

Global Supply Chains with Tariff and Market Uncertainty: Optimization and AI Approaches

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Abstract

Global supply chains, as critical enablers of global economic integration, facilitate cross-border trade, expand market access, and support worldwide production and consumption. At the same time, they are increasingly exposed to risks such as trade policy shifts, tariff uncertainty, geopolitical conflict, natural disasters, supply disruptions, market volatility, and technological change. In response to evolving trade policies, sustainability pressures, tariff uncertainty, and resilience requirements, firms are restructuring their global production and sourcing strategies. This study presents a review of the literature on global supply chain management under tariff and market uncertainty. We analyze operations research approaches to network design, production planning, inventory management, and sourcing, with particular attention to how uncertainties are modeled and integrated into decision-making frameworks. The review further evaluates the role of emerging technologies, including artificial intelligence and machine learning, blockchain, and digital twins, in enhancing resilience and sustainability. In addition, we introduce an ongoing project on agricultural global supply chains under tariff uncertainty as an illustrative case, demonstrating the practical relevance of robust optimization methods. The findings highlight prevailing methodological trends, identify gaps in addressing multidimensional uncertainties, and outline directions for future research aimed at developing more adaptive and robust global supply chain systems.

Keywords

Global supply chains, tariffs, market uncertainty, optimization, AI and machine learning

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Biographies

Guoqing Zhang, PEng, is a Professor of Industrial Engineering in the Supply Chain and Logistics Optimization Research Lab at the Department of Mechanical, Automotive & Materials Engineering, University of Windsor. His research interests include supply chain management and optimization, operations research, manufacturing modeling, e-commerce, warehouse management, data-driven optimization, machine learning, and intelligent decision support systems. He has published over 100 articles in these areas. Dr. Zhang's research is supported by NSERC, MITACS, and CFI. He has provided consulting services to several world-leading companies in the automotive, energy, airline, and food industries. In 2015, his team received the CORS Practice Prize. Additionally, he developed a solver for large-scale linear programming based on the interior point method.

Qi Wang received the bachelor's degree in mathematics from the Department of Applied Mathematics, Qufu Normal University, Qufu, China, in 2019. She is currently pursuing the Ph.D. degree with the College of Mathematics & Information Science, Hebei University, China. She is currently a visiting Ph.D. student at the University of Windsor, majoring in supply chain management and logistics. Her research interests include bilevel robust optimization, supply chain network design problems, and exact algorithms. Her previous research has been published in journals, such as *Engineering Optimization*, *Applied Energy*, and *Transportmetrica A: Transport Science*.