual challenges: mitigating rising costs due to geopolitical risks and maintaining access to indispensable resources.

From a KBV perspective, the strategic importance of knowledge is often deprioritized in cost-sensitive industries. Geopolitical tensions elevate the costs of managing cross-border knowledge-sharing activities, compelling firms to focus on operational efficiency rather than innovation-driven collaborations (Grant, 1996). This trade-off is particularly pronounced in industries like consumer electronics, textiles, and low-margin manufacturing, where firms scale back knowledge-sharing initiatives to avoid risks associated with intellectual property (IP) misappropriation and compliance complexities (Zhu et al., 2024). For instance, during the U.S.–China trade war, heightened tariffs and regulatory restrictions forced firms in these sectors to reduce collaborative efforts, particularly those involving high-risk knowledge exchanges (Prud'homme & von Zedtwitz, 2019).

Empirical evidence further supports the vulnerability of cost-sensitive industries to geopolitical tensions. These sectors exhibit a heightened sensitivity to disruptions in tacit knowledge exchanges, which rely on trust and close interpersonal interactions (Child & Tse, 2001). GPT erode this trust, undermining the relational foundations of knowledge-sharing partnerships. For example, U.S. export controls on high-tech products have forced firms to reassess their collaborative practices, particularly in IP-sensitive industries such as semiconductors and telecommunications (Li et al., 2022; Wang et al., 2020). Building on these insights, we hypothesize the following:

H2a: *Cost sensitivity strengthens the negative effect of geopolitical tensions on knowledge flow intensity, such that the negative relationship is stronger in more cost-sensitive industries.*

Technological substitutability, defined as the degree to which alternative technologies or suppliers can replace existing ones without significant performance or cost implications, plays a pivotal role in shaping firms' responses to GPT. RDT asserts that substitutability diminishes dependency on specific resources or partners, thereby providing firms with greater flexibility to disengage from high-risk relationships during periods of geopolitical uncertainty (Pfeffer & Salancik, 1978; Hillman et al., 2009). For example, the diversification of supply chains during the U.S.–China trade war demonstrates how firms in industries with high substitutability, such as electronics, pivoted to alternative suppliers in countries like Vietnam and India (Fan et al., 2024; Luo et al., 2020).

From a KBV perspective, technological substitutability shapes the calculus of knowledge-sharing. Firms in industries with high substitutability often prioritize protecting proprietary knowledge over sustaining collaborative partnerships, particularly when geopolitical tensions heighten the risks of IP theft or competitive disadvantage (Grant, 1996; Nonaka & Takeuchi, 1995). This dynamic is evident in high-tech sectors, where geopolitical considerations have led firms to reduce joint research and development (R&D) activities with foreign partners in favor of localized innovation strategies (Sun et al., 2020).

Empirical studies corroborate these patterns, showing that firms in high-substitutability industries are more likely to disengage from knowledge-sharing activities under geopolitical stress. In the renewable energy sector, for example, firms have increasingly localized innovation to minimize dependencies on international collaborators, aligning their strategies with both RDT and KBV principles (Charpin et al., 2024; Zhu et al., 2024). Based on these theoretical and empirical insights, we propose the following hypothesis:

H2b: *Technological substitutability strengthens the negative effect of geopolitical tensions on knowledge flow intensity, such that the negative relationship is stronger in industries with higher technological substitutability.*

The relationship between industrial chain dependency and knowledge flow intensity is foundational to understanding the dynamics of global value chains and cross-border innovation networks. Industrial chain dependency reflects the extent to which firms rely on specialized inputs and knowledge-intensive processes from their partners, creating both opportunities for collaboration and vulnerabilities to external disruptions (Gereffi et al., 2005; Luo et al., 2020). Empirical evidence strongly supports this dynamic. For instance, Gereffi and Lee (2012) demonstrated that firms embedded in global value chains engage in extensive knowledge-sharing to enhance efficiency and drive innovation.

From a theoretical perspective, both Resource Dependence Theory (RDT) and the Knowledge-Based View (KBV) provide robust frameworks for understanding how industrial chain dependency drives knowledge flows. RDT emphasizes that firms reliant on external resources are incentivized to engage in collaborations that secure critical inputs and reduce environmental uncertainties (Pfeffer & Salancik, 1978; Hillman et al., 2009). KBV complements this by highlighting the strategic importance of knowledge-sharing in maintaining competitive advantage and fostering innovation (Grant, 1996). Together, these frameworks explain why dependency-driven knowledge flows persist even under conditions of geopolitical uncertainty.

Geopolitical tensions add complexity to this relationship by introducing regulatory barriers, heightened transaction risks, and political uncertainties. However, firms with high industrial chain dependency often exhibit resilience by sustaining knowledge-sharing activities to mitigate these risks (Witt, 2019).

Dependency-driven knowledge flows are not uniform but vary across industries and regions. Sectors heavily reliant on Chinese partners for specialized inputs, such as advanced manufacturing and electronics, are more likely to engage in sustained collaborations than industries with flexible sourcing options (Luo & Wang, 2021; Zhu et al., 2024). These nuances highlight the importance of dependency as a moderating factor in knowledge flow dynamics and underscore its role in sustaining global innovation networks.

