Asset commonality, debt maturity and systemic risk by Allen, Babus and Carletti (JFE, 2012)

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Financial Networks at Tepper
Question

- Whether and how does the interaction between asset commonality and debt maturity generate systemic risk through an information channel?
  - Asset commonality
  - Information contagion

- Motivation
  - Financial instruments: risk diversification + asset commonality
  - Opaque balance sheet: information contagion
  - Short maturity debt: sensitive to liquidity shock and information
Findings

▶ Punchline: the interpretation of a insolvency signal could be different in different network structure.

▶ Clustered vs. unclustered networks
  ▶ conditional distribution of fundamentals
  ▶ information contagion
  ▶ roll over decision
  ▶ systemic risk
  ▶ welfare

▶ Short term debt may lead to information contagion. The degree depends on asset structures.

▶ Clustered network may have greater information spillover and higher roll over risk.
Model Setup

- $t = 0, 1, 2$, risk neutral banks $i = 1, 2, \ldots, 6$
- $R_H, R_L$ with $(p, 1 - p)$ at $t = 2$
- Risk neutral investors break even.
  
  $$pr + (1 - p)\alpha R_L = r_F^2$$

- Bank expected profit
  
  $$\pi_i = p(R_H - r) = E[R] - r_F^2 - (1 - p)\alpha R_L$$

- Risk diversification with $l_i$ other banks
  
  $$X_i = \frac{\theta_{i1} + \theta_{i2} + \ldots + \theta_{i1+l_i}}{1 + l_i}$$
Clustered vs. Unclustered Networks

- Model assumption: at equilibrium under pairwise stability, $l_i^* = 2, \forall i$. 

\[
\begin{align*}
X_1 &= (\theta_1 + \theta_2 + \theta_3) / 3 \\
X_4 &= (\theta_4 + \theta_5 + \theta_6) / 3 \\
X_6 &= (\theta_6 + \theta_1 + \theta_5) / 3 \\
X_5 &= (\theta_4 + \theta_5 + \theta_6) / 3 \\
X_3 &= (\theta_1 + \theta_2 + \theta_3) / 3
\end{align*}
\]
Only \( l^*_i \) matters for the banks’ portfolio returns, not the network structure.  
\[
X_i = \frac{R_i + R_j + R_k}{1 + l^*_i}
\]

Systemic risk and total welfare same for both structures.

<table>
<thead>
<tr>
<th>Project realizations</th>
<th>Number of states</th>
<th>Bank ( i )'s return ( X_i )</th>
<th>( R_L )</th>
<th>( \frac{2R_L + R_H}{3} )</th>
<th>( \frac{R_L + 2R_H}{3} )</th>
<th>( R_H )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ( 6R_H )</td>
<td>( \binom{6}{0} = 1 )</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2 ( R_L, 5R_H )</td>
<td>( \binom{6}{1} = 6 )</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3 ( 2R_L, 4R_H )</td>
<td>( \binom{6}{2} = 15 )</td>
<td>0</td>
<td>3</td>
<td>9</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>4 ( 3R_L, 3R_H )</td>
<td>( \binom{6}{3} = 20 )</td>
<td>1</td>
<td>9</td>
<td>9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5 ( 4R_L, 2R_H )</td>
<td>( \binom{6}{4} = 15 )</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6 ( 5R_L, R_H )</td>
<td>( \binom{6}{5} = 6 )</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7 ( 6R_L )</td>
<td>( \binom{6}{6} = 1 )</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>64</strong></td>
<td><strong>8</strong></td>
<td><strong>24</strong></td>
<td><strong>24</strong></td>
<td><strong>8</strong></td>
<td></td>
</tr>
</tbody>
</table>
Banks are in asset structure $g = \{C,U\}$ and promise return $r_{0j}(g)$

- **Good news: no bank defaults**
  - $q(g)$
  - $\Pr(X_i \geq \rho_{12}^G(g) | G) = 1$
  - Investors receive: $\rho_{12}^G(g)$
  - Banks receive: $X_i - \rho_{12}^G(g)$

- **Bad news: at least one defaults**
  - $1-q(g)$
  - $\Pr(X_i \geq \rho_{12}^B(g) | B)$
  - Investors receive: $\rho_{12}^B(g)$
  - Banks receive: $X_i - \rho_{12}^B(g)$

  - **early liquidation**
    - Investors receive: $r_f$
    - Banks receive: $0$

Date 0

Date 1

Date 2
Short Term Finance: signal

- $Pr(S = B)$ and $\mathbb{E}[X_i|S = B]$ differ.

- $Pr(S = B) = \begin{cases} \frac{15}{64}, & g = C \\ \frac{25}{64}, & g = U \end{cases}$

- $Pr(B|U)$ includes more marginal states than $Pr(B|C)$

- “$S = B|g = C$” is a worse signal, i.e. signals bigger risk

$$\mathbb{E}[X_i(C)|S = B] < \mathbb{E}[X_i(U)|S = B]$$