EFFICIENCY AND STABILITY OF A FINANCIAL ARCHITECTURE WITH TOO-INTERCONNECTED-TO-FAIL INSTITUTIONS

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Motivation

“If the crisis has a single lesson, it is that the too-big-to-fail problem must be solved.” Ben Bernanke, 2010.

“[T]he risk of failure of ‘large, interconnected firms’ must be reduced, whether by reducing their size, curtailing their interconnections, or limiting their activities.” Paul Volcker, 2012.

Dodd-Frank Act, Sec. 123 requires to estimate the benefits and costs of explicit or implicit limits on the maximum size of banks; limitations on the activities or structure of large financial institutions.
Research Questions

- How efficient and stable is the current financial architecture?
- What are the welfare and stability implications of limiting the maximum number of trading partners that financial institutions can have?
Summary of the Results

- On one side, there are benefits of large interconnected financial institutions (LIFIs). They make the liquidity allocation process more efficient in the Fed funds market by allowing for short intermediation chains.

- On the other side, failure of the most interconnected bank triggers larger cascades of failures in the estimated architecture than in the counterfactuals.

- The expected number of bank failures is non-monotonic in the degree of regulation.
The Framework

Unobservable:

- Financial Architecture – Network of Long-Term Trading Relationships
- Price-setting mechanism

Interbank Trading Model:
Mapping from endowments to equilibrium allocations

Observable:

- Network of trades:
  1. Density
  2. Max. num. of lenders
  3. Max. num. of borrowers
  4. Number of banks

Unobservable:

- Efficiency
- Stability
Illustration of the Model

Private value: $V(A)=0$

$P(A)=0.5$

$V(B)=0$

$P(B)=0.5$

$V(C)=0$

$P(C)=0.8$

$V(B1)=1$

$V(B2)=0.5$

$V(C2)=0.8$

$V(C1)=0.9$

Efficient Allocation

Equilibrium Allocation

Surplus loss: $\frac{V_{B1}-V_{C1}}{V_{B1}-V_A} = \frac{1-0.9}{1-0} = 0.1$
The Model*

- n banks trade Fed funds.
- Financial architecture is a network of trading relationships (g).
- One bank at a time receives an endowment of liquidity (deposit).
- Private values for liquidity (V) are uniformly distributed between 0 and 1.

**Definition (Equilibrium)**

i. Bank i’s equilibrium valuation is given by:

\[ P_i = \max \left\{ V_i, \delta \max_{j \in N(i,g)} P_j \right\} \]

ii. Bank i’s equilibrium trading decision is given by:

\[ \sigma_i = \arg\max_{j \in N(i,g) \cup i} P_j \]

# Model Fit (3 parameters)

<table>
<thead>
<tr>
<th>Network Moments Used in the Estimation:</th>
<th>Model</th>
<th>Data*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average density (%)</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Maximum number of lenders to a single bank</td>
<td>111.8</td>
<td>127.6</td>
</tr>
<tr>
<td>Maximum number of borrowers from a single bank</td>
<td>47.2</td>
<td>48.8</td>
</tr>
<tr>
<td>Average number of active banks</td>
<td>473.9</td>
<td>470.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Network Moments Not Used in the Estimation:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of links</td>
<td>1557</td>
<td>1543</td>
</tr>
<tr>
<td>Average number of counterparties</td>
<td>3.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Average path length-in</td>
<td>2.8</td>
<td>2.4</td>
</tr>
<tr>
<td>Average path length-out</td>
<td>2.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Average maximum path length-in</td>
<td>4.6</td>
<td>4.1</td>
</tr>
<tr>
<td>Average maximum path length-out</td>
<td>4.6</td>
<td>4.5</td>
</tr>
<tr>
<td>Diameter</td>
<td>6.7</td>
<td>7.3</td>
</tr>
<tr>
<td>Clustering by lenders</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Clustering by borrowers</td>
<td>0.28</td>
<td>0.12</td>
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<tr>
<td>Reciprocity</td>
<td>6.5</td>
<td>26</td>
</tr>
<tr>
<td>Degree correlation (borrowers, lenders)</td>
<td>-0.28</td>
<td>-0.35</td>
</tr>
<tr>
<td>Degree correlation (lenders, lenders)</td>
<td>-0.13</td>
<td>-0.26</td>
</tr>
</tbody>
</table>

Counterfactual Financial Architectures

Estimated architecture

no cap

Number of trading partners

cap=50

Number of trading partners

Homogeneous architecture

cap=24

Number of trading partners
Efficiency and Stability Measures

**Efficiency Measures**
- Welfare loss = Highest private value – Final borrower’s private value
- Surplus loss = Welfare loss / (maximum possible surplus)
- Expected Surplus Loss (ESL) = average of surplus losses across different realizations of liquidity shocks.

**Stability Measures**
- Use the estimated model to compute exposures (% of loans to each bank relative to total loans).
- Assume the most interconnected bank fails.
- Compute the total number of bank failures:
  - [With interim liquidity] A bank fails when its exposure to a failed counterparty is above 15%.
  - [Without interim liquidity] A bank fails when its exposure to all failed counterparties is above 15%.
- Compute the ESL after contagion.
- Endogenous rerouting of trades.
Efficiency Results

![Graph showing the relationship between Maximum Number of Trading Partners and ESL(%)]

- ESL(%) decreases as the Maximum Number of Trading Partners increases.
- The ESL(%), or Efficiency, drops sharply from around 1.3 at 24 trading partners to approximately 0.6 at 234 trading partners.

This indicates that the efficiency of the system decreases significantly as the number of trading partners increases.
Non-monotonicity Example with Six Banks

- **cap=5**
  - Connections and percentages as described.

- **cap=3**
  - Connections and percentages as described.

- **cap=2**
  - Connections and percentages as described.
Conclusion

• Limits on interconnectedness reduce trading efficiency.

• While restricting the interconnectedness of banks improves stability, the effect is non-monotonic.

• Stability also improves when:
  
  ➢ Banks are required to hold more liquid assets to absorb losses on interbank loans.
  
  ➢ Banks have access to liquidity during the crisis.
  
  ➢ Failed banks' depositors move money to the surviving banks.