Systemic Loops and Liquidity Regulation

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Contagion and Feedback Loops

- Banks are subject to liquidity-solvency nexus (Pierret 2015 recent evidence)
- Fragility on liability side (liquidity scarcity)→ early projects liquidation→fire sale externalities
- Falls in asset returns (fire sales accounting losses)→news reach investors→run the bank
- Theoretical models focus typically on one side of the nexus. Policy neglects nexus: LCR→no role for asset position
- *We model endogenously contagion risk on both sides of banks' balance sheet (including the nexus)→explore the role of LCR*

Contagion in Theoretical Models

- Only *asset price contagion*:

1. Fire sale externalities: Cifuentes, Ferrucci and Shin 2005, Allen and Carletti 2008
2. Network interconnections (debt default): Elliot, Golub and Jackson 2012
3. Aldasoro, Delli Gatti and Faia 2014: both

- *Only liability-side contagion* and nexus (asset side is exogenous or macro-fundamentals):

1. Diamond and Rajan 2005 or Rochet and Vives (2004) banks' runs triggered by exogenous shocks on assets
2. Allen and Gale 1998, runs triggered by business cycle fluctuations
3. Angeloni and Faia (2013) use a combination of the two above

Channels in our model

- Model endogenously contagion risk on both sides of banks' balance sheet:

1. **Asset risk**→
a. Fire sale externalities (banks subject to heterogenous asset shocks)
b. Interbank debt default (network externalities with endogenous propagation);
2. **Liquidity risk**→
a. Runs on STL (global games a' la Morris and Shin 2003, Carlsson and van Damme 1993)
b. Liquidity hoarding (Afonso and Shin 2010)
c. Notice: interbank function as insurance device, but can also propagate contagion
3. **Nexus**→news and regulatory requirements

Liquidity regulation

- LCR does not take into account this nexus: depends only on liability mix, not on asset positions
- Common to all banks independently of their asset position
- In fact, banks more exposed to non-liquid assets also leverage more→hence should be taxed differentially
- Mildly leveraged banks shall not be taxed as they act as liquidity provider and help the insurance function of interbank markets

Policy in Our Model

- The role of LCR phase-in for systemic risk
- Design LCR based on systemic importance (macro-prudential policy) and re-assess the effect on systemic risk
- Measure systemically important banks according to BCBS criteria

Findings

- Systemic risk raises in the past phase of LCR introduction
- Systemic risk decreases monotonically only when asymmetric across banks
- Role of interbank markets for the trade-off between insurance motives and contagion propagation→

a. Banks with low returns on non-liquid assets, leverage less and supply interbank liquidity
b. Taxing them equally as the highly leveraged banks impairs insurance function
c. Taxing highly leveraged banks more→reduces contagion

The Model

- Optimizing risk averse banks: choose interbank exposure (possibility of debt default), non-liquid assets
- Funds themselves with STL→runs triggered by news arrival (global game)
- Price mechanism in both markets endogenous: Tâtonnement process
- Trading matching algorithm: insurance motives (Allen and Gale 200)→maximum entropy

Banks

Choose interbank lending and non-assets to maximize:

$$U(\pi_i) = \frac{(\pi_i)^{1-\sigma}}{1-\sigma}$$

where: $\pi_i = r_i^a \frac{a_i}{p} + r^l \sum_{j=1}^{k} l_{ij} - (r^l + r_i^p) \sum_{j=1}^{k'} b_{ij} - r_i^d d_i$

s.to

$$\frac{c_i + pa_i + l_i - d_i - b_i}{\omega_a pa_i + \omega_l l_i} \geq \gamma$$

$$\frac{c_i}{\omega_d d_i + \omega_b b_i - \min\{\tilde{\omega}_l l_i, 0.75\,(\omega_d d_i + \omega_b b_i)\}} \geq \alpha$$

Runs on STL

Run region (ε_i is a news shock):

$$exp(-\varepsilon_i) r_i^a \frac{a_i}{p} + r^l l_i - r_i^b b_i \geq r_i^d d_i$$

Unique threshold→switching strategy in a simultaneous incomplete information game:

$$\tilde{\varepsilon}_i = log\left(\frac{r_i^a a_i / p}{r_i^d d_i + r_i^b b_i - r^l l_i}\right)$$

Share of deposits being withdrawn will be then given by $\rho_i = \int_{-\infty}^{\tilde{\varepsilon}_i} \theta(\varepsilon) d\varepsilon = \Theta(\tilde{\varepsilon}_i)$.

