Centrality-based Capital Allocations and Bailout Funds

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joint work with Ben Craig and Peter Raupach (Deutsche Bundesbank)

Final Conference of the Macro-prudential Research Network hosted by the ECB

23 June 2014

Outline

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Motivation (I)

- Macro-prudential supervision: a regime shift in supervisory/regulatory framework $\rightarrow$ focus on systemic risk and interconnectedness
- New methods and tools for regulators and policymakers to cope with interconnected systemic financial institutions $\rightarrow$ improve system's robustness to exogenous shocks
- Reform Basel regulations by introducing/revising:
  - $\rightarrow$ leverage ratio
  - $\rightarrow$ capital requirements
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1. How to deal with systemically important financial institutions (SIFIs)?
2. How to make the financial system more resilient to systemic risk?

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Two sources of **systemic risk**:

Common asset shocks (correlated credit exposures) **AND** **Interbank network** (interconnectedness)

We propose two **policy strategies**:

→ **Capital (re)allocations**

→ **Bailout fund mechanism**

- **Results** contribute to the regulatory discussion related to SIFIs and show that "Too-big-to-fail" dominates "Too-interconnected-to-fail"

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- Allen and Gale (2000) refer to a complete network as the most resilient to contagion, while Haldane and May (2011) claim the existence of a tipping-point in connectivity above which knife-edge effects appear

- Elsinger et al. (2006) first to combine common exposures with interbank network (consider both market and credit risk) $\rightarrow$monitor systemic risk of the Austrian banking system

- Gauthier et al. (2012) introduce liquidity risk (through firesales externalities) and try to apply market-based systemic measures to obtain capital allocations (**not tractable** for a system with almost 2000 banks like the one in Germany)

This paper's contributions:

$\rightarrow$ it shows the usefulness of network-based connectivity measures (interbank market)

$\rightarrow$ proposes capital (re)allocations based on a trade-off between idiosyncratic bank riskiness and different interconnectivity measures

