Financial Linkages, Macroprudential Policy, and Systemic Risk[1]

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[1] Joint work with Silvia Gabrieli, Banque de France

Systemic Risk is Dynamic and Takes Various Forms

- Two dimensions of systemic risk
  1. Systemic risk slowly builds in tranquil times and abruptly unravels in times of crisis

    $\Rightarrow$ **time-dimension**

  2. Systemic risk can be transmitted through various channels

    $\Rightarrow$ **cross-sectional dimension**

- Systemic risk channels:
  - financial contagion: Allen and Gale (2000), Freixas, Parigi, and Rochet (2000)
  - common shocks: Acharya and Yorulmazer (2008), Georg (2011)
 - informational spillovers: Acharya and Yorulmazer (2008b), Nier et al. (2007) Ahnert and Georg (2012)

Modelling Systemic Risk is a Challenge

Four reasons why modelling systemic risk is a challenge for economists:

1. **Heterogeneous agents**

2. Complex interactions

3. Dynamic structural change

4. Deviations from rationality

$\Rightarrow$ **In this talk**: focus on the first three points

Financial Intermediaries are Heterogeneous
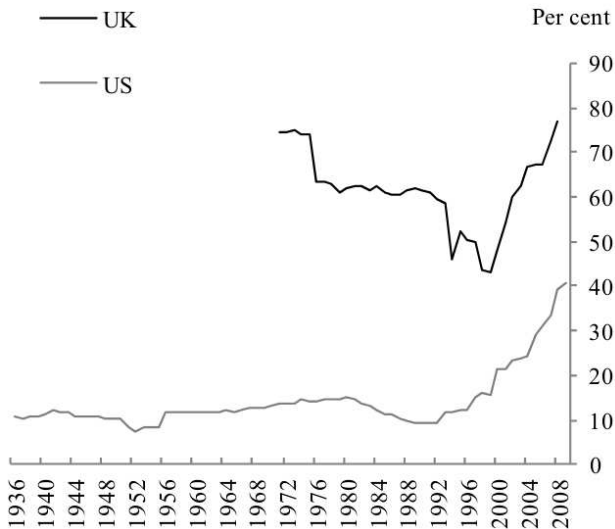
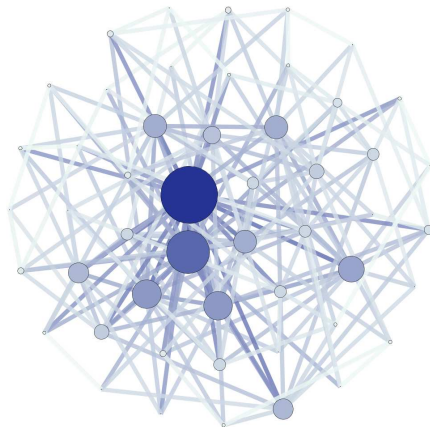Figure: Concentration of the UK and US banking system. Source: Gai, Haldane and Kapadia (2011).
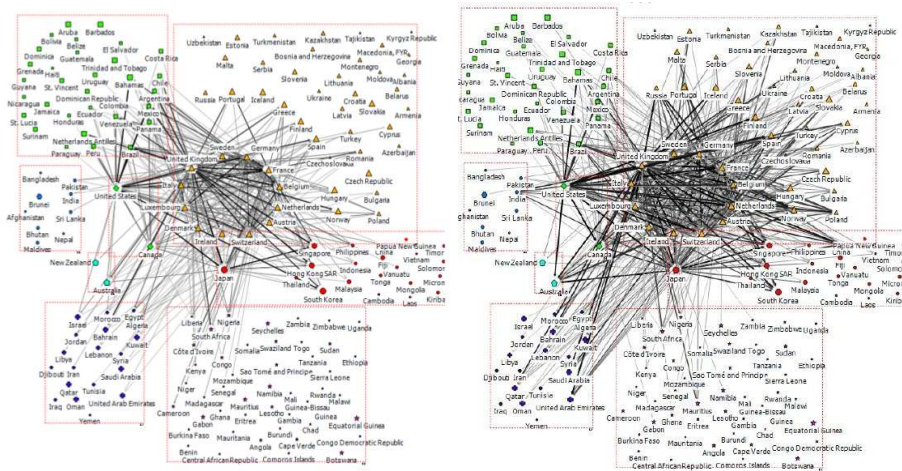
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The Network Structure Matters

Figure: A scale-free network ($k = 4$) of contracts amongst 50 banks.