Based on these insights, we propose the following hypothesis:

H3: *Industrial chain dependency positively affects knowledge flow intensity between U.S. firms and their Chinese partners.*

Switching costs play a critical mediating role in the relationship between industrial chain dependency and knowledge flow intensity. Rooted in the theoretical traditions of RDT and KBV, switching costs capture the economic, relational, and operational barriers that firms face when altering partnerships. These costs are particularly salient in industries characterized by resource specificity, technological complexity, and entrenched supply chain relationships (Williamson, 1985; Hillman et al., 2009). These costs are amplified in industries with limited alternative suppliers or specialized inputs, where disengaging from existing partners risks substantial disruptions (Narula et al., 2022).

KBV provides further insight into the role of switching costs in sustaining knowledge-sharing activities. This co-specialization creates additional barriers to switching partners, as knowledge developed within one partnership may lose value or become inapplicable in a new context (Argyres & Zenger, 2012). By incentivizing firms to maintain existing relationships, switching costs ensure the continuity of knowledge-sharing activities, even in politically uncertain environments. Switching costs arise from several sources: first, asset specificity. Investments in customized technologies and processes tailored to specific partnerships increase the economic and operational barriers to switching (Williamson, 1985). Second, relational embeddedness. Trust and mutual understanding built over time between partners cannot be easily replicated, further deterring disengagement (Uzzi, 1997). Third, knowledge Co-specialization. Knowledge developed collaboratively often holds limited value outside the context of the original partnership, reducing firms' willingness to switch partners (Argyres & Zenger, 2012).

Empirical studies provide robust evidence of the mediating role of switching costs in sustaining knowledge flows. In the pharmaceutical industry, for example, firms maintain cross-border R&D collaborations despite geopolitical tensions due to the high costs of replacing specialized suppliers (Ebers & Maurer, 2014). Similarly, in high-tech industries like semiconductors, firms prioritize continuity in partnerships with Chinese suppliers despite U.S. export controls and regulatory uncertainties (Salk & Simonin, 2012).

Building on these theoretical insights, we propose the following hypothesis:

***H4:** Switching costs mediate the relationship between industrial chain dependency and knowledge flow intensity, such that higher switching costs strengthen the positive effect of industrial chain dependency on knowledge flow intensity.*

METHOD

Data

This study investigates the relationships among geopolitical tensions, industrial chain dependency, technological substitutability, switching costs, and knowledge flow intensity in the context of U.S.–China relations. To empirically test the hypotheses, we constructed a longitudinal dataset covering the period from 2010 to 2024. This timeframe reflects critical years marked by escalating U.S.–China trade tensions and the increasing global reliance on Chinese industrial chains, particularly in high-tech sectors such as semiconductors and pharmaceuticals.

The data were sourced from a combination of proprietary databases to ensure comprehensive coverage. Patent data, representing knowledge flow intensity, were obtained from the World Intellectual Property Organization (WIPO) and the United States Patent and Trademark Office (USPTO). Trade data, essential for assessing industrial chain dependency, were collected from the UN Comtrade database and the OECD Trade in Value Added (TiVA) dataset. Measures of geopolitical risk were derived from the Geopolitical Risk Index (Caldara & Iacoviello, 2022), which quantifies geopolitical uncertainties based on media coverage and policy shifts.

Variables

Geopolitical tension (GPT) is our primary independent variable, and it was captured using the Geopolitical Risk Index (GPR), which quantifies the intensity of tensions across countries and developed by Caldara and Iacoviello (2022). We used the U.S.–China-specific GPR scores, normalized for annual comparisons. This measure captures both the intensity and volatility of geopolitical risks during the study period.

Knowledge flow intensity (KFI), the dependent variable in this hypothesis, was assessed using patent metrics. Knowledge flow intensity was often measured by two two complementary indicators to capture the breadth and depth of cross-border knowledge-sharing activities. First, co-patenting activity between U.S. and Chinese firms was measured as the annual count of patents jointly filed by entities from both countries. This approach reflects formal collaboration efforts and has been widely used in the literature to assess international knowledge-sharing (Hagedoorn, 2002). Second, patent citation frequency was analyzed, focusing on the number of U.S. patents citing Chinese-origin patents, and vice versa. Citation patterns provide insight into the diffusion and utilization of knowledge across borders (Jaffe et al., 1993). In our study, we use WIPO statistics database to measure KFI. Patent_Total_1 in our output tables measures domestic patent families. Patent_Total_2 captures foreign-oriented patent families, reflecting cross-border knowledge flows and international collaborations.

Switching costs, as a mediator in our study, were usually proxied by two indicators. First, product complexity, derived from the Atlas of Economic Complexity (Hausmann et al., 2014), was used to assess the specificity of inputs sourced from Chinese suppliers. Higher complexity values indicate specialized products that are difficult to replace. Second, supply chain concentration was measured using the Herfindahl-Hirschman Index (HHI), calculated from trade data. Industries with higher HHI scores face greater switching costs due to limited alternative suppliers (Zighan et al., 2024).

Cost sensitivity, one of the moderator, was measured as the ratio of operational expenses to total revenue, sourced from BEA's Industry Accounts. Industries with higher ratios were classified as more cost-sensitive, reflecting greater vulnerability to geopolitical and economic shocks.

Technological substitutability, the second moderator, was measured using the diversity of International Patent Classification (IPC) codes within an industry. A higher diversity score indicates greater substitutability, capturing the availability of alternative technological solutions (Buckley et al., 2020). Since we are using different data sources for different hypothesis, we may need to make analysis for each hypothesis.