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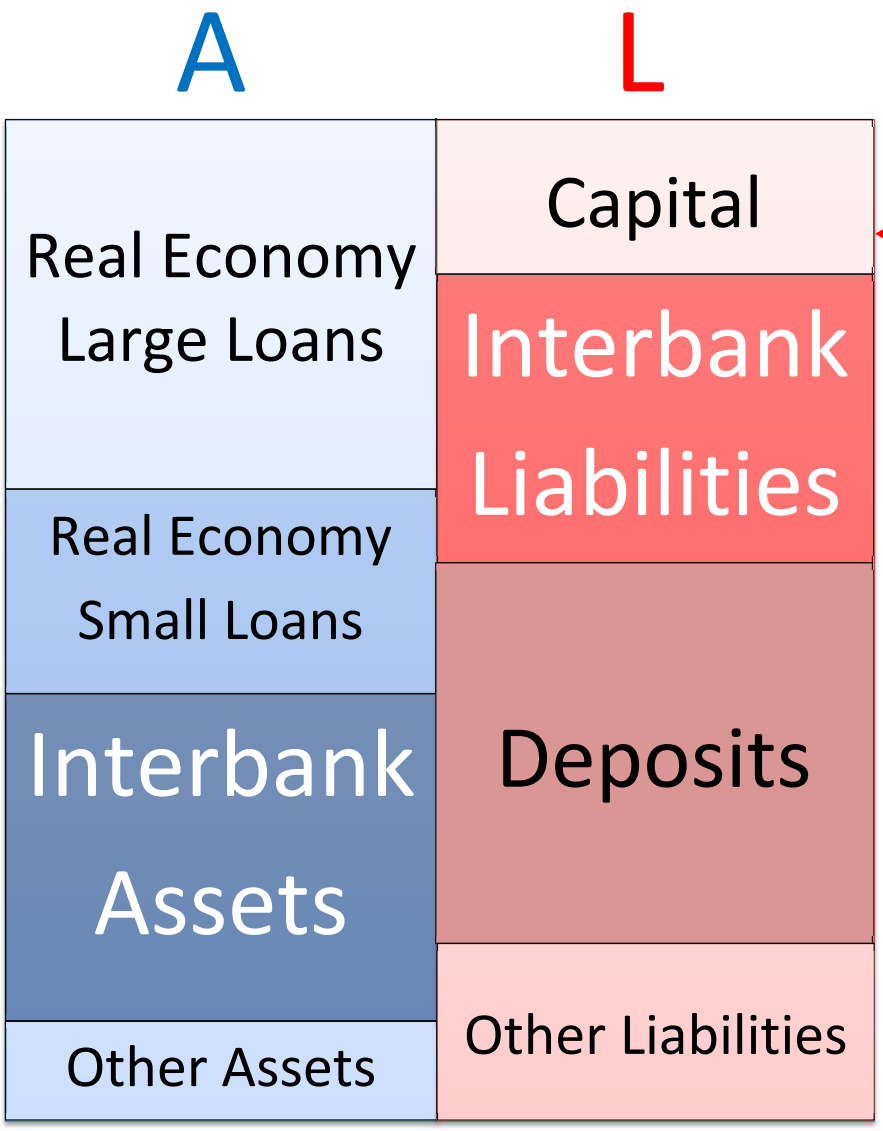
