Measuring and Optimizing Global Value Chain Risks: an Absorbing Markov Model with Rewards

Topic: Input-Output Theory and Methodology (2)
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Global Value Chains are central to our understanding of international trade and economic systems. The dense interdependence that typifies these global networks, a consequence of accelerated globalization, makes them especially susceptible to various disruptions such as geopolitical tensions, energy scarcity shocks, and extreme climatic events. A disturbance in one part of the chain can rapidly lead to cascading effects, resulting in substantial economic impacts that transcend national boundaries. This study develops an Absorbing Markov Model with Rewards to trace the risks in GVCs and to minimize the risks accumulated along GVCs. It employs the input-output table and integrates it with the Absorbing Markov Chain to elucidate the flows within GVCs and a Markov Reward Process to quantify the transmission of risks within these chains. This approach provides a method to quantify how risks accompany the flow of goods and services, considering both the intensity and the propagation of risk factors. This general method makes it applicable to a wide range of aspectsâ€”whether analyzing the flow of value-added, energy, emissions, or other factors and how they pass through different key sectors, or analysing the multi-perspective risks, such as climate change risks, natural resources scarcity risks, geo-political risks, socio-economical risks, and many other aspects.