RESULTS AND DISCUSSION FOR H1

Table 1 reports the descriptive statistics for the geopolitical risk indices and patent-based knowledge flow measures. The mean value of the China geopolitical risk index (GPRC_CHN) is 0.66 (SD = 0.27), whereas the U.S. index (GPRC_USA) averages 2.23 (SD = 0.51), indicating that geopolitical risk has been persistently higher on the U.S. side over the observation period. China's total citation-based knowledge flow intensity (CN_Total) is on average 335,835 citations per year, which is substantially larger than the U.S. total (US_Total = 124,670). For foreign-oriented flows, U.S. firms exhibit a higher level (F_US_Total = 71,526) than Chinese firms (F_CN_Total = 27,426), consistent with the United States' historically more global patenting footprint.

TABLE 1
DESCRIPTIVE STATISTICS

Variable	N	Mean	SD	Min	Max
1. GPRC_CHN (China geopolitical risk index)	14	0.66	0.27	0.38	1.18
2. GPRC_USA (U.S. geopolitical risk index)	14	2.23	0.51	1.7	3.53
3. CN_Total (China KFI – total citations)	14	335,835	227,094	71,010	815,607
4. US_Total (U.S. KFI – total citations)	14	124,670	15,613	95,038	145,244

5. F_CN_Total (China KFI – foreign-oriented)	13	27,426	12,661	11,252	48,088
6. F_US_Total (U.S. KFI – foreign-oriented)	13	71,526	15,540	26,993	85,200

Table 2 presents the regression results for H1. Columns (1) and (2) show the effects of geopolitical tensions on China's total and foreign-oriented patent-based knowledge flows. China's own geopolitical risk index enters with positive and statistically significant coefficients for both outcomes ($\beta = 2.735$, SE = 0.638, $p < 0.01$ for CN_Total; $\beta = 1.718$, SE = 0.575, $p < 0.01$ for F_CN_Total). These estimates indicate that higher China-specific geopolitical tension is associated with higher patent-based knowledge flows originating from China, both overall and toward foreign destinations. In contrast, the coefficient on U.S. geopolitical risk is negative and significant only for China's foreign-oriented flows ($\beta = -0.533$, SE = 0.250, $p < 0.05$), implying that rising U.S. tensions are associated with a decline in Chinese patents directed to foreign markets.

Columns (3) and (4) of Table 2 report the corresponding results for U.S. patent-based knowledge flows. The effects of China's geopolitical risk on U.S. patents are small and not statistically different from zero for both total and foreign-oriented flows ($\beta = 0.295$, SE = 0.211, n.s. for US_Total; $\beta = -0.316$, SE = 0.385, n.s. for F_US_Total). By contrast, U.S. geopolitical risk is negatively related to U.S. foreign-oriented patent-based knowledge flows ($\beta = -0.354$, SE = 0.153, $p < 0.05$), while its effect on total U.S. patenting is not significant ($\beta = -0.057$, SE = 0.075).

Taken together, these findings provide only partial support for H1. Geopolitical tensions do not uniformly depress knowledge flows on both sides. Instead, higher China-specific risk is associated with an increase in China's patent-based knowledge flows, whereas higher U.S. risk is linked to a contraction of foreign-oriented flows from both countries, particularly from the United States. This pattern is consistent with the view that Chinese firms respond to geopolitical pressure with a "defensive innovation" strategy, while U.S. firms retrench from outward knowledge exchanges when domestic geopolitical risk escalates.

TABLE 2
EFFECTS OF GEOPOLITICAL TENSIONS ON PATENT-BASED KNOWLEDGE FLOWS

Dependent variable	China total patent	China foreign-oriented patent	U.S. total patent	U.S. foreign-oriented patent
China geopolitical tension	2.735 (0.638)***	1.718 (0.575)***	0.295 (0.211)	−0.316 (0.385)
95% CI	[1.484, 3.985]	[0.590, 2.845]	[−0.119, 0.709]	[−1.071, 0.439]
U.S. geopolitical tension	−0.154 (0.319)	−0.533 (0.25)**	−0.057 (0.075)	−0.354 (0.153)**
95% CI	[−0.779, 0.470]	[−1.023, −0.043]	[−0.203, 0.089]	[−0.653, −0.055]
R^2	0.606	0.426	0.157	0.539
Observations	14	13	14	13

Note: Coefficients are unstandardized; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

RESULTS FOR H2

H2 focuses on how industry-level characteristics condition the impact of geopolitical tensions on knowledge flows. Table 3 reports the estimates for the moderating effects of cost sensitivity (Model 1) and technological substitutability (Model 2) on China's focal-industry patent families.

In Model (1), China's geopolitical risk index has a positive and significant main effect on focal-industry patents ($\beta = 11.450$, SE = 2.050, $p < 0.01$), indicating that, in industries with low cost sensitivity, higher geopolitical tension is associated with more focal-industry patenting. Cost sensitivity itself is also positively related to focal-industry patents (β = 0.085, SE = 0.029, p < 0.01), suggesting that more cost-sensitive industries tend to generate more patent families on average. The interaction term between China's geopolitical risk and cost sensitivity is negative and statistically significant (β = −0.094, SE = 0.033, p < 0.01). This pattern supports H2a: as cost sensitivity increases, the positive effect of geopolitical tensions on focal-industry knowledge flows diminishes and can become negative in highly cost-sensitive industries. In other words, industries that operate under tight cost constraints are less able to sustain or expand knowledge flows when geopolitical risk rises.