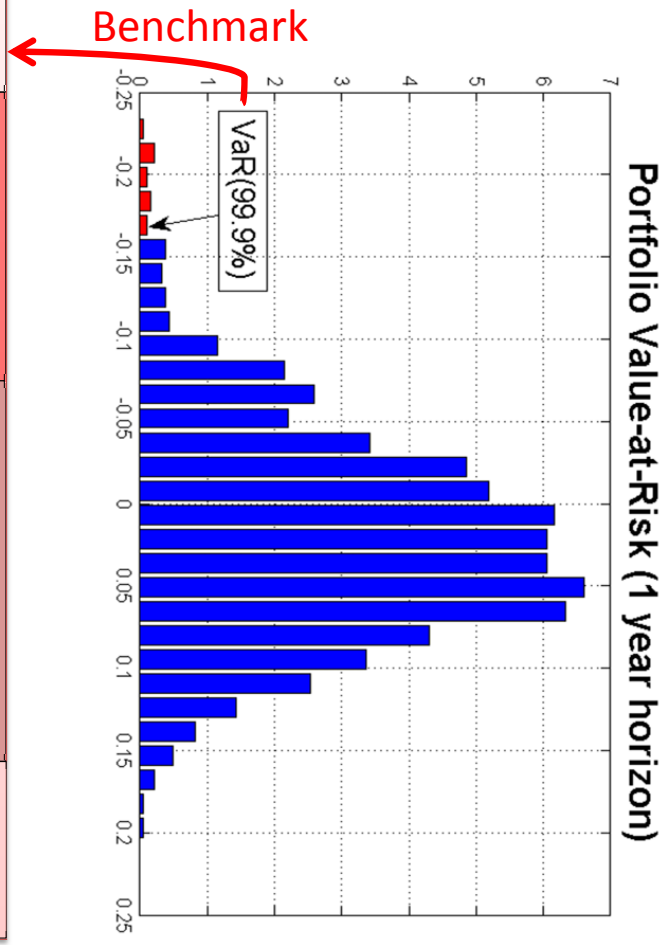
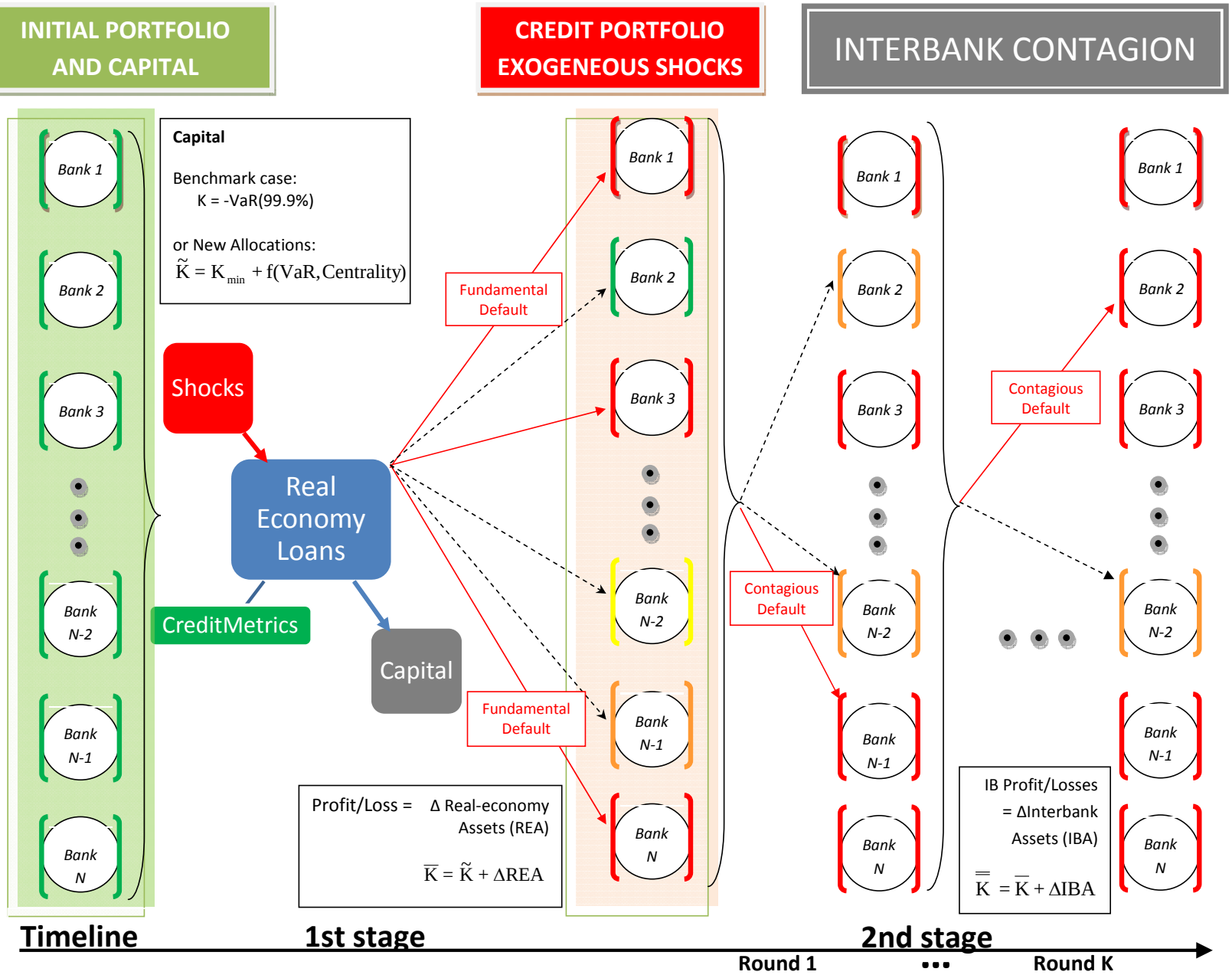
Stylized Balance-sheet and Benchmark Capital