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The Financial System is more Highly Interconnected Today

Figure: Interconnectedness of the international banking network in 1980 (left) and 2007 (right). Source: Minoiu and Reyes (2011) using BIS data.
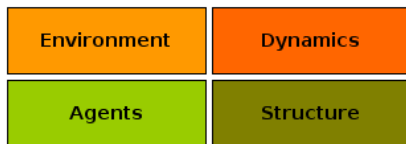
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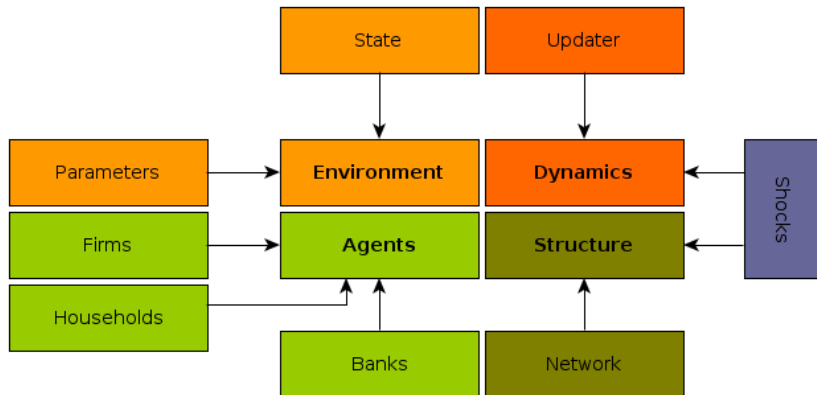
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The Financial System from a Complex Systems Perspective

Figure: The building blocks for a simulation of the financial system

Figure: The building blocks for a simulation of the financial system

# Agent Behaviour and Model Dynamics

- Banks optimize their **portfolio structure and -volume** according to CRRA preferences

$$u = \frac{1}{1-\theta} \left(V(1 + \lambda\mu - \frac{1}{2}\theta\lambda^2\sigma^2) \right)^{(1-\theta)}$$

where θ is risk-aversion parameter

- **Update algorithm** for $k = 1, \ldots, N$ banks and $t = 1, \ldots, \tau$ update steps:
  1. Obtain returns on investments, pay interest on deposits
  2. Deposit in- and out-flows, required reserves
  3. Settle interbank loans
  4. Determine new investment level
  5. Settle liquidity position
  6. Pay dividends
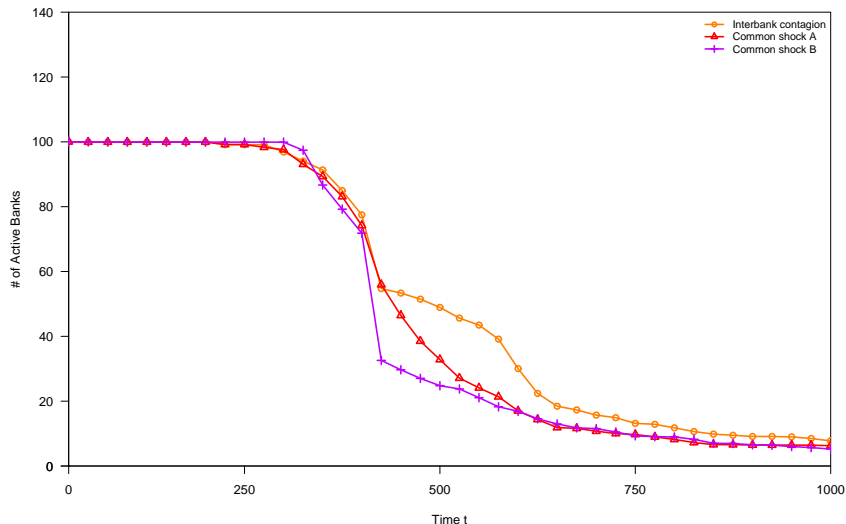
Microfoundations of Banks Determine Model
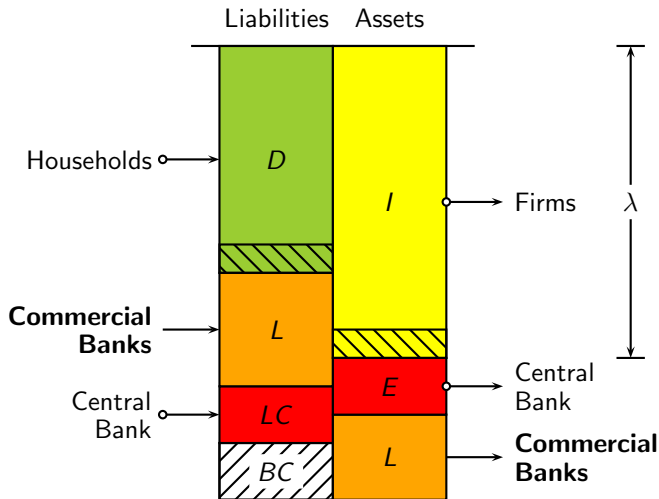
Sources and Remedies of Systemic Risk