Sequential Price Tâtonnement

- Centralized price mechanism: Duffie and Zhu 2011 (bilateral Afonso and Lagos 2012)
- First, Price Tâtonnement in interbank: r^l adjusts step-wise to within a bid-ask band and to equilibrate $\sum_{j=1}^{k} l_{ij}$ and $\sum_{j=1}^{k} b_{ij}$
- Second , Price Tâtonnement in non-liquid asset markets (Cifuentes et. al 2005): total excess supply (aggregate of individual optimizations) equilibrate aggregate demand $p = exp(-\beta \sum_i s_i)$
- Matching trading partners: maximum entropy$\longrightarrow$banks distribute trading evenly to maximize insurance (Allen and Gale 2000)

Contagion channels

- Asset side:

1. Asset commonality, regulatory constraints and endogenous price mechanisms→pecuniary externalities
2. Endogenous interbank debt default

- Liability side:

1. STL runs: coordination problem due to news arrival
2. Risk averse banks hoard liquidity in face of large shocks

- Insurance motives: evenly spread matching partners. Shall be balanced with contagion
- Nexus:

a. Accounting losses→news→runs and liquidity hoarding
b. Liquidity shortage→unfulfilled regulatory requirements→fire sales

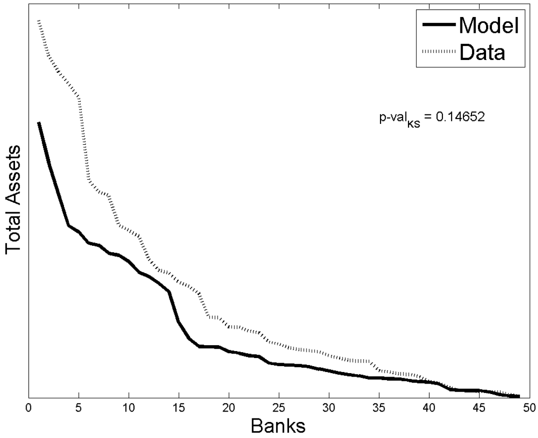
Calibration, Simulation and Systemic Risk

- Simulation of shocks: assign default losses sequentially via clearing algorithm (Eisenberg and Noe 2001)
- Calibration:

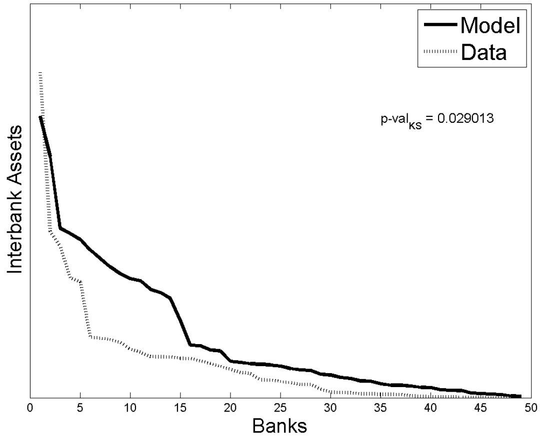
1. Policy parameters are taken from regulation
2. Banks are heterogenous: asset shock distribution and STL returns distributions calibrated on European banks (Alves et. al 2013)
2. Other parameters→estimated, **method of moments** (empirical targets: max level of assets, skewness asset distribution, average leverage and interbank assets)

- Systemic risk:

$$\Phi = \frac{\sum_{\Omega} assets_{\Omega}}{\sum_{i} assets_{i}}$$



(a) Distribution of total assets



(b) Distribution of interbank assets

Figure 1: Distribution of total and interbank assets for model and data. p-val$_{KS}$ denotes the p-value of a two-sided Kolmogorov-Smirnov test.

