Network dynamics and systemic risks: From financial systems to trade to supply chains

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The unprecedented spread of the 2007 – 2010 financial crisis that rippled through the world’s economies highlighted the potential for failures to propagate between institutions in complex networks of interdependencies. Cascading failures can be sparked by even very small deviations from business-as-usual functioning modes, resulting in non-smooth transitions to unwanted paths. As the negative consequences of cascading failures can be profound and far-reaching, especially in today’s interconnected world, the desire to understand, assess, and mitigate system risk has mounted in recent years. Systemic risk describes the likelihood of cascading failures in networks. It can arise in broad range of disparate systems such as trade, supply chains, and financial networks – to name just a few. Crucially, although all systems have unique characteristics, they also share common features arising from their network structure. Since 2014, IIASA has been carrying out a research project, which aims to draw together these commonalities to create a general framework for analyzing systemic risk. Once this framework is in place, it can be used to design policies to reduce risks in a diverse array of applications. In this talk, a number of findings obtained so far for trade, supply chains, and financial networks will be presented. For example, a ‘systemic risk tax’ set to be proportional to the ‘systemic riskiness’ of a bank has been shown to be able to significantly reduce the financial systemic risk in an inter-bank network without affecting the transaction volume (Poledna & Thurner, 2016); systemic risk in supply chains can be mitigated by smart allocation of inventories, which greatly alleviate disruption cascades despite moderately increasing direct losses, with incentivizes for such alleviation being reduced in more fragmented supply chains (Colon et al, 2017); in global trade networks of different commodities network efficiency is positively correlated with growth, but highly efficient systems appear to be less resilient, losing more and gaining less growth following an economic shock (Kharrazi et al, 2017).