Sketch of the Model



Contagion procedure

Standard assumptions of interbank contagion (e.g. Upper(2011)):

1. Banks have *limited liability*.
2. Interbank liabilities are *junior* to non-bank liabilities (e.g. deposits).
3. Losses related to bank defaults are shared *proportionally* among interbank creditors based on the share of their exposure to total interbank liabilities of the defaulted bank.
4. Non-bank assets are liquidated at a certain discount. This extra loss is referred to as *firesales* that are captured by *bankruptcy costs* (BC_i).

$\Rightarrow$*Interbank clearing mechanism* (see Eisenberg and Noe (2001))

Capital (re)allocations

- Bankruptcy costs (at each simulation j of bank i)

$$BC_{i,j} = \underbrace{\phi\, TotalAssets_i}_{\text{litigation costs}} + \underbrace{\overbrace{\lambda_j}^{\substack{\text{system loss}\\ \text{intensity factor}}} \quad \overbrace{(L_{i,j} - K_i)}^{\substack{\text{excess loss}\\ \text{bank i}}}}_{\text{firesales}}$$

- New capital allocations (for bank i)

$$\tilde{K}_i = K_{min,i} + \beta * (K_{\alpha,i} - K_{min,i}) + \gamma * Centrality_i$$

- Target function (to be minimized)

$$\text{System Losses} = \mathbb{E} \sum_i \left[BC_i * \underbrace{I(L_i - K_i > 0)}_{\text{default indicator}} \right]$$

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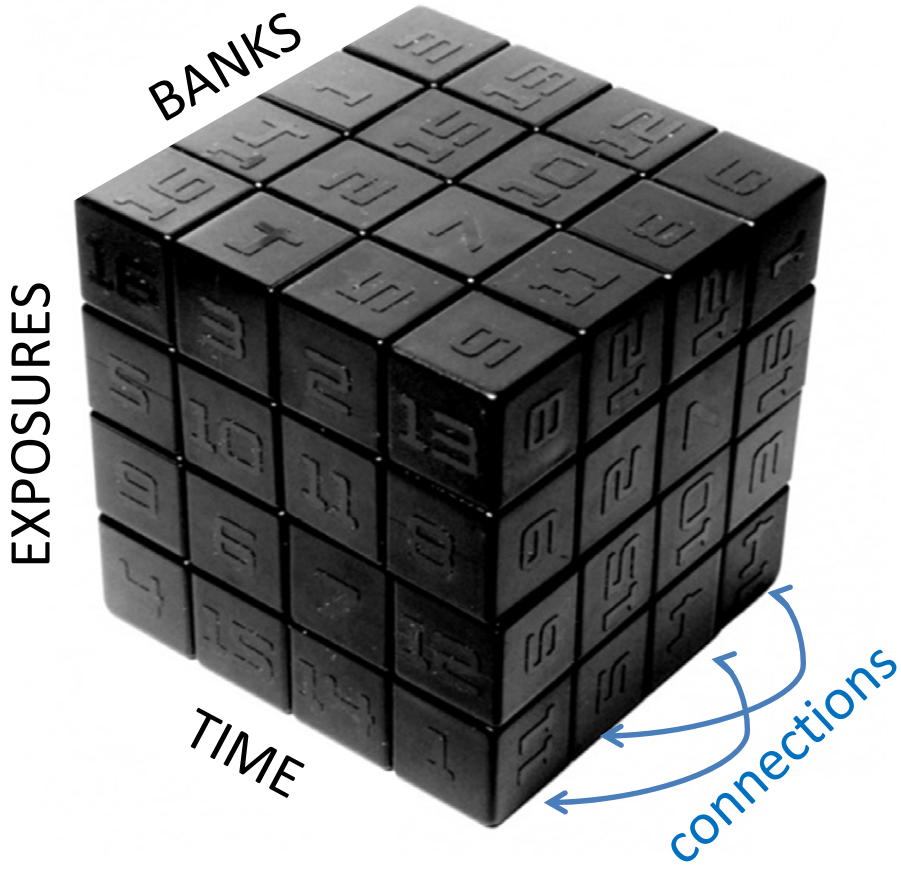
Bundesbank's Goldmine



