Controlling the Stability of an Interconnected Financial Network

Woenho Chung, B.S. in Biomedical Engineering and B.S. in Electrical Engineering
Nathan Vogt, B.S in Electrical Engineering and Master of Business Administration

Dr. Zachary Feinstein, Project Advisor
Project Timeline: January 2017 - May 2017
Problem Statement

Eisenberg-Noe Model

Control Strategies

Methodology

Results
Problem Statement

**Cascading Failure**: Failure in network of interconnected parts so that the breakdown of single node leads to the collapse of successive elements

**Systemic Risk**: Banks linked via bilateral transactions (interbank loans) become indirectly linked in a network
Eisenberg-Noe Model

**Statement (A)** - The sum of what nodes $j$ (where $j$ is 0, 1... n) owe to node $i$ has to be less than or equal to $i$'s liquid asset account

\[
\min \sum_{i=1}^{N} q(i), \quad N = \text{total number of banks in the system}
\]

**Statement (B)** - The amount node $i$ owes the other nodes plus a potential clearing amount has to equal the total liabilities minus other current liabilities

\[
\begin{align*}
\sum_{j=1}^{N-1} L_{ji} &\leq Q_i \\
\sum_{j=1}^{N-1} L_{ij} + q_i &= L_i
\end{align*}
\]

**Goal**: The linear programming problem minimizes the clearing vector for the network
Fire Sale Implementation

**Definition:** Firms sell illiquid assets as a loss when facing debt

**Financial Implementation:** We ordered the firms’ assets from most liquefiable to least: other assets, long-term investments, PP&E, and unsellable assets

**Coding Implementation:** Our code uses a fixed point iteration method to model falling prices as a cosh function.

**End Result:** The addition of fire sale creates a new clearing vector with the prices of the illiquid asset classes
Control Strategies

**Central Clearing Party**: Central clearing reduces the overall amount of risks in the market. Attacks issue of interconnectedness by using an external node to clear all debt in the system.

**Circuit Break / Islanding**: isolate the defaulting node and re-run the system without the node. The resolution regime divides the defaulting node’s asset completely to line of creditors.

**Bailout / Rescue Fund**: Small portion of B/S allocated to RF to increase stability of system and market profitability. When initial node defaults, the RF sends the amount needed to prevent the default (similar to bailout).
Methodology

<table>
<thead>
<tr>
<th>Stress</th>
<th>No Control</th>
<th>CCP</th>
<th>Islanding</th>
<th>Bailout</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Stress</td>
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<td>Endogenous</td>
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**Endogenous Stress**: Lowered Bank of America’s assets to zero

**Exogenous Stress**: Lowered all banks’ assets by half
Methodology

Figure 12: An Islanding model. An endogenous stress is initially applied to the Eisenberg-Noe model then the islanding mechanism is implemented. The liquid asset account of Bank of America has been reduced to 0.

Lines: show direction of Liabilities

Red Circles: show defaulting bank and size of debt
Results

Figure 10: Four representations of the CCP model with an exogenous stress of 50%.

Islanding: 2-3 major defaults on average

CCP: 1-2 medium defaults on average

Bailout: No default but large vector into system

Almost always: Large well-connected banks fail first, demonstrating systemic risk
Results

**Islanding**: Least Practical and Least effective

**Bailout**: Practical and Most effective. Fairness?

**CCP**: Better than no control implementation
Thank You!

- Problem Statement
- Eisenberg-Noe Model
- Control Strategies
- Methodology
- Results