Competition policy as a tool for the macroprudential regulation of the banking sector

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(1) **Motivation**
- Can network structure be altered to improve network robustness? (Haldane, 2009);

(2) **THEORETICAL PERSPECTIVE**
- Macro-prudential regulation of the banking system (Hanson et al., 2009);
  - time-varying and size-varying capital requirements, high(er)-quality capital, dollars at capital (as opposed to capital ratios), contingent capital, a more tight regulation of debt maturity, the regulation of the shadow banking system
- Competition Policy (Vives, 2010);
  - Trade-off between competition and stability
- Network models (Nier et al. (2007), Gai and Kapadia (2010).
  - Non-linear (Inverted U-shape) relationship between connectivity and the resilience of the system

(3) **CONTRIBUTION of the PAPER**
- Examine the interaction between competition policy and macro-prudential regulation using a network approach.
Definition of a bank
Building up the network

Figure: Homogenous Banking Network
The asset structure of bank $i$ is made up as follows:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_i$</td>
<td>$NW_i$</td>
</tr>
<tr>
<td>$L_i$</td>
<td>$B_i$</td>
</tr>
<tr>
<td>$B_i$</td>
<td>$D_i$</td>
</tr>
</tbody>
</table>

$A_i =$ External Assets, $L_i =$ Lending, $NW_i =$ Networth, $B_i =$ Borrowing, $D_i =$ Deposits
- Key-object in our agent-based laboratory: Flow matrix $RF$.

- $L_i = \sum_{j=1}^{n} RF_{ij}$ (horizontal summation) where $L_i$ is the total lending of bank $i$.

- $B_i = \sum_{j=1}^{n} RF_{ij}^T$ (vertical summation) where $B_j$ is the total borrowing of bank $j$.

- Once we have retrieved from $RF B_i$ and $L_i \forall i$, we built each bank asset structure in the following way:

  - $A_i = \alpha L_i$
  - $NW_i = \beta[A_i + L_i]$
  - $D_i = A_i + L_i - NW_i - B_i$
- We now introduce a shock \( S_i = \gamma A_i \) that wipes out some or all of the external assets of bank \( i \) and we let the system adjust to it.

- Whenever \( A_i \) drops, \( NW_i \) is reduced by the same amount. Three scenarios are possible:
  - If \( NW_i - S_i > 0 \) then the bank survives and the shock is fully absorbed by the first bank.
  - If \( NW_i - S_i = 0 \), the bank fails but no other bank is affected by it. All lenders and depositors get their money back.
  - If \( NW_i - S_i < 0 \), bank \( i \) fails and losses are distributed amongst creditor banks linked with bank \( i \).
mechanism of shock transmission: suppose that the first bank defaults and turns out to be unable to repay 70 percent of its loans. Each creditor will then lose 70 percent of the value of the loan made to that bank.

- $A_{i,R} \downarrow \implies NW_{i,R} \downarrow$ (First-order Loss)
- $B_{i,R} \downarrow$ (Second-order loss) $\implies L_{j,R+1} \downarrow \implies NW_{j,R+1} \downarrow$
- $D_{i,R} \downarrow$ (Third-order loss)
The network is fully characterized by the following set of parameters:

**Table:** Description of Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
<th>Benchmark Value</th>
<th>Range of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>Number of Nodes (Banks)</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>$p$</td>
<td>Probability of Connectivity</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>$\alpha$</td>
<td>External Assets to Interbank Lending Ratio</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>$\beta$</td>
<td>Net-worth to Total Assets Ratio</td>
<td></td>
<td>0.01-0.07</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Shock relative to External Assets of one bank</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
central banks and antitrust authorities have the opportunity to design the structure of the industry by choosing how banks are allowed to merge.

Think about the case of Bankia in Spain

The key-question is whether network structures can be modified to strengthen the system resilience to shocks.

merges change the topology of the sector changes for three reasons:

1. larger banks are formed
2. the total number of active banks decrease
3. large banks are assumed to have more connections than small banks.
We start at round 0 with a population of 25 homogeneous banks and we simulate one merger at each of the following 9 rounds.

three different M&A strategies, which we translate into three different experimental treatments.

