Capital Requirements, Liquidity and Financial Stability: the case of Brazil

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Objectives

- To build a network model to simulate effects of shocks on a banking system subject to regulatory constraints.
- To use this model to stress test the Brazilian banking system under a variety of shocks to support an assessment of its possible reactions.
Main contributions

- We study the reactions to asset-side shocks of a banking system subject to a set of rules: attending to capital requirements, contagion channels: direct exposures, fire sales of market-to-mkt (MTM) assets, fire sales of non-MTM assets.

- We propose a method to compute individual banks contributions to systemic losses.

- We find:
  - Small shocks: medium-sized banks among the largest contributors.
  - As shocks become severe, only big banks contribute significantly.
  - Procyclicality tends to increase with shock severity.
  - Asset prices decay rates are relevant for systemic losses.
Model basics

- Model extends Cifuentes, Ferrucci and Shin (2005);
- Network of mutually exposed banks;
- Banks must comply with capital requirements;
- To achieve compliance, banks sell risky assets;
- Risky assets (liquid or illiquid) are not perfectly liquid, thus fire sales imply in price falls;
- Asset sales produce externatilities affecting other banks;
- Banks suffering losses:
  - Banks that suffer direct losses from their debtors in the network
  - Banks that fire-sell assets
  - Banks that own assets subject to MtM
- Losses can lead banks to lose their compliance or even to insolvency.
## Model – Balance sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_i$</td>
<td>$D_i$</td>
</tr>
<tr>
<td>$\sum_j x_{ij}$</td>
<td>$\sum_j x_{ji}$</td>
</tr>
<tr>
<td>$A_i^L$</td>
<td>$L_i^O$</td>
</tr>
<tr>
<td>$A_i^I$</td>
<td>$L_i$</td>
</tr>
<tr>
<td>$F_i^A$</td>
<td>$V_i$</td>
</tr>
</tbody>
</table>
- Initial state, with / without shocks
- Cycles until equilibrium
  1. Banks update balance sheets against possible losses

Model – Timeline

- Initial state
- Equilibrium
- Feedback to the banking system
- Externalities sources
2. Banks check solvency and estimate network payments
3. Insolvent: bank liquidated – generate externalities
4. Banks compute RWA and check compliance with F (capital requirement ratio)
5. Compliant banks: do not generate externalities, but are subject to externalities from others on next cycles.
6. Non-compliant banks:
   • Try adjustment: put liquid assets to sale (outside network).
7. If liquid assets fire sales aren’t enough:
   • Try adjustment: put illiquid assets to sale (outside network).
8. Can’t adjust after all: bank is liquidated (liquidation costs).
Model – Timeline

9. Trading (generate externalities)
   9A Liquid assets: supply → market price → trading
       Next cycle, liquid assets are marked to market.
   9B Illiquid assets: supply → market price → trading
10. Aggregate new externalities
   • New externalities: feedback
   • Otherwise: all non-liquidated banks are compliant: equilibrium
Data

- Date: Dec/2013
- Banks (conglomerates + individual banks): 124 commercial + investment
- Supervisory variables (division into liquid / illiquid assets, capital ratio, regulatory capital)
- Interbank exposures network (interbank onlending, credit, credit assignment, interfinancial deposits and other securities)
- Accounting data (we get deposits, cash-equivalent assets, loans and fund providing portfolios)

- Data from CBB, Financial System Monitoring Department.

- Assumed max. price decays: 20% Liq assets, 30% Illiq assets.
Simulations

Bad debt ratio increases – in percentage points of the portfolio of loans.

![Graph showing the relationship between losses and total assets ratio](image-url)
Simulations

Bad debt ratio increases – in percentage points of the portfolio of loans. Liquidity: cash equivalent assets that can be spent buying risky assets.
Simulations

Bad debt ratio increases – in percentage points of the portfolio of loans. Procyclicality measure: additional losses / initial shock.

![Graph showing additional losses and initial shock vs. bad debt ratio]
Simulations
Default of individual banks

Little impact provoked by contagion: lost assets \( \leq 1.5\% \) total assets
Losses provoked by most individual big banks amplify less than 50%.
Simulations

Banks contributions to risk under a bad debt ratio increase of 10 p.p.

\[
\text{Contribution}_i(\%) = \frac{\Delta \text{Loss}_{\text{bank immunized}}}{\Delta \text{Loss}_{\text{normal simulation}}}
\]
Suppose a bank needs to put liquid assets to sale because at the moment its capital ratio is 0.10 instead of 0.11:

- **Small bank:**
  - Small amount sold
  - Little price fall → little additional losses (MtM), usually absorbed by capital buffers.

- **Big bank:**
  - Large amount sold
  - Significant price fall → significant additional losses (MtM) → feedback (acceleration)

This explains the increase of shock amplification in this model: the capital buffer of big banks is consumed and they need to sell assets.
For the decay 70/55 and beyond, big banks contribute significantly with losses selling large amounts of illiquid assets.
Simulations
Robustness test

Beyond the decay 70/55, procyclicality increases faster.
Simulations
Robustness test

➢ Application: during crises, different asset prices decay rates can produce very different outcomes, especially the steeper ones.
Conclusions

- Simulations and resilience: after an increase of 10 p.p. in the bad debt ratio, estimated total losses are around 0.5%. The simulated default of an individual bank provokes less than 2% total loss.

- Contributions to systemic losses are related with size, for a stress scenario of 10 p.p. shock to the bad debt ratio.

- Regarding procyclicality (shocks amplification), we can conclude:
  - It increases with the severity of the initial shock.
  - Fire sales by big banks is an important amplification mechanism.
  - If decay rates are high, small differences in the rate produce rather different outcomes.
THANK YOU