Model (2) in Table 3 replaces cost sensitivity with technological substitutability. Again, the main effect of China's geopolitical risk is strongly positive (β = 20.700, SE = 3.000, p < 0.01), as is the main effect of technological substitutability (β = 1.221, SE = 0.192, p < 0.01). However, the interaction term between China's geopolitical risk and technological substitutability is negative and highly significant (β = −1.167, SE = 0.297, p < 0.01). This finding is consistent with H2b. In industries where technologies are more easily substituted, the marginal effect of geopolitical tensions on focal-industry patenting becomes less positive and may turn negative. Firms in these industries can more readily shift to alternative technologies or partners, which weakens the tension-induced expansion of China's patent-based knowledge flows.

Across both models, the control variables behave as expected. Patent families in other industries in China and the United States are positively associated with focal-industry patenting, while the year trend is negative, reflecting a gradual decline in focal-industry patenting over the sample period. Overall, the results in Table 3 support the view that the impact of geopolitical tensions on knowledge flows is highly heterogeneous across industries and depends on cost structures and technological alternatives.

TABLE 3
MODERATING EFFECTS OF COST SENSITIVITY AND TECHNOLOGICAL SUBSTITUTABILITY

	(1) Cost sensitivity moderator	**(2) Technological substitutability moderator**
Dependent variable	China focal-industry patent families ($\times 10^5$)	China focal-industry patent families ($\times 10^5$)
China geopolitical tension	11.450 (2.050)***	20.700 (3.000)***
95% CI	[7.432, 15.468]	[14.820, 26.580]
Cost sensitivity (CV)	0.085 (0.029)***	—
95% CI	[0.029, 0.142]	—
Technological substitutability	—	1.221 (0.192)***
95% CI	—	[0.845, 1.597]
China tension × Cost sensitivity	−0.094 (0.033)***	—
95% CI	[−0.158, −0.029]	—

China tension × Tech substitutability	—	−1.167 (0.297)***
95% CI	—	[−1.749, −0.585]
China other-industry patents (×10⁵)	0.152 (0.051)***	0.121 (0.048)**
U.S. other-industry patents (×10⁵)	0.073 (0.029)**	0.064 (0.032)**
Year	−0.225 (0.054)***	−0.153 (0.042)***
R^2	0.703	0.821
Observations	14	14

RESULTS FOR H3 AND H4

We also tested the impact of industrial chain dependency (ICD) and switching costs (SC) on knowledge flow intensity (KFI) in the context of geopolitical dynamics, focusing on China-U.S. trade interactions. We constructed a dataset comprising key variables such as trade concentration index (TCI), trade dependency ratio (TDR), switching costs, and total knowledge flow intensity (CN_Total and US_Total). Control variables include geopolitical risk indices (GPRC_CHN and GPRC_USA), GDP growth rates, and year fixed effects.

For industrial chain dependency (ICD), we are using Trade Concentration Index (TCI) and Trade Dependency Ratio (TDR) to measure. Trade Concentration Index (TCI) measures the intensity of trade dependency within industrial chains:

$$\text{TCI} = \frac{(\text{Export Value} + \text{Import Value})^2}{(\text{Total Export} + \text{Total Import})^2}.$$

Trade Dependency Ratio (TDR) captures the relative dependency of imports to total trade:

$$\text{TDR} = \frac{\text{Import Value}}{\text{Import Value+Other Imports}}.$$

Switching Costs (SC) represents the proxy for the costs incurred when changing suppliers or partners, based on the intensity and exclusivity of trade ties:

$$\text{SC} = \text{f}(\text{ICD}, \text{Partner Specificity}).$$

To test H3 and H4, we employed a multi-step regression and mediation analysis. Here is the base model for Direct Effects Analysis (H3):

$$\text{KFI}=\beta_0 + \beta_1 \cdot \text{TCI} + \beta_2 \cdot \text{Controls} + \epsilon. \text{KFI} = \beta_0 + \beta_1 \cdot \text{TDR} + \beta_2 \cdot \text{Controls} + \epsilon.$$

For testing Mediation Analysis (H4), we created three steps:

$$\text{Path a}: SC = \beta_0 + \beta_1 \cdot TCI/TDR + \beta_2 \cdot Controls + \epsilon.$$

$$\text{Path b}: KFI = \beta_0 + \beta_1 \cdot SC + \beta_2 \cdot Controls + \epsilon.$$

$$\text{Full Model}: KFI = \beta_0 + \beta_1 \cdot TCI/TDR + \beta_2 \cdot SC + \beta_3 \cdot Controls + \epsilon.$$

We next examine the role of industrial chain dependency and switching costs in shaping patent-based knowledge flows (H3 and H4). Table 4 reports the direct effects of trade-based industrial chain dependency—measured by exports to and imports from China—on total citation-based knowledge flows for China and the United States, controlling for both countries' geopolitical risk indices.

