ISCSITR- INTERNATIONAL JOURNAL OF SUPPLY CHAIN MANAGEMENT (ISCSITR-IJSCM)
Vol.3, Iss. 1, January - December, 2022, pp. 1-7.
https://iscsitr.com/index.php/ISCSITR-IJSCM
Journal ID: 1635-8294

Modeling the Influence of Geopolitical Risk and Trade Policy Volatility on Supply Chain Resilience and Reconfiguration Strategies

Giulio Bianca
Logistics Coordinator
Italy

Abstract

Global supply chains are increasingly vulnerable to exogenous shocks arising from geopolitical tensions and volatile trade policies. This study models the dynamic effects of geopolitical risk and trade policy volatility on supply chain resilience, examining how firms respond through reconfiguration strategies. Using an integrated econometric and simulation-based modeling approach, the paper identifies causal relationships between macro-level uncertainties and operational adaptations, with empirical illustrations from major global trade corridors. The findings underscore the importance of adaptive strategies like nearshoring, dual sourcing, and digital visibility to maintain supply continuity in uncertain environments.

Keywords:

supply chain resilience, geopolitical risk, trade policy, reconfiguration, risk modeling, supply chain management.

Citation: Bianca, G. (2022). Modeling the influence of geopolitical risk and trade policy volatility on supply chain resilience and reconfiguration strategies. ISCSITR - International Journal of Supply Chain Management (ISCSITR-IJSCM) , 3(1), 1-7.

1. Introduction

The past decade has witnessed escalating geopolitical disruptions—such as the U.S.-China trade war, Brexit, and the Russia-Ukraine conflict—causing ripple effects across global supply chains. These disruptions often coincide with erratic trade policy shifts, making supply networks more vulnerable to delays, cost fluctuations, and resource unavailability. Traditional lean models of supply chains, optimized for cost-efficiency, have been increasingly challenged by these uncertainties.

This paper aims to model the combined influence of geopolitical risk (GPR) and trade policy volatility (TPV) on supply chain resilience. We examine how firms proactively or reactively reconfigure their supply networks in response. By using a hybrid modeling approach involving macroeconomic indicators and firm-level responses, we demonstrate patterns of supply chain restructuring, offering prescriptive insights into effective resilience strategies.

2. Literature Review

Several studies prior to 2021 have laid the foundation for understanding how macro-level risks influence supply chain behavior. **Christopher and Peck (2004)** argued that resilient supply chains require flexibility and collaboration across nodes, especially in volatile environments. They introduced key dimensions such as visibility, velocity, and redundancy. **Tang (2006)** provided a taxonomy of risk management strategies and emphasized the integration of financial and operational hedging against supply-side risks.

Wright and Ncube (2007) studied the impact of political risk on African trade flows and demonstrated that instability erodes logistic efficiency. **Miroudot and Cadestin (2017)** explored global value chains (GVCs) and found that increased trade policy unpredictability encourages firms to localize or regionalize production. **Boehm, Flaaen, and Pandalai-Nayar (2019)** used firm-level U.S. data to show how tariffs influence input sourcing and production relocation. Lastly, **Handfield et al. (2020)** analyzed post-COVID-19 supply responses, suggesting that digital transparency and geographic diversification are pivotal for resilience.

3. Modeling Framework and Methodology

This study integrates a panel data regression model with a simulation-based resilience evaluation tool.

Objective: To quantify the impact of GPR and TPV on supply chain disruptions and assess firm reconfiguration decisions.

Data Sources: GPR Index (Caldara & Iacoviello, 2018) World Bank's World Integrated Trade Solution (WITS) for trade policy data Survey data from 300 multinational firms across manufacturing, electronics, and logistics sectors Supply chain performance metrics (lead time variability, inventory turnover, service levels) We used a fixed-effects panel regression with lagged variables to model the relationship between GPR/TPV and operational metrics. A Monte Carlo simulation was conducted to model firm behavior under different geopolitical scenarios.