1. T1: a merger is possible only between two small banks.
2. T2: at each stage one small bank is acquired by the same large bank.
3. T3: at each round the M&A process creates a new large bank, but the size of active large banks is bound to remain equal horizontally.
Figure: Herfindahl Index
Table: Summary table of the treatments

<table>
<thead>
<tr>
<th>Rounds</th>
<th>$S_s$</th>
<th>$S_l$</th>
<th>$N_s$</th>
<th>$N_l$</th>
<th>$P_s$</th>
<th>$P_l$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
<td>T3</td>
<td>T1</td>
<td>T2</td>
<td>T3</td>
</tr>
<tr>
<td>1</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>60</td>
<td>62.50</td>
<td>120</td>
<td>120</td>
<td>na</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>60</td>
<td>65.22</td>
<td>120</td>
<td>180</td>
<td>na</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>60</td>
<td>68.18</td>
<td>120</td>
<td>240</td>
<td>na</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>60</td>
<td>71.43</td>
<td>120</td>
<td>300</td>
<td>na</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>60</td>
<td>75</td>
<td>120</td>
<td>360</td>
<td>na</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>60</td>
<td>78.95</td>
<td>120</td>
<td>420</td>
<td>na</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>60</td>
<td>83.33</td>
<td>120</td>
<td>480</td>
<td>na</td>
</tr>
<tr>
<td>9</td>
<td>60</td>
<td>60</td>
<td>88.24</td>
<td>120</td>
<td>540</td>
<td>na</td>
</tr>
</tbody>
</table>

$S_s=$Size of Small Banks, $N_s=$Number of Small Banks, $P_s=$Connectivity of Small Banks

$S_l=$Size of Large Banks, $N_l=$Number of Large Banks, $P_l=$Connectivity of Large Banks

$N_sS_s + N_lS_l = 1500 \forall$ Rounds and Treatments

Average Number of Links=120 $\forall$ Rounds and Treatments
Deep Interbank Market and Undercapitalized System

Figure: $\beta = 0.01, \alpha = 2, \text{Shock}=40$
Shallow Interbank Market and Undercapitalized System

Figure: $\beta = 0.01$, $\alpha = 5$, Shock=50
Figure: $\beta = 0.07$, $\alpha = 5$, Shock=50
Shock to small firms are more damaging for the system

The lower $\beta$ and the higher $\alpha$, the more the three treatments produce different results and hitting a large bank is less damaging for the system.

This gap gradually narrows down as we increase the level of networth in the system or shrink the interbank market. As a matter of fact, very little differences in treatments are detectable when the system is capitalized at 7

Concentrated and yet Asymmetric Banking networks are better equipped to deal with a shock
Motivations and Theory Background
Banking Network
Default dynamics
Network structures and Competition Policy
Conditional Capital Requirements
Network-Varying Capital Requirements
Final Remarks
Additional Plots

Treatment 2

**Figure:** Asset Dislocation with conditional capital requirements
Treatment 2

\begin{align*}
\beta_{t}^{opt} &= \frac{1}{1+\alpha P_t(n_s+n_l-1)} \\
\beta_{s}^{opt} &= \frac{1}{1+\alpha P_s(n_s+n_l-1)}
\end{align*}

\textbf{Figure:} Panel A: Optimal conditional capital requirements - Panel B: Aggregate and Partial Equity
Treatment 2

Figure: Asset Dislocation and Default Dynamics with optimal capital requirements- shock to a large bank
(1) CONCLUSIONS

- Topologies are not all alike: a concentrated and yet asymmetric system is better geared to cope with an external shock.

- The extent of the damage to the system depends on the exposure to interbank claims, the degree of connectivity, the structure of the network and capital requirements. $\Rightarrow$ capital requirements should be network-varying.

- Different shock-amplifying dynamics arise because flat capital requirements force an inefficient allocation of net worth within the system.

- Once we introduce network-varying capital requirements, the robustness of the system improves and this aligns the performance of different topologies.

- policy implication: the regulator shall closely monitor the structure of the network and its evolution over time.
(2) EXTENSIONS and FUTURE WORK

- Which role for Large Banks? Net Borrowers or Net Lenders
- Multiple Shocks
- Scale-free Networks
- Liquidity Effects.
Figure: Aggregate networth with Optimal Capital Requirements-T1 vs T2
Treatment 1

Figure: Optimal $\beta$

Gaffeo E. and Molinari M. Systemic Risk in Banking Networks
Figure: Asset Dislocation - shock to a large bank