Column (1) of Table 4 shows that export dependency on China is positively and significantly related to China's total citation-based knowledge flows ($\beta = 2.68 \times 10^{-7}$, $SE = 3.00 \times 10^{-8}$, $p < 0.001$), whereas import dependency is not statistically significant. This result provides support for H3 on the Chinese side: industries that export more intensively to China exhibit higher levels of patent-based knowledge flows. In column (2), however, export dependency carries a negative and significant coefficient for U.S. total citations ($\beta = -9.89 \times 10^{-8}$, $SE = 1.09 \times 10^{-8}$, $p < 0.001$), and import dependency again remains insignificant. Moreover, both China's and the United States' geopolitical risk indices enter with large negative and highly significant coefficients in both models (e.g., $\beta = -5.278 \times 10^{5}$, $SE = 1.45 \times 10^{4}$, $p < 0.001$ for GPRC_CHN on CN_Total; $\beta = -9.095 \times 10^{3}$, $SE = 3.15 \times 10^{2}$, $p < 0.001$ for GPRC_USA on US_Total). These estimates underscore the strong dampening effect of geopolitical tensions on overall knowledge flows, even after accounting for trade dependence. Taken together, the evidence suggests that industrial chain dependency through exports to China is associated with higher knowledge flows for China but lower flows for the United States, offering only partial support for H3.

Table 5 investigates the mediating role of switching costs. Models (1) and (2) regress the switching-cost index on two alternative measures of industrial chain dependency: the trade concentration index with China and the trade dependency ratio with China. In both specifications, the coefficients on industrial chain dependency are negative ($\beta = -61.04$, $SE = 25.33$ for the trade concentration index; $\beta = -25.72$, $SE = 7.36$ for the trade dependency ratio), indicating that stronger trade-based dependency is associated with lower, rather than higher, switching costs. Model (3) relates China's knowledge flow intensity to these same industrial chain measures and switching costs. The coefficient on switching costs is negative ($\beta = -9.23$, $SE = 2.66$), while the coefficient on the trade dependency ratio is small and not clearly distinguishable from zero ($\beta = 0.923$, $SE = 0.846$).

The pattern in Table 5 does not support the proposed mediation mechanism in H4. We do not find evidence that industrial chain dependency operates through higher switching costs to increase knowledge flow intensity. Instead, switching costs are negatively related to China's knowledge flows, and trade-based dependency is either unrelated or negatively related to switching costs. These results suggest that, in the current geopolitical environment, deep trade ties and high switching costs do not necessarily anchor patent-based knowledge exchanges. Rather, geopolitical risk appears to dominate and may weaken the stabilizing role of industrial chain dependency envisioned in our theoretical framework.

TABLE 4
INDUSTRIAL CHAIN DEPENDENCY AND PATENT-BASED KNOWLEDGE FLOWS

	(1) China total patent	**(2) U.S. total patent**
Dependent variable	CN_Total (total citations)	US_Total (total citations)
Industrial chain dependency – exports to China	2.68e−07 (3.00e−08)***	−9.89e−08 (1.09e−08)***

95% CI	[−3.20e−07, 8.56e−07]	[−3.12e−07, 1.14e−07]
Industrial chain dependency – imports from China	7.60e−07 (9.76e−07)	−3.42e−08 (3.34e−08)
95% CI	[−1.15e−06, 2.67e−06]	[−9.95e−08, 3.12e−08]
China geopolitical tension (GPRC_CHN)	−5.278e+05 (1.45E+04)***	−1.318e+03 (1.61E+03)
U.S. geopolitical tension (GPRC_USA)	−1.461e+05 (2.83E+03)***	−9.095e+03 (3.15E+02)***
Intercept	1.158e+06 (8.24E+03)***	1.584e+05 (9.16E+02)***
R^2	0.7246	0.251
Adjusted R^2	0.7244	0.2505
Observations	6,020	6,020

TABLE 5
MEDIATION ANALYSIS OF SWITCHING COSTS

	(1) Switching costs ~ Trade concentration index with China	**(2) Switching costs ~ Trade dependency ratio with China**	**(3) China knowledge flow intensity ~ Switching costs**
Dependent variable	Switching costs	Switching costs	China knowledge flow intensity
Industrial chain dependency – trade concentration index with China	−61.04 (25.33)	—	−9.23 (2.66)
Industrial chain dependency – trade dependency ratio with China	—	−25.72 (7.36)	0.923 (0.846)
R^2	0.853	0.924	
Adjusted R^2	0.706	0.849	

CONCLUSION

This study examines how geopolitical tensions between the United States and China shape patent-based knowledge flows, and how these effects vary across industries. Drawing on Resource Dependence Theory (RDT) and the Knowledge-Based View (KBV), we analyze annual geopolitical risk indices, trade dependence measures, and patent citation data to uncover when and how cross-border knowledge exchanges are sustained or disrupted.

Our results show that geopolitical tensions do not simply suppress knowledge flows in a uniform way. Higher China-specific geopolitical risk is associated with stronger Chinese patent-based knowledge flows, both in total and in foreign-oriented patents, suggesting a form of "defensive innovation" under pressure. By contrast, higher U.S. geopolitical risk is associated with a decline in U.S. foreign-oriented patent flows and with weaker outward knowledge exchange more generally. These asymmetric responses point to different strategic adjustment paths under rising geopolitical risk.

The analysis further reveals strong industry heterogeneity. In the focal industry, the main effect of China's geopolitical risk on patenting is positive, but this effect is significantly weakened in industries with higher cost sensitivity and in those with greater technological substitutability. In cost-sensitive and highly substitutable industries, the net impact of geopolitical tensions on knowledge flows can move from positive to neutral or negative, as firms face stronger pressure to contain costs and can more readily shift away from risky partners and technologies. Finally, we find only partial support for the stabilizing role of industrial chain dependency and switching costs. Export-based dependence on China is associated with higher knowledge flows for China but lower flows for the United States, and switching costs do not mediate a positive relationship between trade dependence and knowledge flow intensity.

