Centre for Risk Studies

5th Risk Summit: Special Topics Seminar

Understanding Financial Catastrophes

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Systemic Risk

- Systemic risk can be defined as "a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy.” (FSB, IMF, BIS)
- Systemic risk is endogenous (Danielsson et al. 12, Geanakoplos et al. 12).
- Risk associated with the collapse/breakdown of a system caused by the interactions between its components.

Motivation

- *when the crisis came, the serious limitations of existing economic and financial models became apparent"*

  (J.-C. Trichet, president of ECB, 2010)

Motivation

- *"We suffered adverse 25-standard deviation events, several days in a row according to our models."*
  - David Viniar, CFO, Goldman Sachs after huge losses in 2008

- *"The 1987 'Black Monday' has a likelihood of 10^{-148} in traditional 'random walk' mathematics."*
  - Economist Gene Stanley, Boston University

- *"according to our models this just could not happen"*
  - Robert Merton, one of the nobel-prizewinning architects of the Black-Scholes model, 1998 on the day after Long-Term Capital lost $4.4 Billion

Financial Networks

- Networks of financial institutions (banks) with mutual relationship.
- How can stress that originates in a part of the system propagate to the whole network?
- Many contagion channels
  - Interbank lending and counterparty risk
  - Overlapping portfolios and liquidity risk (fire sales)
  - Funding and rollover risk

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Contagion due to Counterparty Risk

(Gai and Kapadia 2011)

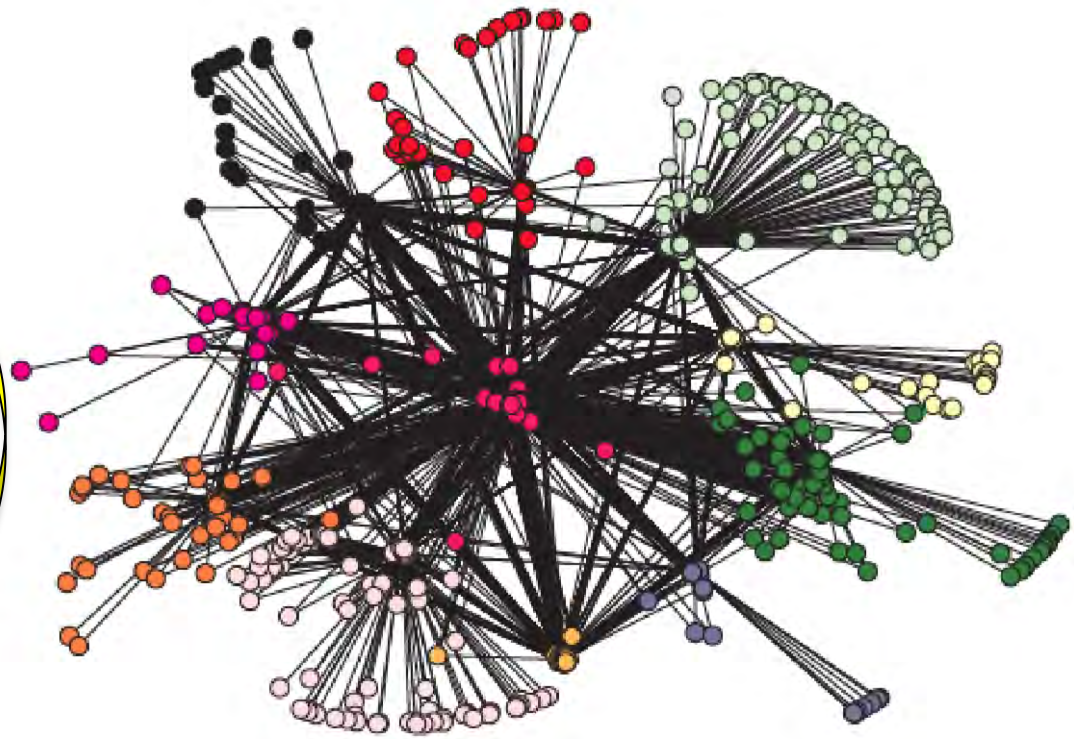
Bank default

⇩

Default on interbank loans

⇩

Losses to other banks



(from Boss et al. 2003)

Contagion due to Overlapping Portfolios

(Caccioli, Shrestha, Moore, Farmer Journal of Banking and Finance 2014)

