

Systemic risk in financial networks - How does the structure affect the stability?

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During the financial crisis in 2008, a shock in one market spread globally and it became obvious how interconnected the financial network is nowadays. This has raised questions of how the financial network structure affect the stability of the economy, when exposed to shocks. Does a higher degree of connections absorb or amplify the systemic risk? And what happens in networks where the shock cannot cascade in cycles?

The global economy is characterized by little transparency and high complexity, which makes empirical studies difficult. However, by defining a theoretical financial network model, it is possible to better understand how the structure of the monetary flows between financial institutions affects systemic risk when one or several shocks are present. The model aims to mimic an inter-bank lending system by using graph theory with links, representing loans borrowed and lent by both financial institutions, represented by nodes, and the outside network of non-financial entities. Then, one may introduce shocks to the network, which reduce the liquidity, to measure the performance, in terms of number of defaulting institutions or total loss incurred by the shocks.

The role of connections in financial networks has been debated and both more connected and less connected networks have been described as shock amplifiers in the literature. By looking at the maximally connected complete network and the minimally connected ring network, exemplified in Figure 1, it is concluded that the complete network always perform better than or equal to the ring network when one or all institutions are exposed to the same shock. Though, when some institutions are subject to a shock, the complete network can perform worse than the ring network in some cases.

The ring and complete network are cyclic,

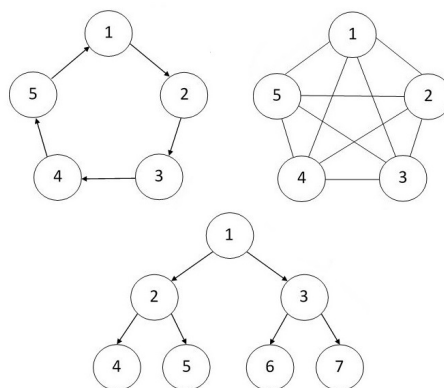


Figure 1: Upper left: Ring network. Upper right: Complete network. Below: Tree network.

which means that the shock can spread in cycles, returning to already affected institutions and causing additional damage. For acyclic networks, like the tree network in Figure 1, the shock can only spread in one direction, from the one borrower of a node and to its creditors. When shocking one institution, the main factor absorbing the shock and restricting the systemic risk is an increasing number of creditors for each node. The worst shock propagation is found when each node only has one creditor and the network resembles the ring network. The acyclic tree network may also have random elements with an unknown number of creditors, generated by some discrete probability distribution. To reduce the probability of default and limit the contagion, a distribution with low variance and a high expected number of creditors is recommended.

In order to prevent future financial crises of large magnitude, more research is suggested to further understand the factors affecting systemic risk. Especially the systemically important institutions, which, if hit by a shock, cause the worst performance of the network, need to be better identified and new measures need to be developed as the traditional measures finding central institutions are not sufficient for the financial network.