Discussion of "Centrality-based Capital Allocations and Bailout Funds" Alter, Craig, and Raupach (2014)

Alireza Tahbaz-Salehi
Columbia Business School

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Financial Networks

- Much recent interest in the relationship between systemic risk and network effects, mainly a consequence of the Financial Crisis.

- Large body of recent, theoretical works
  - direct contractual linkages
  - fire-sales and pecuniary externalities
  - etc.

- Sure, the models are theoretically nice, but are they relevant?
- Almost no quantitive/empirical analysis.

This Paper

- Uses a very rich dataset to fill this void
  Extracts the interbank network of the German banking system

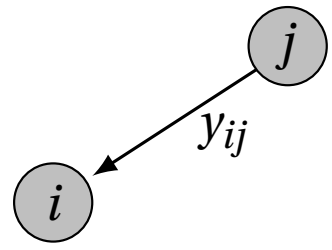
- A fairly elaborate model of banks' balance sheets, exogenous shocks, and the contagion mechanism

- Main Question: whether policies that rely on network statistics can improve stability of the system as a whole.

- Simulate the extent of contagion under different policies
  - Tax interconnectivity through capital charges (*ex ante* policy) (what I will focus on)
  - A bailout fund based on network statistics (*ex post* policy)

Theoretical Framework (Simplified)

- n institutions/banks
- Banks have outside and interbank liabilities and assets.
- The financial network captures the extent of interbank liabilities.



- Each bank holds some capital k_i.
- Depositors and other creditors are senior to interbank creditors (v_i).
- Banks are subject to exogenous shocks to their assets ϵ_i^{real}.

Contagion Mechanism

- If a bank defaults, its creditors get paid on a *pro rata* basis.
- The total out-payment of bank i is equal to

$$x_i = \max\left\{\min\left\{\sum_{j=1}^{n} \pi_{ij} x_j + k_i - v_i - \epsilon_i^{real}, \sum_{j=1}^{n} y_{ji}\right\}, 0\right\}.$$

  where $\pi_{ij} = y_{ij} / \sum_{r=1}^{n} y_{rj}$.

- Solution Concept: the vector of interbank payments $x^* = (x_1^*, \ldots, x_n^*)$ that solves the above system of equations.

- Alternatively, if $L_i^{IB} = \sum_{j=1}^{n} y_{ji} - x_i$:

$$L_i^{IB} = \min\left\{\max\left\{\sum_{j=1}^{n} \pi_{ij} L_j^{IB} + v_i + \epsilon_i^{real} - k_i, 0\right\}, \sum_{j=1}^{n} y_{ji}\right\}$$

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Contagion Mechanism

- Shocks propagate over the interbank linkages.
  (a variant of the model of Eisenberg and Noe, 2001)

- If a bank defaults, there is a bankruptcy costs of C_i proportional to the bank's size.

- Total deadweight social loss:

$$L_{agg} = \sum_{i=1}^{n} C_i \cdot \mathbf{1}\{i \text{ defaults}\}$$

- Set capital requirements to minimize $\mathbb{E}[L_{agg}]$.

Network Centralities

- Set capital requirements based not only on banks' individual riskiness (VaR), but also some widely used network statistics of the banks.
- Centrality of bank i: $c_i : \mathbb{R}_+^{n \times n} \to \mathbb{R}_+$
- Examples:
  - the size of i's total interbank assets

$$c_i = \sum_{j=1}^{n} y_{ij}$$

  - eigenvector centrality: c is the eigenvector of the liabilities matrix

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Network-Based Capital Requirements