Taken together, these findings underline that geopolitical tensions reshape, rather than uniformly suppress, cross-border knowledge flows, and that their impact depends critically on both country-specific conditions and industry characteristics.

This study offers several contributions to RDT, KBV, and the emerging literature on geopolitics and innovation.

First, we extend RDT by explicitly incorporating geopolitical risk as a salient external contingency that reshapes interdependence between firms and their cross-border partners. While RDT has emphasized how organizations manage resource dependence through structural and relational strategies, our results show that geopolitical shocks can trigger asymmetric adjustments: Chinese firms increase patenting and knowledge flows as a form of adaptation, whereas U.S. firms scale back outward flows when domestic geopolitical risk rises. This asymmetry suggests that the same external shock can alter dependence structures in different ways across countries.

Second, we contribute to the KBV by showing that the effect of geopolitical tensions on knowledge flows is conditional on industry-level characteristics. The moderating roles of cost sensitivity and technological substitutability demonstrate that firms' knowledge-sharing responses are shaped by economic and technological constraints. In industries with low cost pressure or limited substitutes, geopolitical tensions can coincide with intensified patenting and knowledge exchange. In more cost-sensitive or substitutable industries, the same tensions are more likely to lead to withdrawal and reconfiguration of knowledge ties. These results highlight the importance of embedding KBV arguments in concrete industry contexts.

Third, we revisit the common assumption that deep trade-based industrial chain dependency and high switching costs will automatically stabilize knowledge flows under political stress. Our results offer only partial support for this view. Export dependence on China is associated with higher citation-based knowledge flows for China but lower flows for the United States, and switching costs do not play the expected positive mediating role. In high-tension environments, geopolitical risk appears to dominate the stabilizing influence of trade dependence and sunk investments. This suggests that RDT-based expectations about the buffering role of dependence and switching costs need to be reconsidered when geopolitical risk becomes a central dimension of the environment.

The findings also carry implications for managers and policymakers. For firms embedded in U.S.–China innovation linkages, geopolitical tensions should be treated not only as a regulatory or legal risk, but as a strategic factor that can reshape access to external knowledge. Managers in cost-sensitive and highly substitutable industries, in particular, need to anticipate that geopolitical shocks can quickly translate into pressure to cut cross-border collaborations and to redesign global search strategies. In contrast, firms operating in industries with limited technological substitutes may need to invest more deliberately in governance and risk-mitigation mechanisms to preserve critical knowledge ties.

For policymakers, the results suggest that broad geopolitical measures can have asymmetric and sometimes unintended effects on innovation. While restrictions and controls may succeed in reducing certain types of cross-border exchanges, they can also induce defensive innovation responses in targeted countries and reorient knowledge flows rather than eliminating them. Policies that increase transparency, reduce uncertainty around permissible forms of collaboration, and focus narrowly on genuinely sensitive technologies may help avoid collateral damage to broader innovation networks.

LIMITATIONS AND FUTURE RESEARCH

This study relies on secondary data sources, including patent citations, trade flows, and geopolitical risk indices, which may not fully capture the nuances of firm-level strategies and decision-making processes. While the analysis spans multiple industries, the generalizability of findings to non-U.S.–China contexts or sectors not covered in the dataset may be limited. Future research could incorporate primary data collection, such as surveys or interviews, to gain deeper insights into firm-specific responses to geopolitical tensions.

This study primarily examines the U.S.–China relationship, which may limit its applicability to other geopolitical contexts. Emerging tensions in other regions, such as Europe or Southeast Asia, present unique challenges and dynamics that could influence knowledge flows differently. Expanding the scope of analysis to include multiple geopolitical relationships would enhance the understanding of how global firms navigate diverse political environments.

REFERENCES

Argyres, N.S., & Zenger, T.R. (2012). Capabilities, transaction costs, and firm boundaries. *Organization Science, 23*(6), 1643-1657.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99-120.

Bednarski, L., Roscoe, S., Blome, C., & Schleper, M.C. (2024). Geopolitical disruptions in global supply chains: a state-of-the-art literature review. *Production Planning & Control*, pp. 1-27.

Bown, C.P. (2019). The 2018 US-China trade conflict after forty years of special protection. *China Economic Journal, 12*(2), 109-136.

Buckley, P.J. (2020). China’s Belt and Road Initiative and the COVID-19 crisis. *Journal of International Business Policy, 3*(3), 311-314.

Buckley, P., & Casson, M. (2019). Decision-making in international business. *Journal of International Business Studies, 50*, 1424-1439.

Bussy, A., & Zheng, H. (2023). Responses of FDI to geopolitical risks: The role of governance, information, and technology. *International Business Review, 32*(4), 102136.

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review, 112*(4), 1194-1225.

Casciaro, T., & Piskorski, M.J. (2005). Power imbalance, mutual dependence, and constraint absorption: A closer look at resource dependence theory. *Administrative science quarterly, 50*(2), 167-199.

Charpin, R., London, J., & Vincent, N. (2024). The effect of geopolitical tensions on international research collaborations and its implications for global operations management. *International Journal of Production Economics, 268*, 109120.

Child, J., & Tse, D.K. (2001). China's transition and its implications for international business. *Journal of international business studies, 32*, 5-21.

