Modeling Contagion in Financial Networks

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The recent global financial crisis has highlighted the need for a more complete understanding of systemic risk within financial markets. Through a simple network model we try to explain the emergence of systemic risk as a consequence of agents trying to minimize their individual risk. The model used is based upon the work of Gai and Kapadia on networks of interlinked balance sheets. Systemic risk is quantified using the traditional static methods of stress tests to characterize the emergence of cascading failures triggered by a single bank default. The initial defaulting bank is selected according to different protocols (random or targeted attack). This initial failure can then spread across the network because of counterparty loss.

In this study we consider networks with realistic topological features and realistic distributions of balance sheet size. We explore the effect of degree, degree distribution, and degree correlation on contagion. After exploring the traditional model with homogeneous assets distribution, we consider a more realistic model in which bank assets and liabilities are heterogeneously distributed. This allows us to address, in our framework, the “too big vs too interconnected to fail” debate. Further we simulate various policy solutions and determine their efficacy at preventing contagion.

Our main results are:

1) Compared to Erdös-Renyi random networks, heterogeneous uncorrelated networks are more robust with respect to the failure of random banks but more fragile with respect to the failure of the most connected banks.

2) A heterogeneous distribution of assets increases the probability of contagion even with respect to random failures.

3) Within the framework of the model a policy targeted to increase the capital buffer of a few big banks can significantly reduce the contagion probability in highly connected networks. In contrast, a policy targeted to increase the capital buffer of the most connected banks is ineffective.

4) Correlations, depending on their direction, can either decrease or increase the probability of contagion. Disassortative mixing, observed in real networks, acts to reduce contagion