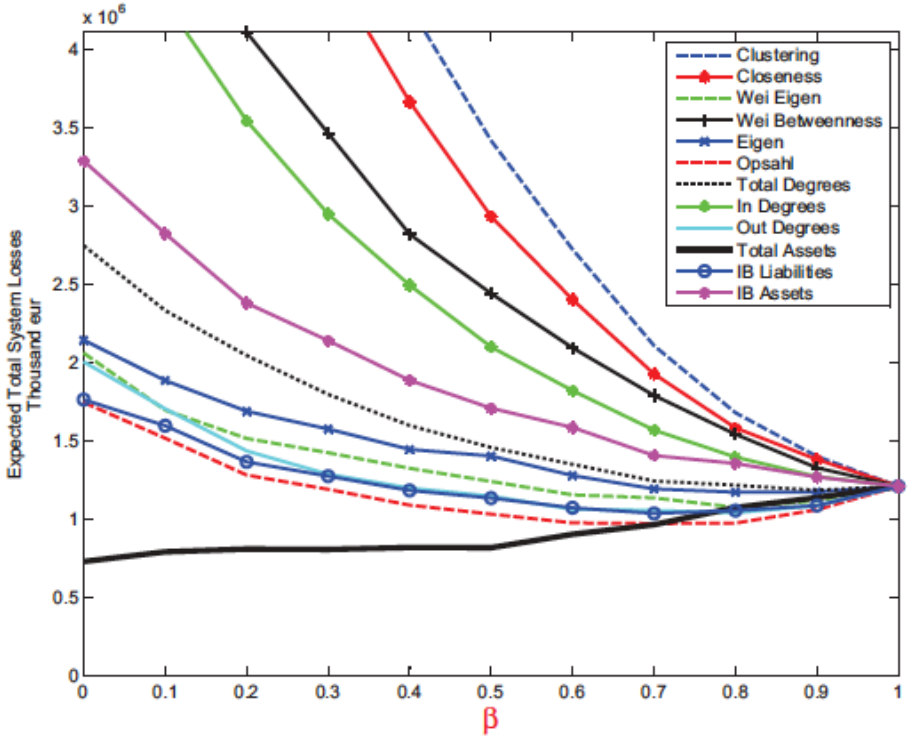
- Set capital requirements based on centralities and a no-network benchmark:

$$k_i = \beta k_i^{VaR} + (1-\beta)\left(\frac{c_i}{\sum_{j=1}^{n} c_j}\right)\sum_{j=1}^{n} k_j^{VaR}$$

- Choose β such that L_{agg} is minimized.

- The rationale being that shocks to more "central" banks would propagate more.

Main Results: Capital Requirements



- Setting capital requirements based on total assets leads to the most improvement.
- Aside from the size of total assets, capital requirements based on Opsahl centrality provide the best performance.

Comments

- First Observation: capital rules based on size outperform all other centrality measures.

- However, size is hardwired into the performance measure:
  - Larger banks are assumed to have a higher bankruptcy cost.
  - Not surprising that the capital allocations best on size dominate all other metrics.

Comment: What is the "Right" Network Statistic?

- The paper relies on a specific structural model of interbank contagion.
- So why not rely on the "network statistic" that is implied by the structural model?
- In fact, off-the-shelf measures can be misleading in identifying systemically important financial institutions.

A Simple Linear Economy

- Suppose that spillovers are linear:

$$L_i^{IB} = \sum_{j=1}^{n} \pi_{ij} L_j^{IB} + \epsilon_i^{real}.$$

- Total losses:

$$L_{agg}^{IB} = \sum_{i=1}^{n} L_i^{IB}.$$

- In such an economy:

$$\frac{dL_{agg}}{d\epsilon_j} = \text{eigenvector centrality of bank } j$$

Network Statistics

- Eigenvector centrality is the correct notion for systemic importance of a financial institution if interactions/spillovers are linear.
  (or at least, when the interactions are smooth, so that can be linearly approximated).

- This may not generalize to an economy with non-smooth interactions:
  - debt contracts
  - bankruptcy costs
  - etc.