Systemic risk through interbank contagion and fire-sales

- Interbank contagion is a source of systemic risk, but not the major one

- Common shocks are quantitatively the greater threat

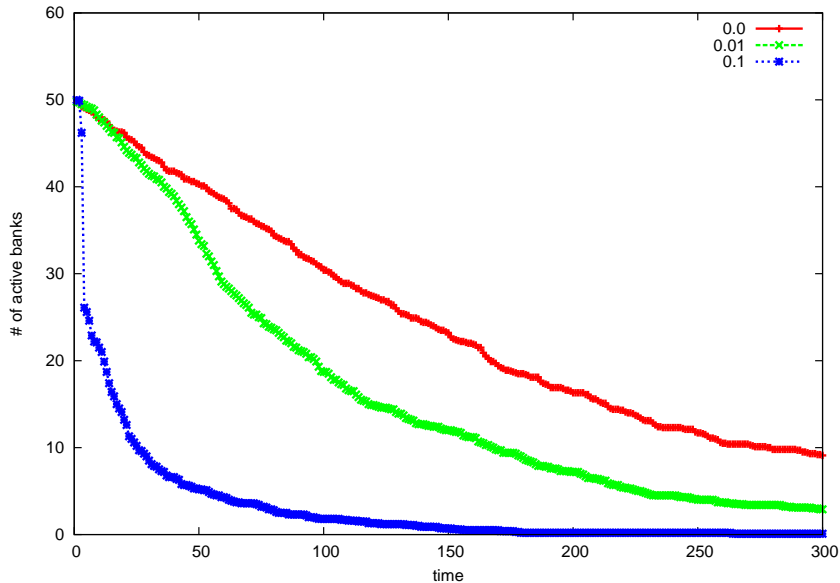- Fire-sales can be caused by cash-in-the-market pricing:

$$p(\gamma, t, I_l(t)) = \exp\left(-\gamma \cdot \frac{(I(0) - I(t) + I_l(t))}{I(0)}\right)$$
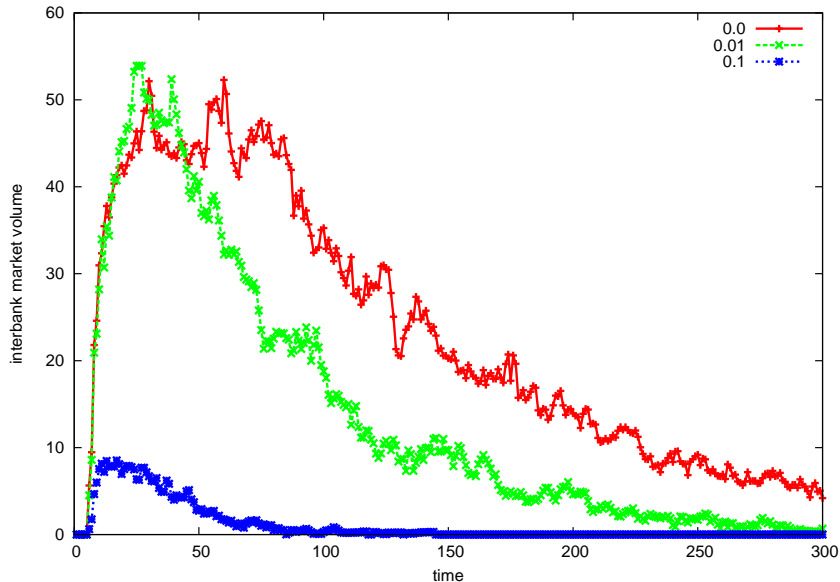
Contagion and Common Shocks

Figure: The impact of different forms of systemic risk on financial stability in a crisis scenario ($\rho_f^+ = 0.09, \rho_f^- = -0.08$) in a random network (`connLevel=0.8`)