Bank default

⇩

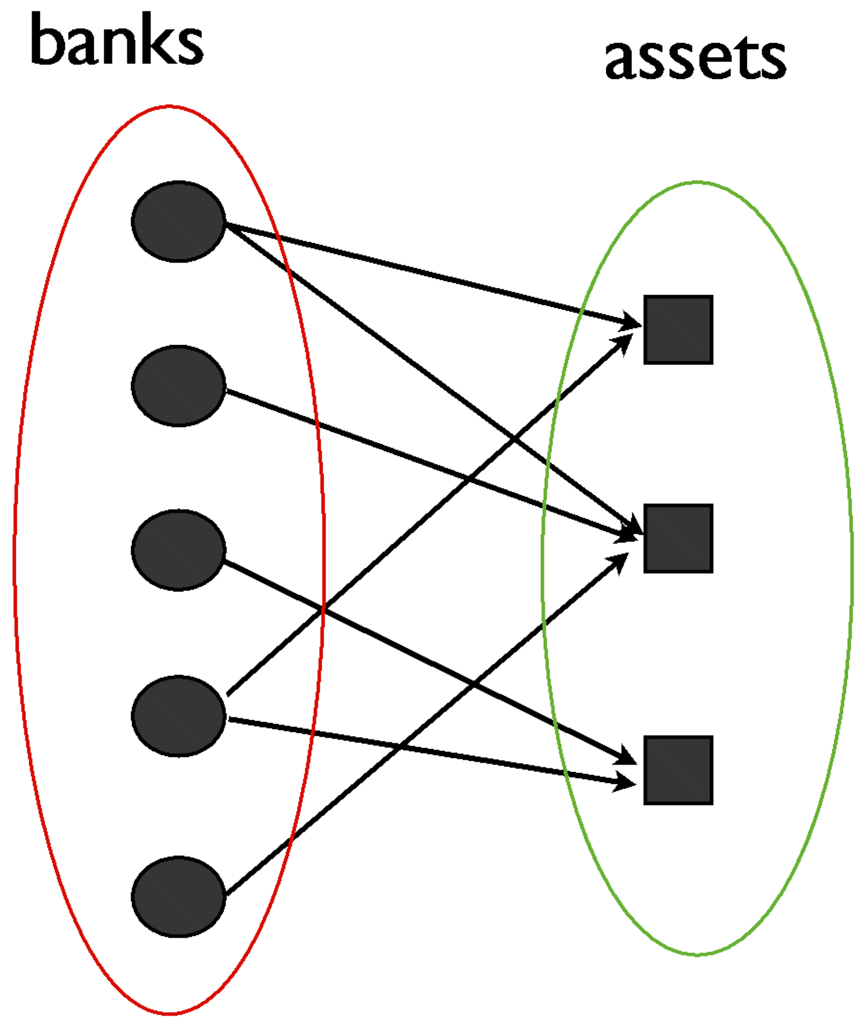
Fire sale

⇩

Asset devaluation

⇩

Losses to other banks



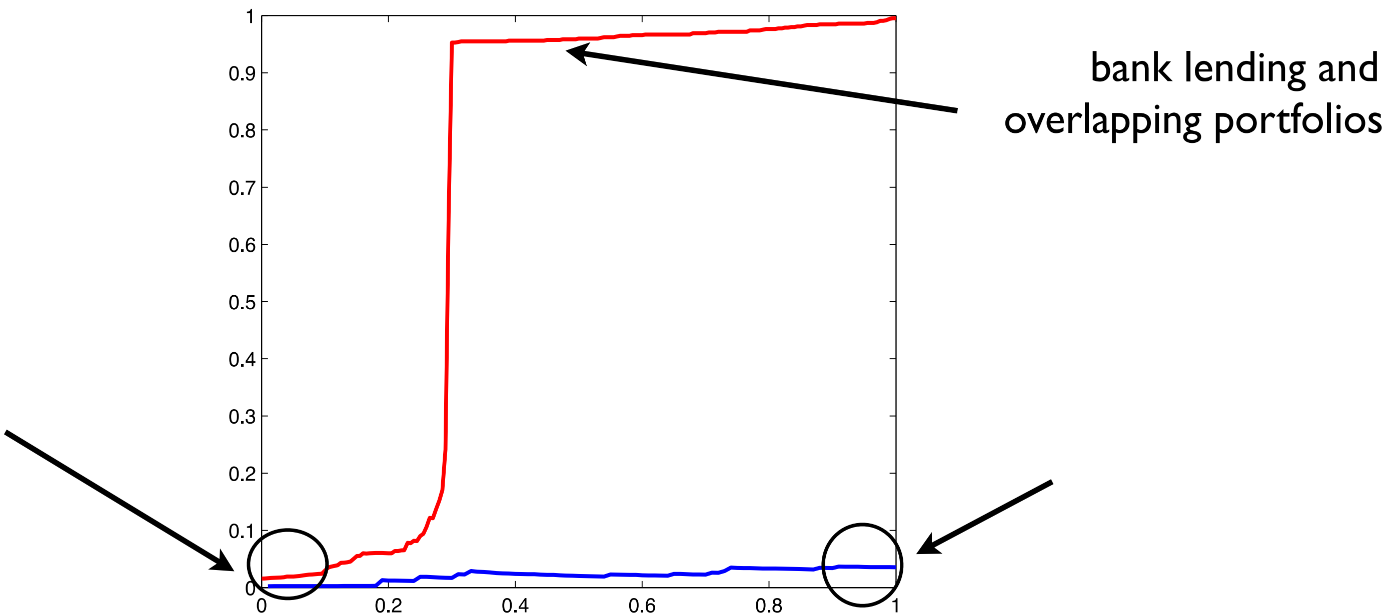
Stress Tests

1. Exogenous shock: default of a single bank
2. Compute losses to banks connected to the defaulted one