Our Data

Time: 2005 Q1 – **2011 Q1**

No of Banks: **1764**

No of connections: **22.000**

Other credit exposures:

≈380.000

Portfolio Sectors: **21**

Main data source:

German Credit Register

(„Gross- und Millionenkreditstatistik“)

Interconnectedness measures

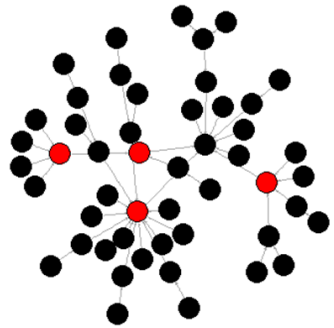
- **Degree**: number of borrowing/lending relations (out and in)
- **Strength**: The total interbank amount lent/borrowed in the interbank market

Opsahl centrality

- **Closeness**: the inverse of sum of *shortest distances* to all other nodes

  "An important node is typically "close" to, and can interact quickly with, the other nodes in the network."

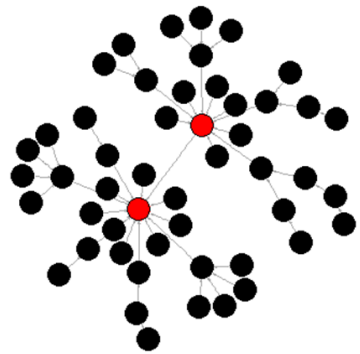
Betweenness



- **Betweenness**: the share of shortest paths going through a bank (typically a broker dealer)

  "An important node will lie on a high proportion of paths between other nodes in the network."

Eigenvector centrality



- **Eigenvector centrality**: *"An important node is connected to important neighbors."* (Bonacich)