Non-Smooth Interactions: Debt Contracts

- Consider an economy in which all banks are of equal sizes: (identical interbank assets and liabilities)

$$\sum_{j=1}^{n} y_{ij} = \sum_{j=1}^{n} y_{ji} = y.$$

- All banks have identical eigenvalue centralities.
- Also, suppose that banks are linked via standard debt contracts (as in the current paper):

$$L_i^{IB} = \min\left\{y, \max\left\{0, \sum_{j=1}^{n} \pi_{ij} L_j^{IB} + \epsilon_i^{real} - k\right\}\right\}$$

- Total losses:

$$L_{agg} = C \cdot \sum_{i=1}^{n} 1\{i \text{ defaults}\}$$

Network Statistics

- Harmonic distance of bank i from bank j

$$m_{ij} = 1 + \sum_{k \neq j} \pi_{ik} m_{kj}.$$

Proposition (Acemoglu *et al.*, 2014)

Suppose bank j is hit with a large enough shock. Then, bank i defaults if and only if

$$m_{ij} \leq m^*$$

for some m^*.

- Despite the fact that all banks have the same eigenvector centrality, weighted out-degree, weighted in-degree, Bonacich centrality, ...

Network Statistics

- Implication: A bank is systemically more important the shorter the harmonic distances of other banks to it are.
- Intuition: with linear interactions, positive and negative shocks propagate symmetrically, but not if the interactions are not smooth.
- More importantly: the “correct” notion of centrality should come from the structural model of network interactions.

Comment: Equilibrium Multiplicity

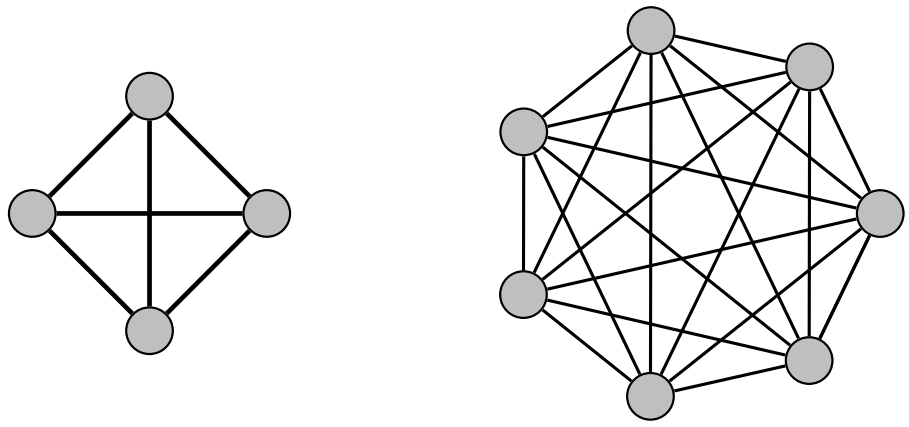
- Introducing bankruptcy costs:
  suppose that there is a drop in the value of a bank's assets if it defaults:

$$L_i^{IB} = \min\left\{y, \max\left\{0, \sum_{j=1}^{n} \pi_{ij} L_j^{IB} + \epsilon_i^{real} + C \cdot \mathbf{1}\{i \text{ defaults}\} - k\right\}\right\}$$

- Because of the discontinuity, the economy may have multiple equilibria.
- The paper focuses on the equilibrium with the minimum losses.

Comment: Equilibrium Multiplicity

- The set of systemically important banks may depend on the equilibrium selected.



- In the “best” eq. banks on the left are more systemically important.
- In the “worst” eq. banks on the right are more systemically important.

- Optimal capital requirements may be sensitive to the equilibrium selected.

Summary

- Very important and relevant work:
  - Many theoretical studies, but almost no quantitative analyses of the mechanisms studied in the literature
  - The paper fills an important void.

- Main comment: the proper network statistic/moment should be a consequence of the structural model of interbank spillovers.
- Off-the-shelf network statistics can be misleading.
- Equilibrium multiplicity would make the picture more complicated.