3. A bank defaults if its loss exceeds its equity
4. Repeat 2 and 3 until no new defaults occur

Under what conditions do we observe global cascades of bankruptcies?

An Empirical Study

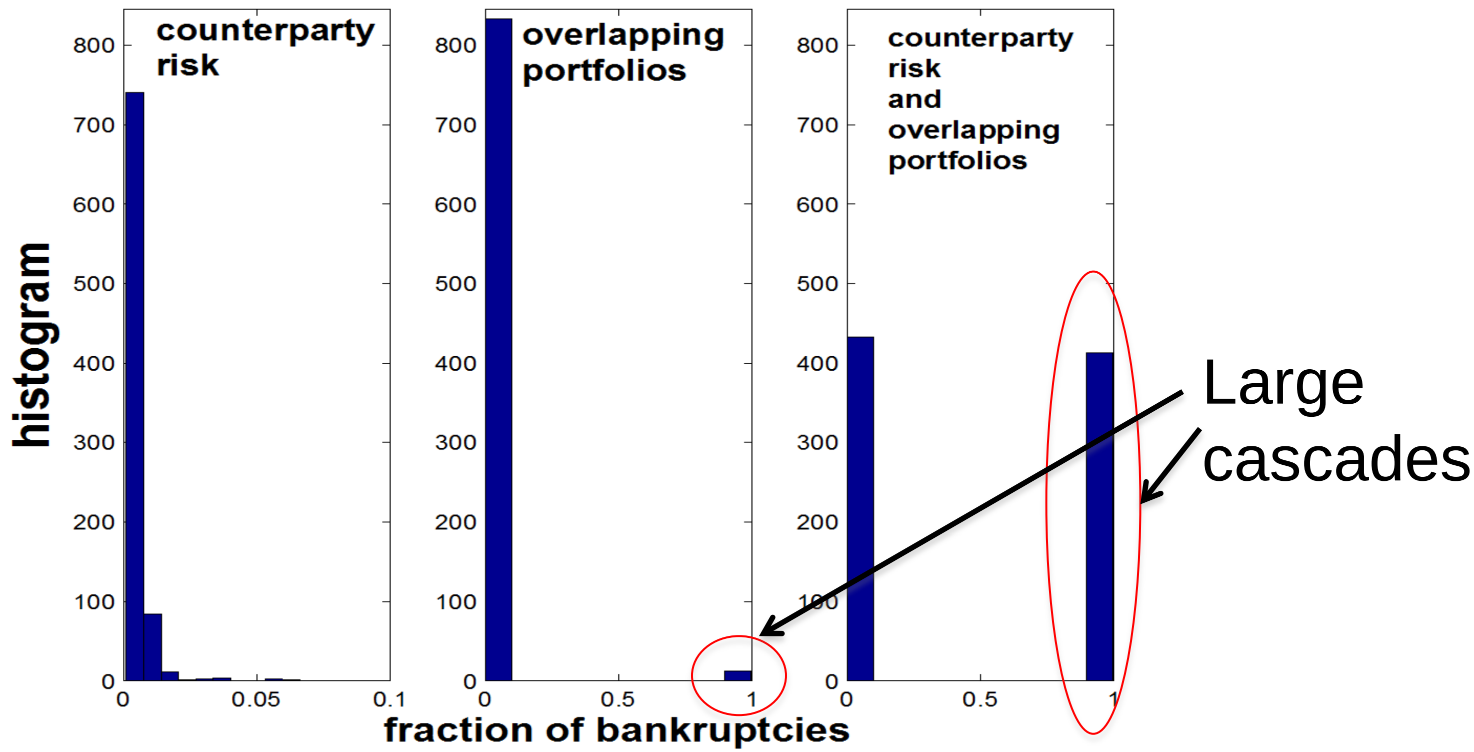
(Caccioli, Farmer ,Foti, Rockmore 2013)