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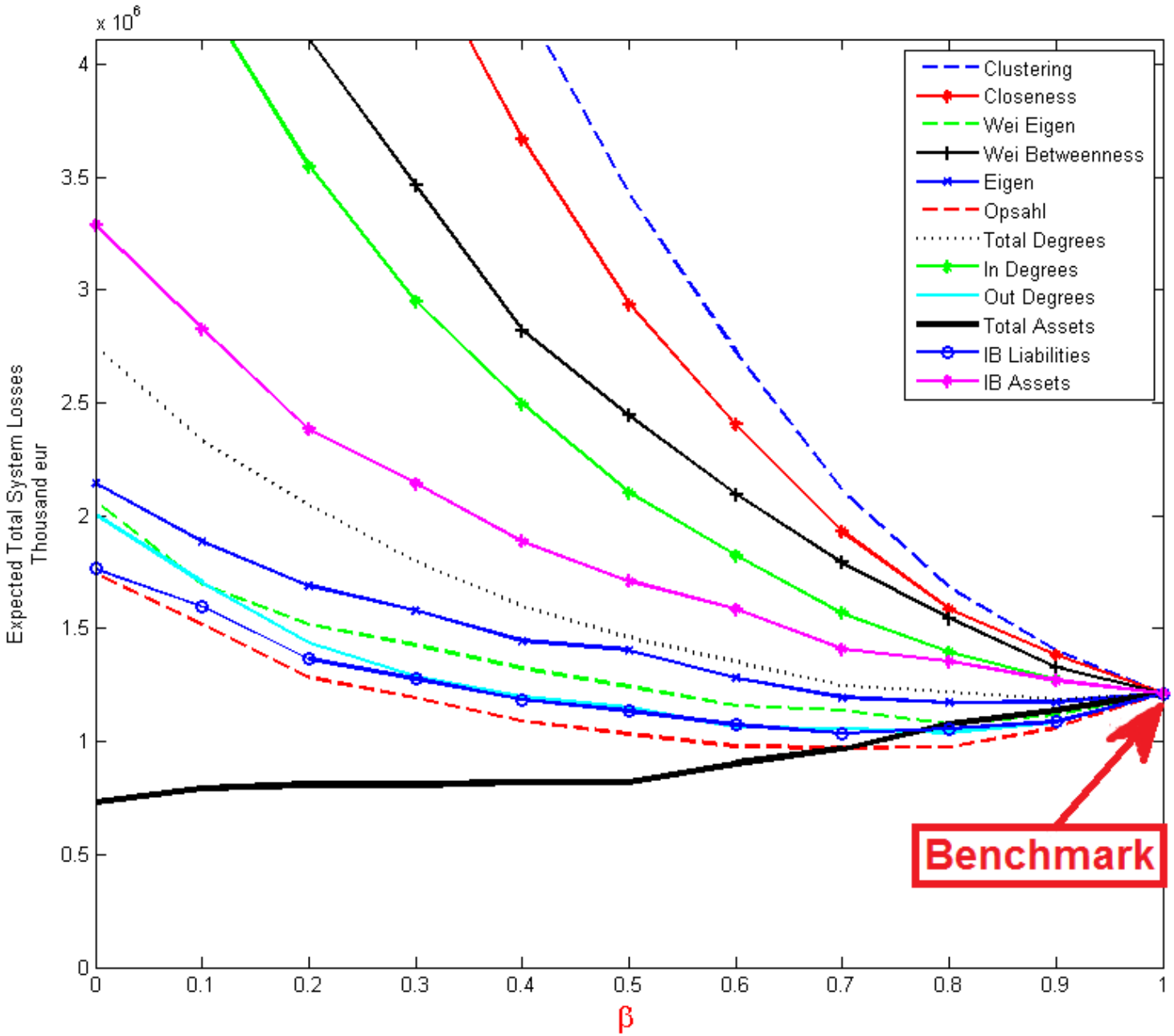
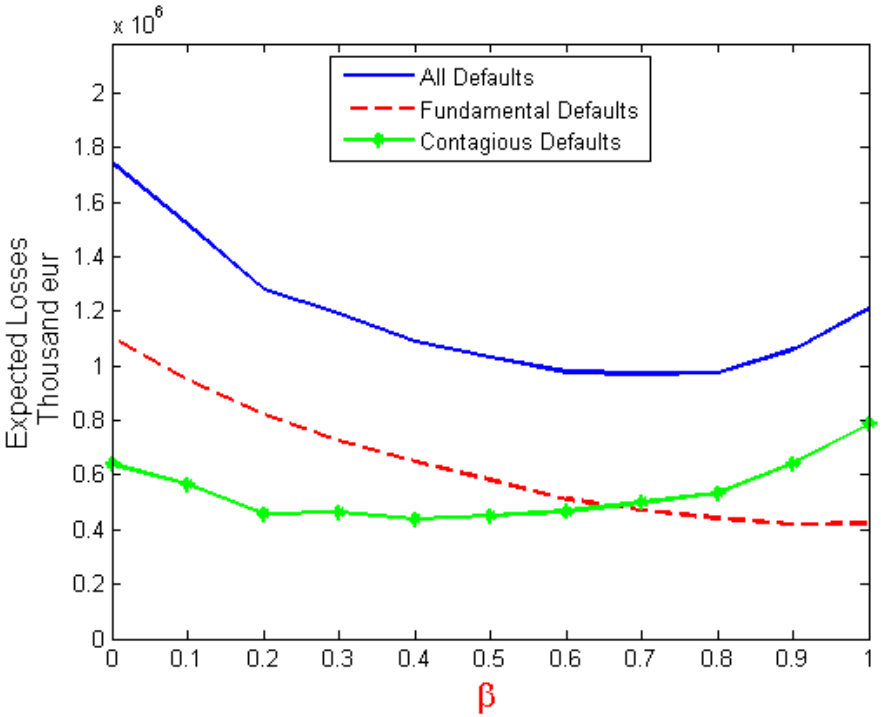
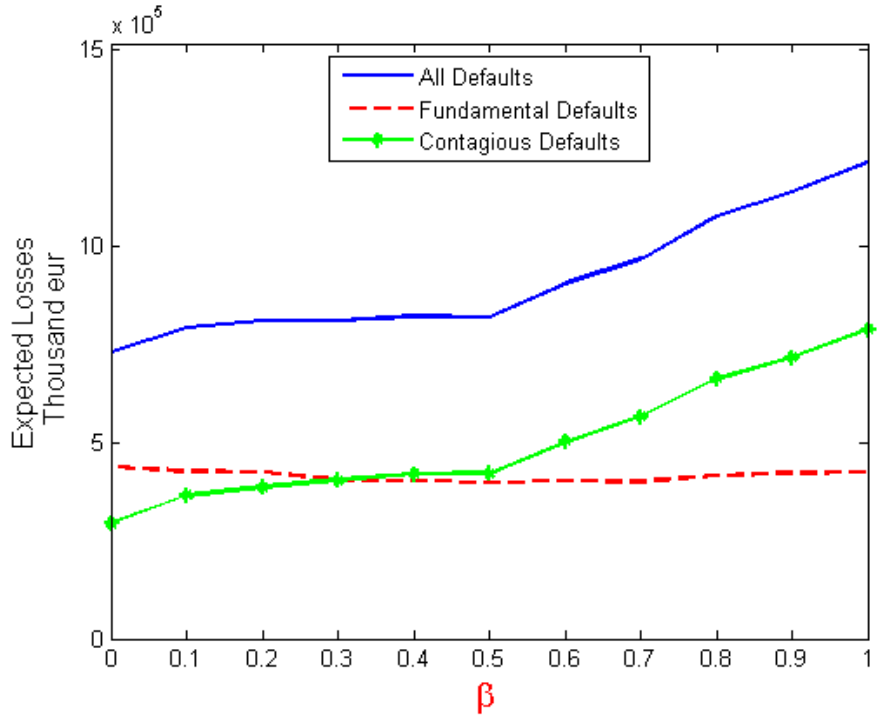
Main results