Endogenous Fire Sales

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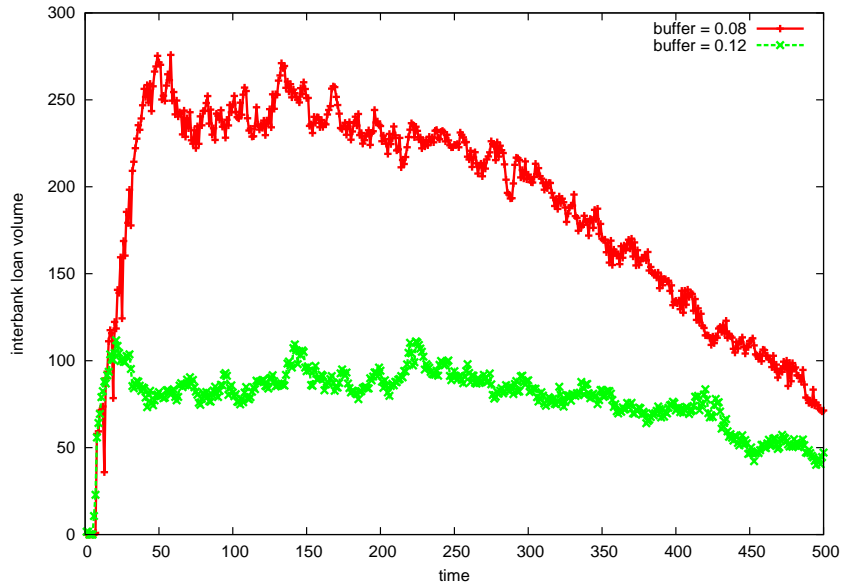
A number of tools has been proposed to alleviate systemic risk:

- Time-dimension: **countercyclical capital buffer**, leverage ratio, dynamic risk-weights, provisioning, liquidity requirements, **reserve requirements**
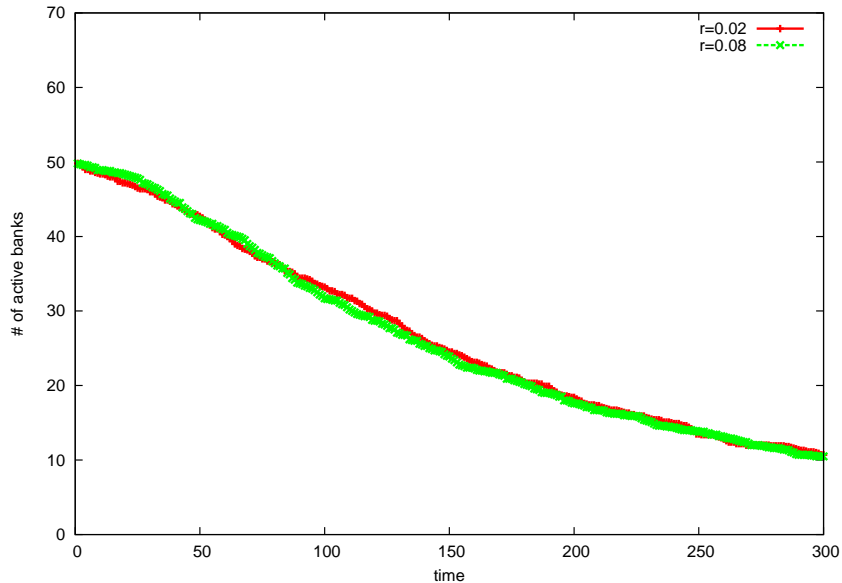- Cross-sectional dimension: concentration limits, **SIFI surcharge**
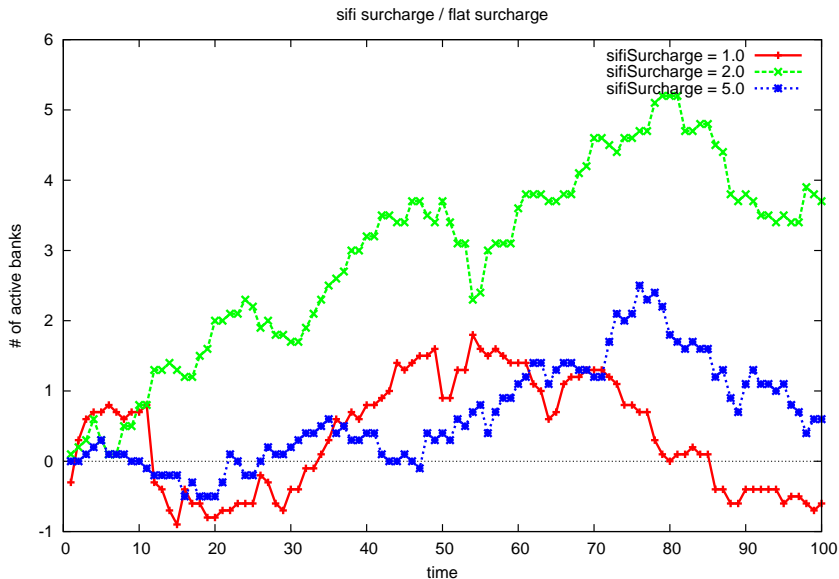
Countercyclical Capital Buffers
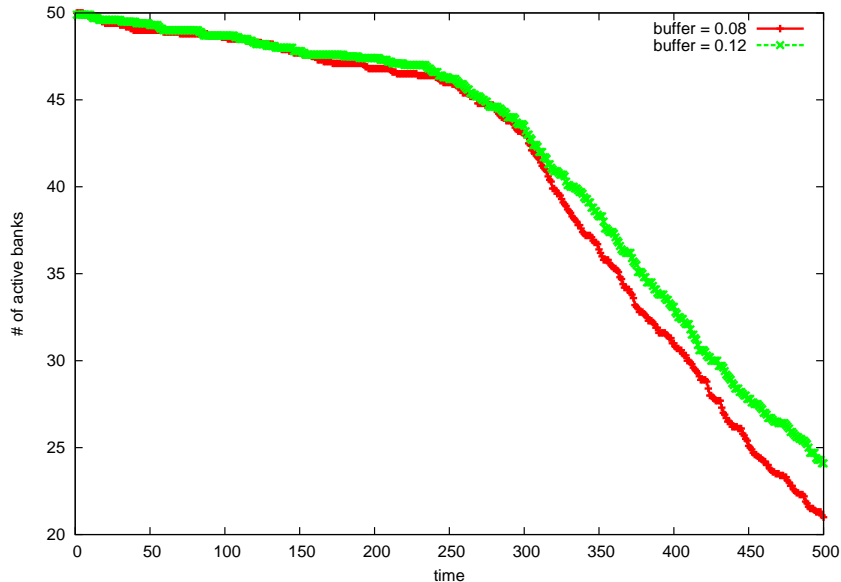
Counterclical Capital Buffers