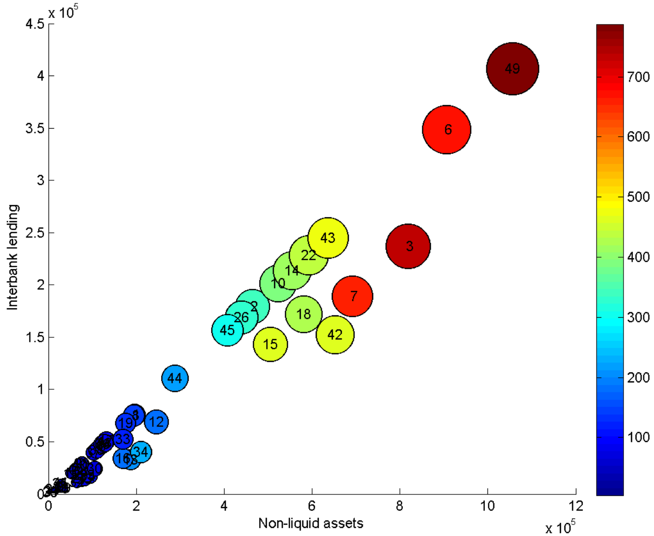
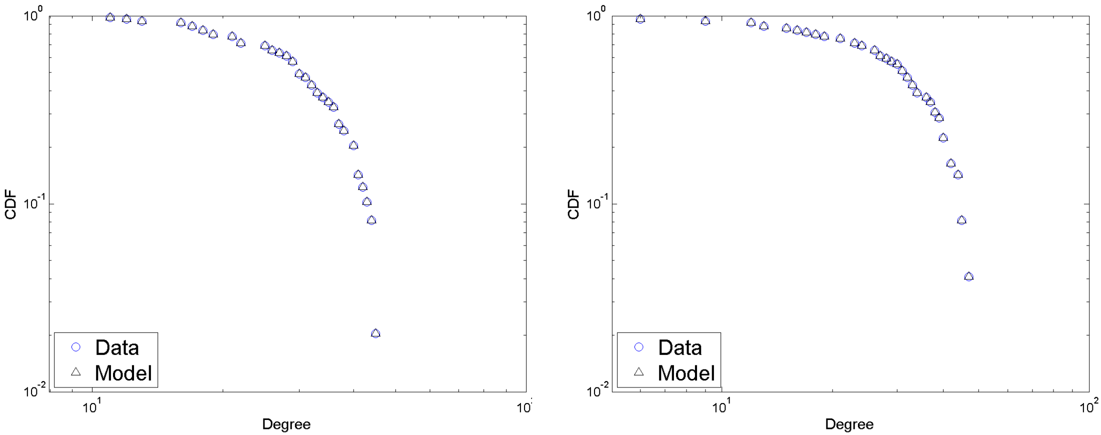


Figure 2: Baseline configuration. Nodes size indicates total assets, while node color denotes the systemic importance ranking.

	Model	**Data**
Density (%)	63.14	63.14
Average Degree	30.31	30.31
Average Path Length	1.17	1.17
Betweenness Centrality (Av.)	0.04	0.05
Eigenvector Centrality (Av.)	0.08	0.10
Clustering Coefficient (Av.)	0.41	0.40
Assortativity		
out-in degree	-0.25	-0.25
in-out degree	-0.04	-0.04
out-out degree	-0.06	-0.06
in-in degree	-0.11	-0.11
Modularity (Maximum)	0.22	0.22
Reciprocity	0.72	0.72
Reciprocity (normalized)	0.25	0.25

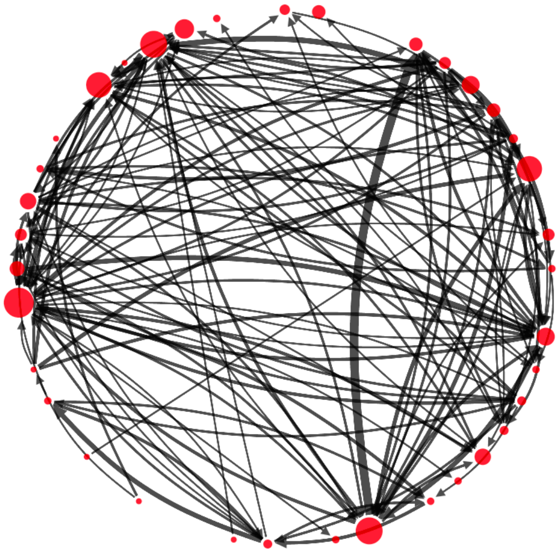
Table 2: Network indicators of model and data



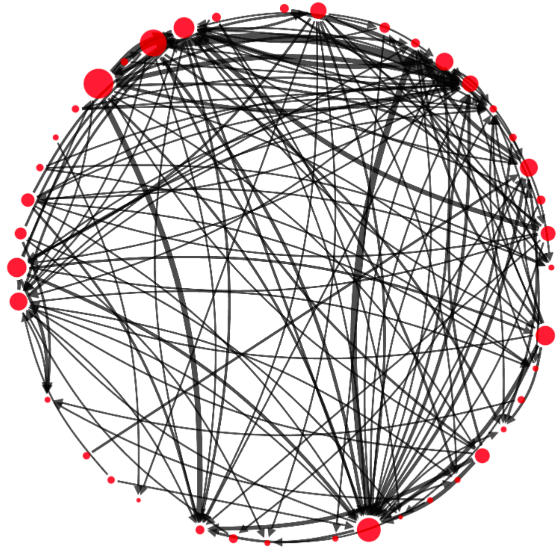
(a) In-degree distribution

(b) Out-degree distribution

Figure 3: Degree distribution for model and data in log-log scale.



