Quantifying the Impacts of Industry Preparedness Strategies with a Risk-Based Input-Output Model

Topic: Modelling disasters
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Supply chain risk management has been a popular topic with both practitioners and researchers, and different models have been proposed to help companies prepare for and react to a disruption in their supply chain. However, less attention has been given to exploring the wide-spread economic consequences that preparedness strategies have on a region following a disruptive event. Such strategies that may be used to mitigate supply chain risk include holding inventory, sourcing from multiple suppliers, maintaining surge capacity, and using alternate modes of transportation. We use a risk-based input-output model that integrates a priori preparedness decisions (e.g., inventory, alternate transportation routes, different suppliers) for the ultimate occurrence of a disruptive event. We examine the conditions that incentivize industries to prepare for a disruptive event and how those decisions impact their reactions to a supply chain disruption.

We extend the Dynamic Inoperability Input-Output Model (DIIM) to quantify how these strategies affect economic production within a region following a supply chain disruption. The DIIM is derived from the traditional input-output model and is parameterized by Bureau of Economic Analysis data as well as other regional sources. Instead of modeling industry output, the DIIM models the temporal propagation of industry inoperability, or the extent to which logical interdependencies lead to lost productivity. We propose a decision analysis model of supply chain preparedness strategies that is integrated with the DIIM to measure the efficacy of such strategies across multiple industries. We deploy the model with a data-driven multi-regional case study.