

A Risk Analysis on the Network Concentration of Global Supply Chains

Topic: Structural Decomposition Analysis (Chair: Bart Los, University of Groningen)

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The world economy in the 21st century has given rise to a new production arrangement known as global value chains (GVCs), in which production processes are sliced and relocated to places where the corresponding tasks are most efficiently performed. Due to the rapid advancement of transportation modes and information and communication technology (ICT), production networks continue to expand to cover every corner of the globe. Concurrently, the pursuit of optimal allocation of resources often results in the agglomeration and concentration of key production capacities in a certain region of a certain country.

This may work well in an ordinary environment, but when circumstances change for the worse, such production hubs can become "choke points" of the entire economic system. Multiple examples can be found in recent history: the Lehman Shock, the Great East Japan Earthquake, and various forms of cyber-attacks, where hyper economic interdependency rendered production and financial systems particularly vulnerable to a single point of failure.

This series of incidents has driven our attention to the systematic risk associated with the skewed concentration of supply chains in global production networks. The flow of goods, money, people, and information jointly form a highly complex nexus of economic activities, and a shock generated in a core region may rapidly and extensively propagate to other regions across national borders in an unforeseeable manner.

Against this backdrop, we propose a novel approach to construct a risk indicator for firms' business operations, especially in a global context, by mapping the degree of network concentration of supply chains. This is done along a line of traditional techniques in input-output economics known as the "key sector analysis," yet with methodological augmentation by a compatible analytical framework in network theory.

The OECD's Inter-Country Input-Output Tables are chosen as analytical data. The latest version, published in 2021, is based on 45 industries (concordant with ISIC Rev.4), covering 66 countries/regions from 1995 to 2018, allowing comprehensive time and geographic coverage for GVC analyses

The novelty of this study is that we measure concentration risks in terms of the frequency with which a particular supply chain passes through a high-risk region, as opposed to the conventional approach based on a volume concept. If the analysis is directed to supply chain disruptions (such as natural disasters or geopolitical conflicts), then the measurement will reveal the degree of supply chain vulnerability to unpredictable incidents in the region of analytical concern.