Opsahl vs Total Assets

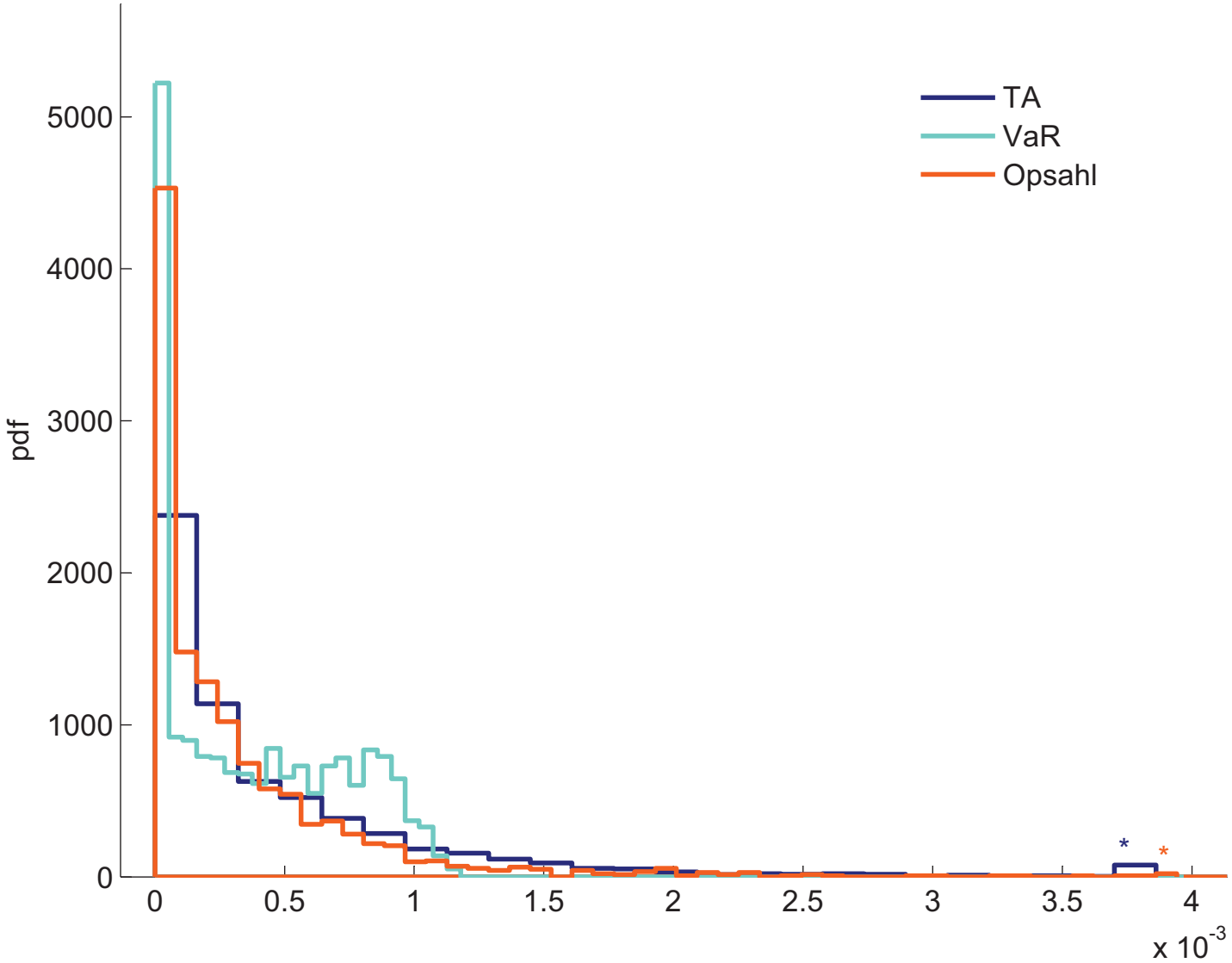


(a) Opsahl



(b) Total Assets

PDs distributions: Before interbank contagion



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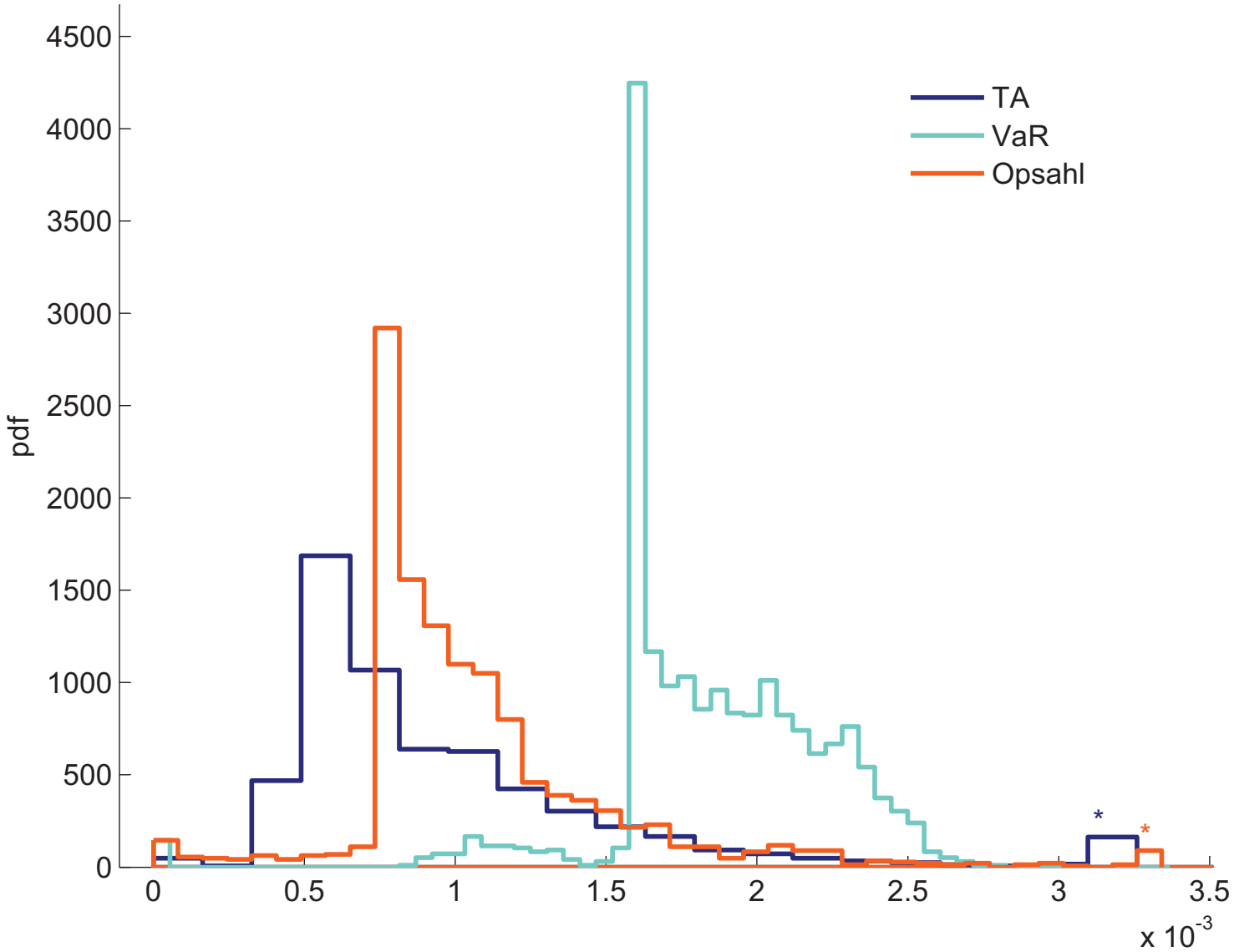

