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

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Questions

• How efficient and stable is a financial architecture with large interconnected banks?

• What are welfare and stability implications of limiting the maximum number of trading partners that financial institutions can have?

  • *Financial architecture* is a network of trading relationships.
  • *Efficiency* is low when there is a misallocation of liquidity/risks in over-the-counter market.
  • *Stability* is defined as a decline in efficiency when banks fail due to operational, systemic, or contagion risks.
Contribution

- Analysis is based on the real (calibrated) financial architecture.
- Quantify trading efficiency in ten financial architectures with different levels of concentration.
- Quantify not only the number of bank failures during a crisis scenario, but also the decline in efficiency.
- Contagion risk calculation is based on endogenous exposures between banks.
- Policy Implications
1. **Calibrate**: use a simulated method of moment to find model inputs that generate a network of trades with similar properties as in the data

2. **Compute**: efficiency and stability of the calibrated architecture

3. **Comparative statics**: efficiency and stability of nine counterfactual financial architectures
Equilibrium daily network of trades in the model. Only one third of all trading relationships are equilibrium trades.

Network of trades in the Fed funds market on September 29, 2006
Source: Bech and Atalay (2010)
# Equilibrium Network of Trades: Model vs. Data

<table>
<thead>
<tr>
<th>Moments</th>
<th>Model Implied Network of Trades</th>
<th>Fed Funds data (2006)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average network density (%)</td>
<td>0.73</td>
<td>0.7</td>
</tr>
<tr>
<td>Average max number of lenders to a single bank</td>
<td>116.6</td>
<td>127.6</td>
</tr>
<tr>
<td>Average max number of borrowers from a single bank</td>
<td>48.2</td>
<td>48.8</td>
</tr>
<tr>
<td>Average number of active banks</td>
<td>514</td>
<td>470</td>
</tr>
<tr>
<td>Average max number of intermediaries</td>
<td>6.2</td>
<td>6.3</td>
</tr>
</tbody>
</table>


- Size of the financial architecture: 986 banks trading at least one day
- All moments are computed by averaging over 250 trading days
Trading Model in Over-the-Counter Market

Initial allocation: \( E(1) = 1 \)

Private valuation: \( V(5) = 0.4 \)

\[ P(1) = 0.35 \quad P(2) = 0.25 \quad P(3) = 0.5 \quad P(4) = 1 \]

Feasible first-best allocation

Welfare loss = 1 - 0.4 = 0.6
Surplus loss = (1 - 0.4) / (1 - 0.3) = 0.857

i. Bank \( i \)’s equilibrium valuation is given by:

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

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

\[
\sigma_i = \arg\max_{j \in N(i,g) \cup i} P_j
\]
The calibrated and counterfactual financial architectures are generated using preferential attachment process:

- Start with a core of 11 banks (calibrated parameter) and add new banks with 11 trading relationships until reach 986 banks in total.
- The maximum number of trading partners is capped in the counterfactual financial architectures.
Efficiency and Stability Measures

Efficiency

• Expected surplus loss (ESL) = surplus created via trading / max. feasible surplus
  • Average of surplus loss over millions of trades
  • Cannot be measured from data directly, requires a model.
  • A market without trading will have ESL=100%

Stability

• For one architecture: change in efficiency (ESL) when banks fail

• Across architectures:
  • ESL after some banks fail
  • number of banks failures
Efficiency Comparison

Expected Surplus Loss (%)

Current architecture
Endogenous Contagion

• Banks trade in the interbank market and create bilateral exposures

• Bank with the most number of counterparties fails

• Its counterparties fail if have exposure above 15%
  • Exposure of bank A to bank B = Loans to bank B / all loans provided by bank A

• Endogenous cascade of failures: each bank that has exposure above 15% to a failed bank also fails.
What matters for efficiency is not how many banks fail, but which banks fail.

Number of bank failures is a bad predictor of welfare loss (correlation -0.44)

Non-monotonicity is important for policy

If there are several most interconnected banks, fail the one with the lowest index.
• If there are several most interconnected banks then average cascade sizes across these banks.
• Between 30% to 55% of banks fail in endogenous contagion risk.
• The number of bank failures is non-monotonic.
• Regulation can increase the number of failures.
The maximum number of failures triggered by a failure of a single bank is higher for restricted architectures.

The number of bank failures is non-monotonic.
What Bank is Systemically Important is Hard to Predict

Fraction of banks in each category that trigger the largest cascade
• It is hard to predict what bank triggers the largest cascade because there are many waves
Regulated Architectures are More Fragile

Average number of banks failures

Size of the largest contagion cluster

- Compute the size of the cascade triggered by failure of every banks
- Average across banks
- Consistent with current stress tests

- If any bank in the cluster fails, it triggers failure of all other banks in the cluster (and maybe more)
Operational Risk (10% of banks fail randomly)
Systemic Risk (10% of most interconnected banks fail)

Expected Surplus Loss (%)

Maximum Number of Trading Partners

- No Crisis
- Systemic Risk
Contagion Risk (10% probability of contagion)

ESL (%) vs % of banks fail

Maximum Number of Trading Partners
Policy Implications

- Optimal regulation of too-interconnected-to-fail banks (Dodd-Frank, Sec 123) depends on the probability of the future crises, their type and severity, speed and cost of recovery:
  
  i. **Operational risk**: no trade-off, no need to regulate

  ii. **Systemic risk & exogenous contagion risk**: exists a trade-off between efficiency and stability. Financial architecture with too-interconnected-to-fail banks is more efficient but less resilient to these risks.

  iii. **Endogenous contagion risk**: severity of the crisis depends on the threshold of exposure above which banks fail. Current financial architecture can experience many bank failures, but it is more efficient even after the failures.
    
    • Regulation can be suboptimal because more strict restrictions on the maximum number of counterparties can result in a more fragile financial architecture.

    • Banks that are the most interconnected are not always the most systemically important.

    • More banks could trigger the largest cascade in the regulated architectures, making regulation of these architectures more demanding in terms of recourses.
Conclusion

The framework allows me to quantify trading efficiency of a financial architecture with large interconnected banks and compute benefits of these banks.

It also allows me to quantify welfare effects of financial contagion, systemic risk, and operational risk.

Provides methodology to calibrate financial architecture based on network of realized trades.

Can be used for assessment of financial regulation of systemically important financial institutions (e.g. Dodd-Frank, Sec. 123)