Biggest contribution to systemic risk comes
from interaction between different contagion mechanisms

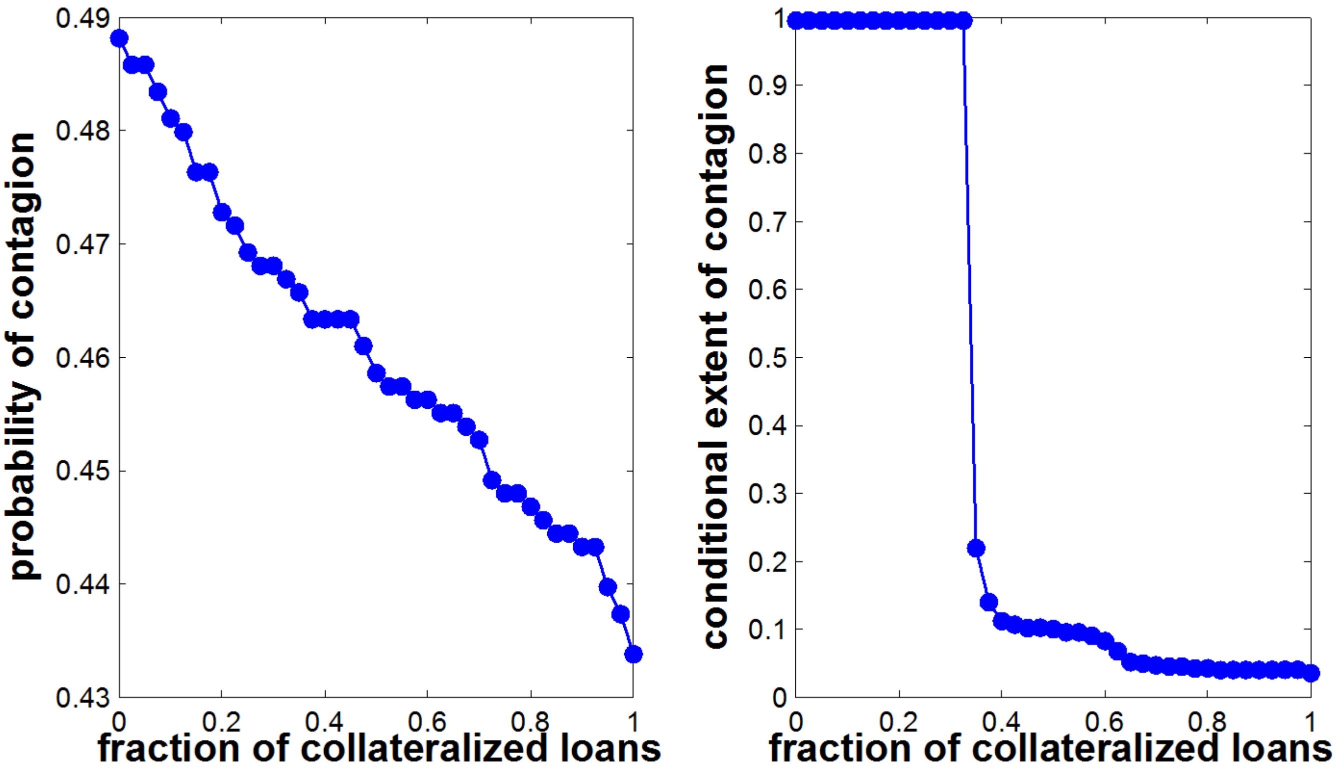
An Empirical Study

(Caccioli, Farmer ,Foti, Rockmore 2013)