Cuypers, I.R., Hennart, J.F., Silverman, B.S., & Ertug, G. (2021). Transaction cost theory: Past progress, current challenges, and suggestions for the future. *Academy of Management Annals, 15*(1), 111-150.

Drees, J.M., & Heugens, P.P.M.A.R. (2010). Resource Dependence Theory: A Meta-Analysis. In *Academy of Management Conference*.
Du, X., Tang, C., Qi, Q., & Zhao, Z. (2023). Geopolitical risk and green outward foreign direct investment location choice: evidence from Chinese listed companies. *Environmental Science and Pollution Research, 30*(47), 103602-103619.
Ebers, M., & Maurer, I. (2014). Connections count: How relational embeddedness and relational empowerment foster absorptive capacity. *Research Policy, 43*(2), 318-332.
Eden, L., & Miller, S.R. (2004). Distance matters: Liability of foreignness, institutional distance and ownership strategy. In *Theories of the Multinational Enterprise: Diversity, Complexity and Relevance* (Vol. 16, pp. 187-221). Emerald Group Publishing Limited.
Emerson, R.M. (1964). Power-dependence relations: Two experiments. *Sociometry*, pp. 282-298.
Fan, D., Ma, P., Cui, L., & Yiu, D.W. (2024). Locking in overseas buyers amid geopolitical conflicts. *Journal of Operations Management*.
Fan, Z., & Chen, X. (2024). The Impact of Unconventional Monetary Policy on China's Economic and Financial Cycle: Application of a Structural Vector Autoregression Model Based on High-Frequency Data. *Mathematics, 12*(13), 1967.
Felin, T., & Hesterly, W.S. (2007). The knowledge-based view, nested heterogeneity, and new value creation: Philosophical considerations on the locus of knowledge. *Academy of Management Review, 32*(1), 195-218.
Freedman, L. (2017). *Destined for War: Can America and China Escape Thucydides's Trap?*
Foss, N.J., Husted, K., & Michailova, S. (2010). Governing knowledge sharing in organizations: Levels of analysis, governance mechanisms, and research directions. *Journal of Management Studies*, *47*(3), 455-482.
Fugate, B.S., Stank, T.P., & Mentzer, J.T. (2009). Linking improved knowledge management to operational and organizational performance. *Journal of Operations Management, 27*(3), 247-264.
Gereffi, G., & Lee, J. (2012). Why the world suddenly cares about global supply chains. *Journal of Supply Chain Management, 48*(3), 24-32.
Grant, R.M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(S2), 109-122.
Hagedoorn, J. (2002). Inter-firm R&D partnerships: an overview of major trends and patterns since 1960. *Research Policy, 31*(4), 477-492.
Hausmann, R., Hidalgo, C.A., Bustos, S., Coscia, M., & Simoes, A. (2014). *The atlas of economic complexity: Mapping paths to prosperity*. MIT Press.
Hillman, A.J., Withers, M.C., & Collins, B.J. (2009). Resource dependence theory: A review. *Journal of Management, 35*(6), 1404-1427.
Jaffe, A.B., Trajtenberg, M., & Henderson, R. (1993). Geographic localization of knowledge spillovers as evidenced by patent citations. *The Quarterly Journal of Economics, 108*(3), 577-598.
Ji, Q., Zhang, X., & Zhu, Y. (2020). Multifractal analysis of the impact of US–China trade friction on US and China soy futures markets. *Physica A: Statistical Mechanics and its Applications, 542*, 123222.
Jiang, G.F., & Yang, Z. (2022). Resource dependence theory in international business. *Global Strategy Journal, 12*(3), 331–354.
Jin, S.Y., Chai, H., & Lee, C.C. (2024). Knowledge Transfer of China's HSR Standards "Going Global" Based on System Dynamics. *Journal of the Knowledge Economy, 15*(2), 6111-6150.
Jones, M.V. (1999). The internationalization of small high-technology firms. *Journal of International Marketing, 7*(4), 15-41.
Juergensen, J., Narula, R., & Surdu, I. (2024). *International business and organizational innovation: An agenda for future research.* Multinational Business Review.
Katz, D., & Kahn, R.L. (1966). *The Social Psychology of Organizations.* Wiley.
Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science, 3*(3), 383-397.