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Bailout Fund Mechanism

The bailout fund has the following features:

1. it has limited resources;
2. it saves banks based on a ranking rule, obtained from a centrality-based index;
3. it utilizes funds to rescue and recapitalize banks before the interbank contagion takes place.

$$Bailout_{max} = \eta \sum_{i} (K_{\alpha,i} - K_{min,i})$$

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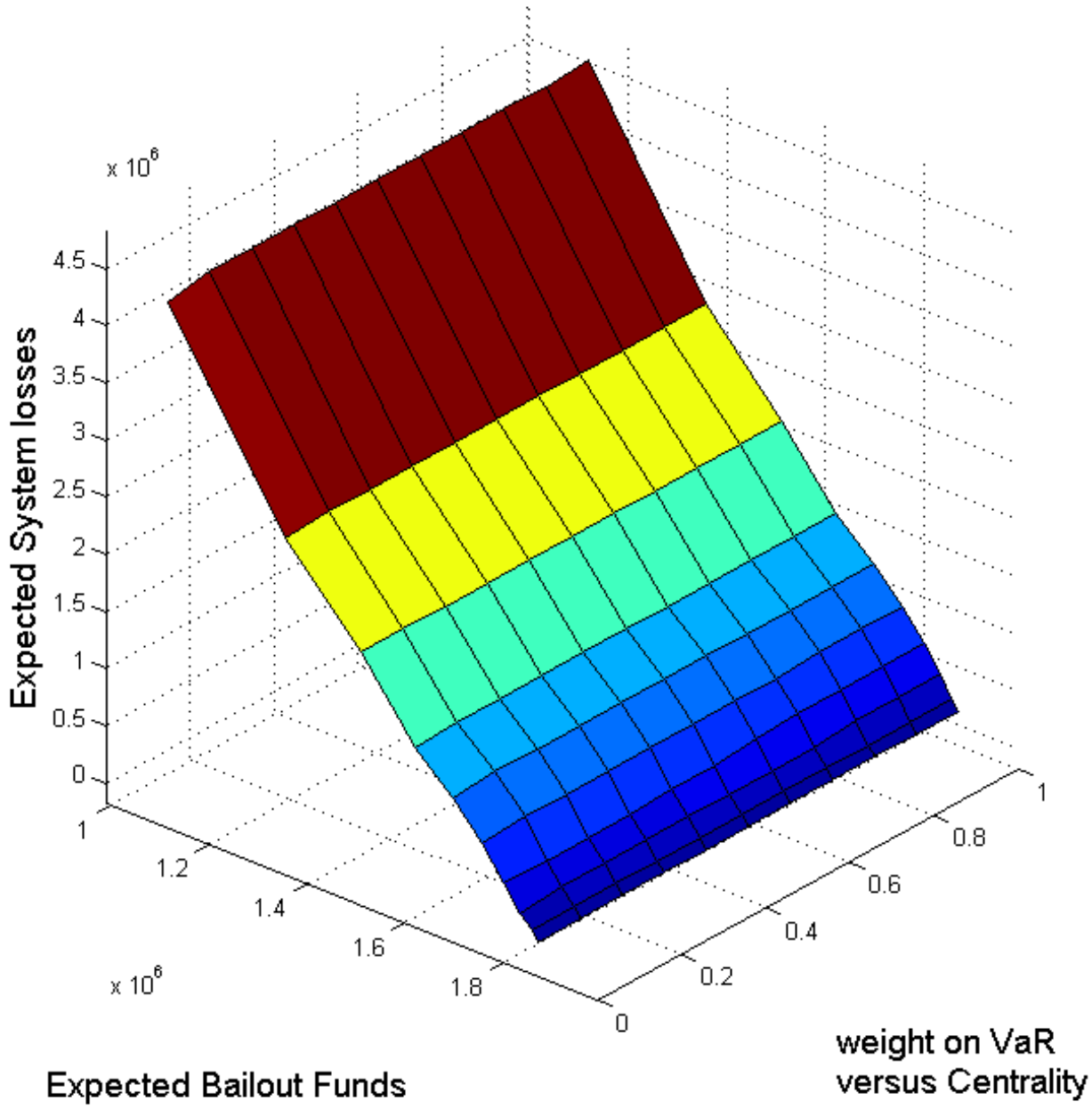

Summary

- We propose a novel framework to compute capital allocations (possible capital surcharges) tractable for large banking systems.
- Our results show that Too-big-to-fail dominates Too-interconnected-to-fail (for our specific target functions)
- We propose a second policy direction: a centrality-based bailout fund mechanism.

- **Outlook**
  - Extend capital allocation rules to include more than one parameter
  - Calculate insurance premium for each bank based on the expected bailout

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