(a) Data



(b) Model

Figure 4: Network charts. Node size indicates total assets. Arrows go from lender to borrower and their width indicates size of exposures. Only the top 150 links in terms of value are shown.

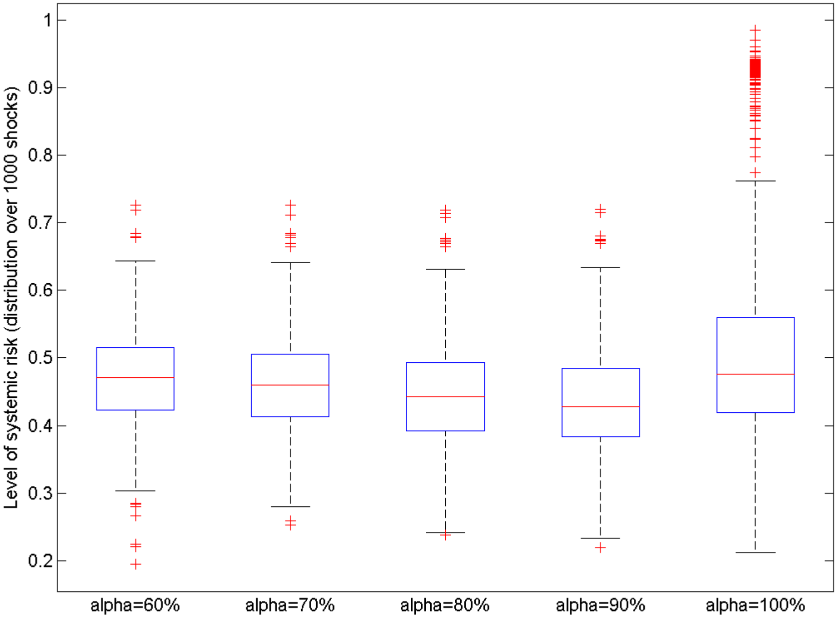


Figure 5: Systemic risk for different stages of the phase-in of LCR.

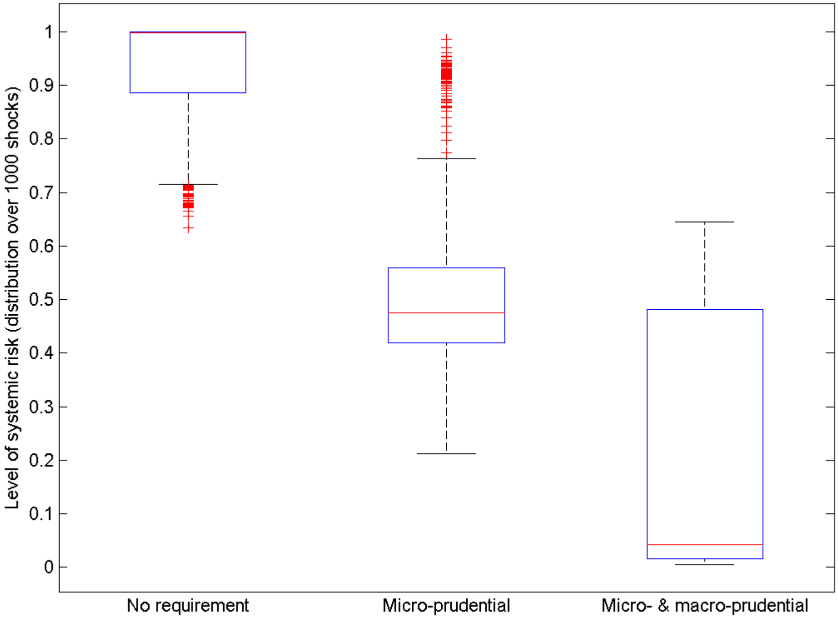


Figure 6: Systemic risk for different prudential regimes.

Conclusions

- Banking network model with contagion risk on both sides of banks' balance sheet
- Assess the role of LCR phase-in
- Bank-based policy instruments reduce systemic risk
- Future theoretical advances:

1. Bilateral bargaining
2. Dynamic banks' optimization

- Optimal prudential policy: min risk/max welfare, account for policy/banks strategic interactions

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