Varying Reserve Requirements

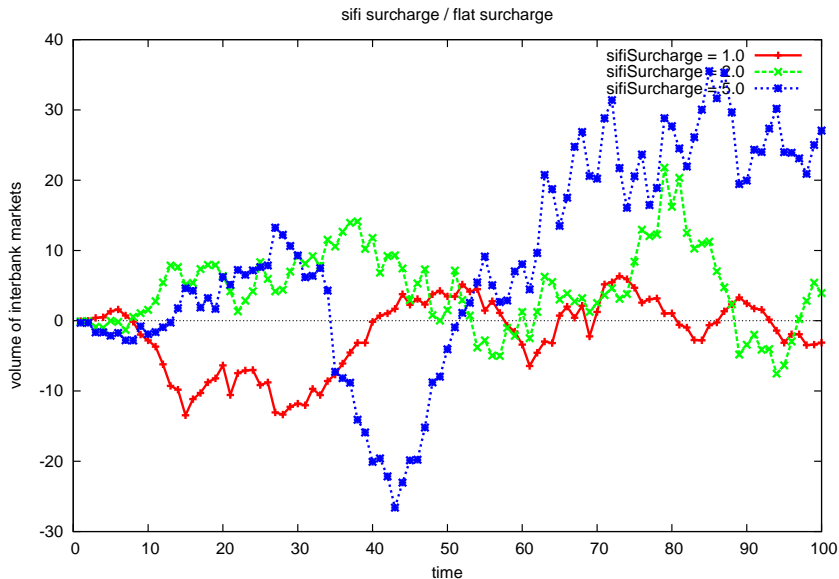# A SIFI surcharge can be more effective

sifi surcharge / flat surcharge

A SIFI surcharge can be more effective

sifi surcharge / flat surcharge

volume of interbank markets vs. time

sifiSurcharge = 1.0
sifiSurcharge = 2.0
sifiSurcharge = 5.0

Conclusion

- Heterogeneous agents, complex interactions, and dynamic structural change calls for a more flexible set of models   ⇒ **Multi-Agent Network Models**

- Agent behaviour is the weak link in models today

- Network models to assess systemic risk can be used to analyse recently proposed **macroprudential measures**:   ⇒ countercyclical capital buffers, reserve requirements, SIFI surcharge

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Open Source MAS released on 1 July 2011: `http://cabdyn.ox.ac.uk`

⇒ **Thank you!**