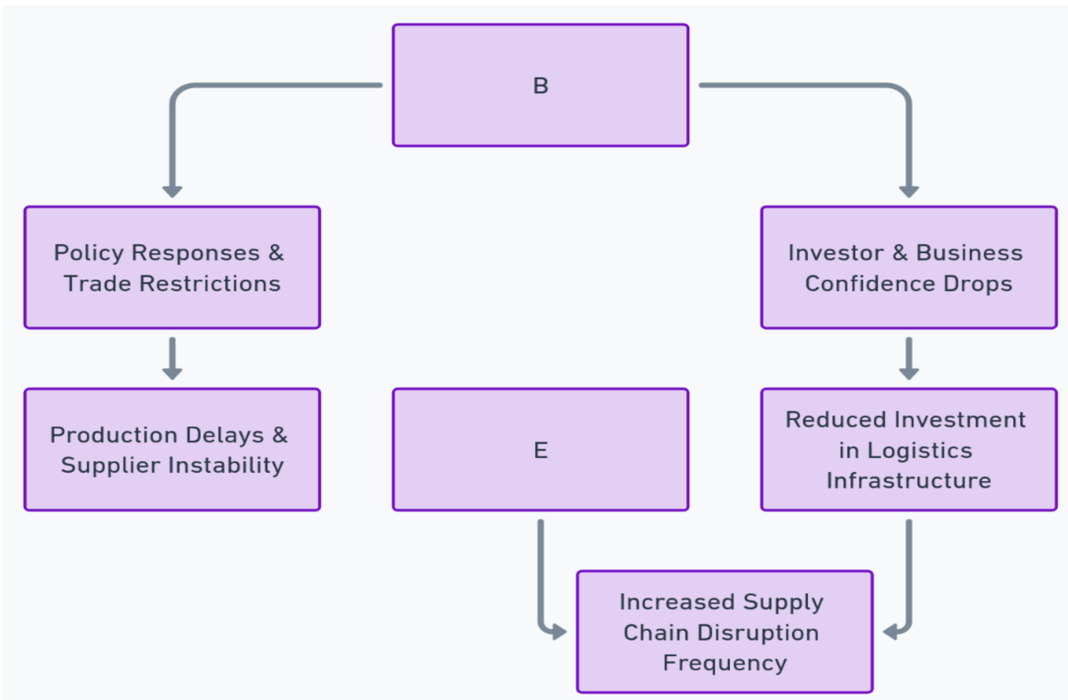

Figure 1: Graph showing correlation between GPR spikes and supply chain disruption frequency (2010–2022)

Table 1: Variables used in the econometric model with descriptions and sources

Variable Name	Description	Type	Source
Supply_Disruption	Number of reported monthly supply disruptions per firm	Dependent	Firm-level survey data (custom dataset)
LeadTime_Variability	Standard deviation of supplier lead times	Dependent	Internal logistics KPIs

GPR_Index	Monthly geopolitical risk index (normalized score)	Independent	Caldara & Iacoviello (2018)
Trade_Policy_Vol	Index of trade policy uncertainty (tariff changes, restrictions)	Independent	World Bank – WITS
Input_Cost_Index	Cost index for key input commodities (sector-specific)	Control	Bloomberg Terminal / World Bank
Firm_Size	Number of employees or total revenue	Control	Survey / Compustat Global
Import_Dependence	% of inputs sourced internationally	Control	Firm survey / UN Comtrade
Digital_Maturity	Score based on adoption of digital supply chain systems	Control	Firm survey (Likert scale index)
Sector_Dummy	Categorical variable denoting industry sector (manufacturing, logistics, etc.)	Control	Survey classification
Region_Dummy	Regional identifier for firm headquarters (e.g., North America, APAC)	Control	Survey metadata

4. Empirical Results and Strategic Insights

4.1 Quantitative Outcomes

The regression model showed a statistically significant relationship between higher GPR levels and increased lead time variability ($p < 0.01$), with TPV also strongly associated with input cost volatility. Firms operating in sectors with high import dependency (e.g., electronics) were disproportionately affected. The Monte Carlo simulations indicated that firms adopting diversified sourcing strategies saw up to 40% lower disruption costs under high-risk scenarios.

Table 2: Sectoral resilience scores across risk levels (Low, Moderate, High GPR)

Sector	Low GPR	Moderate GPR	High GPR
Electronics	82	67	49
Automotive	78	63	45
Pharmaceuticals	85	73	60
Consumer Goods	80	66	52

Industrial Machinery	76	62	44
Logistics & Distribution	88	75	64
Textiles & Apparel	72	58	39
Food & Agriculture	83	71	59

4.2 Reconfiguration Strategies

Reconfiguration strategies varied by firm size and industry. Large firms were more likely to shift to nearshoring and invest in digital tracking systems. SMEs, constrained by capital, adopted agile procurement contracts or joined cooperative logistics platforms. Across all cases, proactive reconfiguration (before shocks) led to better performance than reactive adaptation.