Biggest contribution to systemic risk comes from interaction between different contagion mechanisms

Reducing Vulnerability



To reduce the size of cascades the fraction of insured loans has to be more than ~ 35%.

Financial Catastrophe Scenarios 2014-5

Asset Bubble Shock

China Property Bubble Collapse

Sudden collapse of property prices in China mainland

Sovereign Default Shock

Country defaults

Sudden default of a country on its debt

High-Inflation World

High levels of inflation run for many years

Rampant inflation running in many countries

De-Americanization of Economy

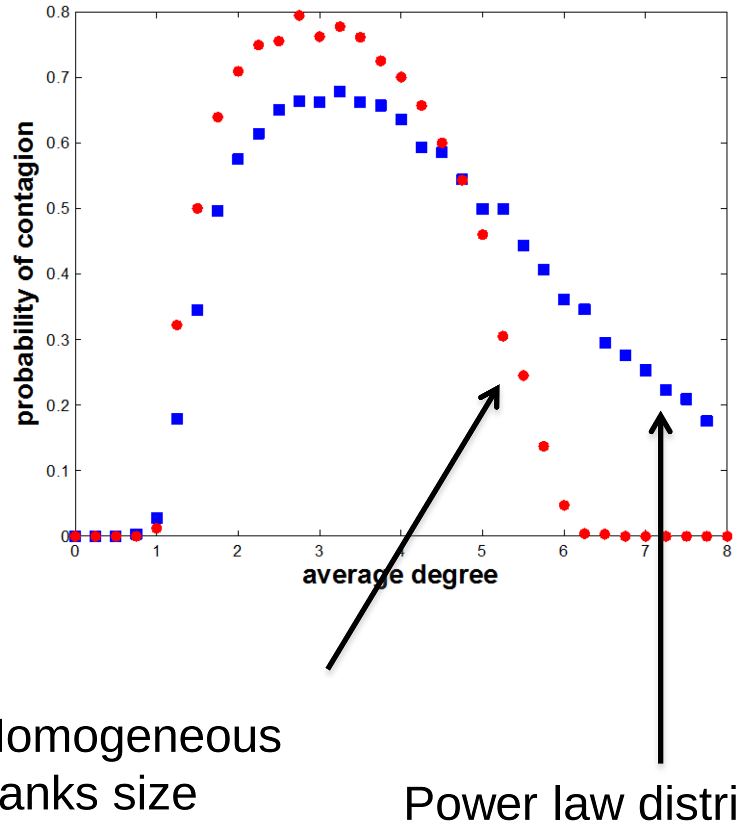
Dollar loses its dominance as a trading currency

US dollar replaced by another or multiple currencies

Calibrating the Model

(Caccioli, Catanach and Farmer, ACS 2012)

- Calibration is essential for a correct estimation of risk
- Ensembles of networks (as in Andy Skelton's presentation)



Calibrating the Model

- Good information on size, equity and leverage
- Information on portfolio overlaps inferred from return on assets
- Information on direct interbank linkages is difficult to obtain, in particular on a global scale
- Current focus on ensembles rather than specific network (see Andy Skelton's presentation)
- We are trying to understand what is the minimum amount of information needed to provide a reasonable estimation of systemic risk

Conclusions

- Endogenous dimension of systemic risk
- Amplification and contagion due to feedback loops
  - Counterparty risk
  - Overlapping portfolios
- The interaction between different contagion mechanisms is the main contribution to systemic risk
- Calibration

Financial Risk and Network Theory Conference
Tuesday 23 September 2014

- Conference on **Financial Risk and Network Theory**
- Centre for Risk Studies Conference at Judge Business School, Cambridge
- Tuesday 23 Sept 2014
- Co-hosted with Journal of Finance Network Theory
  - Inaugural conference
- Current call for papers

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