Kretschmer, T., & Khashabi, P. (2020). Digital transformation and organization design: An integrated approach. *California Management Review, 62*(4), 86-104.
Li, J., Shapiro, D., Peng, M.W., & Ufimtseva, A. (2022). Corporate diplomacy in the age of US–China rivalry. *Academy of Management Perspectives, 36*(4), 1007-1032.
Li, R., Ren, F., & Wang, Q. (2024). China–US scientific collaboration on sustainable development amidst geopolitical tensions. *Humanities and Social Sciences Communications, 11*(1), 1-19.
Li, X., Tong, Y., Zhong, K., Xu, G., & Zhao, W. (2024). Geopolitical risk and foreign subsidiary performance of emerging market multinationals. *Journal of Multinational Financial Management, 72*, 100836.
Luo, Y. (2020). Adaptive learning in international business. *Journal of International Business Studies, 51*(9), 1547-1567.
Luo, Y., & Tung, R.L. (2007). International expansion of emerging market enterprises: A springboard perspective. *Journal of International Business Studies, 38*, 481-498.
Luo, Y., & Witt, M.A. (2021). Springboard MNEs under de-globalization. *Journal of International Business Studies*, 1-14.
Martín-de Castro, G., López-Sáez, P., & Delgado-Verde, M. (2011). Towards a knowledge-based view of firm innovation. Theory and empirical research. *Journal of Knowledge Management, 15*(6), 871-874.
Mellahi, K., Frynas, J.G., Sun, P., & Siegel, D. (2016). A review of the nonmarket strategy literature: Toward a multi-theoretical integration. *Journal of Management, 42*(1), 143-173.
Meyer, K.E., & Peng, M.W. (2005). Probing theoretically into Central and Eastern Europe: Transactions, resources, and institutions. *Journal of International Business Studies, 36*(6), 600.
Moisio, S. (2018). *Geopolitics of the knowledge-based economy* (p. 194). Taylor & Francis.
Morrison, W.M. (2019). China's economic rise: History, trends, challenges, and implications for the United States. *Current Politics and Economics of Northern and Western Asia, 28*(2/3), 189-242.
Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review, 23*(2), 242-266.
Nienhüser, W. (2008). Resource dependence theory-how well does it explain behavior of organizations? *Management revue*, 9-32.
Nonaka, I., & Takeuchi, H. (2007). The knowledge-creating company. *Harvard Business Review, 85*(7/8), 162.
Nonaka, I., & Von Krogh, G. (2009). Perspective—Tacit knowledge and knowledge conversion: Controversy and advancement in organizational knowledge creation theory. *Organization Science, 20*(3), 635-652.
Pfeffer, J., & Nowak, P. (1976). Joint ventures and interorganizational interdependence. *Administrative Science Quarterly*, 398-418.
Pfeffer, J., & Salancik, G.R. (1978). The external control. New York.
Pfeffer, J., & Salancik, G. (2015). External control of organizations—Resource dependence perspective. *Organizational Behavior, 2*, 355-370. Routledge.
Prud'homme, D., Zhang, T., Prud'homme, D., & Zhang, T. (2019). IP Measures for Transmission and Exploitation of Technological Knowledge. *China's Intellectual Property Regime for Innovation: Risks to Business and National Development*, pp. 73-92.
Puranam, P., Singh, H., & Zollo, M. (2006). Organizing for innovation: Managing the coordination-autonomy dilemma in technology acquisitions. *Academy of Management Journal, 49*(2), 263-280.
Rugman, A.M., & Douglas, S. (2018). The Strategic Management of Multinationals and World Product Mandating 1. *Managing the Multinational Subsidiary*, pp. 90-101.
Saikia, A., Bhattacharya, S.N., & Dwivedi, R. (2024). Institutional theory and multinational corporation internationalization strategy: a systematic review and future research agenda. *International Journal of Emerging Markets*.

Salk, J.E., & Simonin, B.L. (2012). Collaborating, Learning and Leveraging Knowledge Across Borders: A Meta-Theory of Learning. *Handbook of Organizational Learning and Knowledge Management*, 605-633.
Spender, J.C. (1996). Making knowledge the basis of a dynamic theory of the firm. *Strategic management journal, 17*(S2), 45-62.
Subramaniam, M., & Youndt, M.A. (2005). The influence of intellectual capital on the types of innovative capabilities. *Academy of Management journal, 48*(3), 450-463.
Sun, J., Maksimov, V., Wang, S.L., & Luo, Y. (2021). Developing compositional capability in emerging-market SMEs. *Journal of World Business, 56*(3), 101148.
Tay, D., Zamborsky, P., & Ingrst, I. (2021). *Integrating Knowledge in Cross-border Acquisitions: A Knowledge-based View of Open Innovation in an International Context.* SSRN 3974130.
Teece, D.J. (2020). Hand in glove: Open innovation and the dynamic capabilities framework. *Strategic Management Review, 1*(2), 233-253.
Tse, C.H., Meyer, K.E., Pan, Y., & Chi, T. (2024). Evolution of MNE strategies amid China's changing institutions: a thematic review. *Journal of International Business Studies, 55*(6), 657-675.
Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal, 17*(S2), 11-25.
Uzzi, B. (1997). Social structure and competition in interfirm networks. *Administrative Science Quarterly, 42*(1), 37-69.
Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*(2), 171-180.
Williamson, O.E. (1981). The economics of organization: The transaction cost approach. *American Journal of Sociology, 87*(3), 548-577.
Witt, M.A. (2019). De-globalization: Theories, predictions, and opportunities for international business research. *Journal of International Business Studies, 50*(7), 1053-1077.
Witt, M.A., Lewin, A.Y., Li, P.P., & Gaur, A. (2023). Decoupling in international business: Evidence, drivers, impact, and implications for IB research. *Journal of World Business, 58*(1), 101399.
Yeung, H.W.C., Huang, S., & Xing, Y. (2023). *From fabless to fabs everywhere? Semiconductor global value chains in transition.*
Zander, U., & Kogut, B. (1995). Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test. *Organization Science, 6*(1), 76-92.
Zhu, S., Nuruzzaman, N., & Hashai, N. (2024). How Geopolitical Tensions Influence the Innovation of MNC's Foreign Subsidiaries?. In *Academy of Management Proceedings* (Vol. 2024, No. 1, p.18347). Valhalla, NY 10595: Academy of Management.
Zighan, S., Dwaikat, N.Y., Alkalha, Z., & Abualqumboz, M. (2024). Knowledge management for supply chain resilience in pharmaceutical industry: evidence from the Middle East region. *The International Journal of Logistics Management, 35*(4), 1142-1167.