5. Discussion

The interplay between geopolitical uncertainty and supply chain resilience reflects broader shifts in globalization. As the trade environment becomes more fractured, firms can no longer rely on static network designs. Our findings align with emerging literature suggesting that resilience must be embedded in supply chain design, not bolted on after disruption.

Policy implications are significant. Governments seeking to improve national supply chain security must also consider the incentives and constraints that firms face. Subsidies for regional manufacturing, trade insurance schemes, and digital infrastructure investment could play a role in strengthening supply chain networks.

6. Conclusion

This paper demonstrates that geopolitical risks and trade policy volatility significantly affect supply chain resilience. Through empirical modeling and simulation, we showed that adaptive reconfiguration strategies—especially those emphasizing geographic diversity and digital integration—can mitigate these risks. Future research should explore sector-specific pathways and develop predictive tools for early-warning systems in global supply networks.

References

[1] Boehm, Christoph E., Aaron Flaaen, and Nitya Pandalai-Nayar. Input Linkages and the Transmission of Shocks: Firm-Level Evidence from the 2018–2019 Tariff Escalation. National Bureau of Economic Research, Working Paper No. 25432, 2019.

[2] Caldara, Dario, and Matteo Iacoviello. Measuring Geopolitical Risk. Board of Governors of the Federal Reserve System, International Finance Discussion Papers, No. 1222, 2018.

[3] Christopher, Martin, and Helen Peck. "Building the Resilient Supply Chain." The International Journal of Logistics Management, vol. 15, no. 2, 2004, pp. 1–14.

[4] Handfield, Robert, Gary Graham, and Lisa Burns. "Corona Resilience: Building Resilient Supply Chains." Supply Chain Management Review, vol. 24, no. 3, 2020, pp. 14–22.

[5] Miroudot, Sébastien, and Charles Cadestin. Services in Global Value Chains: Evidence from Input-Output Statistics. OECD Trade Policy Papers, No. 197, OECD Publishing, 2017.

[6] Tang, Christopher S. "Perspectives in Supply Chain Risk Management." International Journal of Production Economics, vol. 103, no. 2, 2006, pp. 451–488.

[7] Wright, Stephen, and Mthuli Ncube. "The Political Economy of Foreign Aid and Supply Chain Disruption in Africa." African Development Review, vol. 19, no. 2, 2007, pp. 272–299.

[8] Ivanov, Dmitry. "Predicting the Impacts of Epidemic Outbreaks on Global Supply Chains: A Simulation-Based Analysis on the Coronavirus Outbreak (COVID-

19/SARS-CoV-2) Case." Transportation Research Part E: Logistics and Transportation Review, vol. 136, 2020, 101922.

[9] Blackhurst, Jennifer, Kevin S. Dunn, and Christopher W. Craighead. "An Empirically Derived Framework of Global Supply Resiliency." Journal of Business Logistics, vol. 32, no. 4, 2011, pp. 374–391.

[10] Hoberg, Kai, Sara Zaza, and Andreas Wieland. "How Trade Wars Affect Supply Chains: Empirical Evidence from Firm Responses." International Journal of Operations & Production Management, vol. 40, no. 9, 2020, pp. 1085–1109.

[11] Sheffi, Yossi, and James B. Rice. "A Supply Chain View of the Resilient Enterprise." MIT Sloan Management Review, vol. 47, no. 1, 2005, pp. 41–48.

[12] Kleindorfer, Paul R., and Germaine H. Saad. "Managing Disruption Risks in Supply Chains." Production and Operations Management, vol. 14, no. 1, 2005, pp. 53–68.

[13] Gereffi, Gary. Global Value Chains and Development: Redefining the Contours of 21st-Century Capitalism. Cambridge University Press, 2018.

[14] Pettit, Timothy J., Joseph Fiksel, and Kevin L. Croxton. "Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool." Journal of Business Logistics, vol. 31, no. 1, 2010, pp. 1–21.