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CAN IT HAPPEN AGAIN?

**Interbank Lending and the Spread of Bank Failures:
A Network Model of Systemic Risk**

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Can it happen again???

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Can it happen again???

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Markets are regulated. However, there is a huge IT gap between public (regulators) and private (participant of the market) sector.

→ **TECHNOLOGY MATTERS**

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World IT Spending

"Banks are essentially technology firms"
(Hugo Banziger, chief risk officer at Deutsche Bank)

"Banks had lot of tools to create leverage, but not many to manage risk"
(Roger Portnoy, Daylight Venture Partners)

Category	Spending (\$bn)
Manufacturing	433
Financial services	503
Government	390
Retail & wholesale trade	211
Services	272
Other	273
Communications	202
Total	6000

Source: Gartner

(The Economist, 5th-11th Dec 2009)

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Roadmap

Systemic Risk and Contagion

Financial Network of Interbank Lending:

- The idea
- The model
- Simulation

Concluding Remarks

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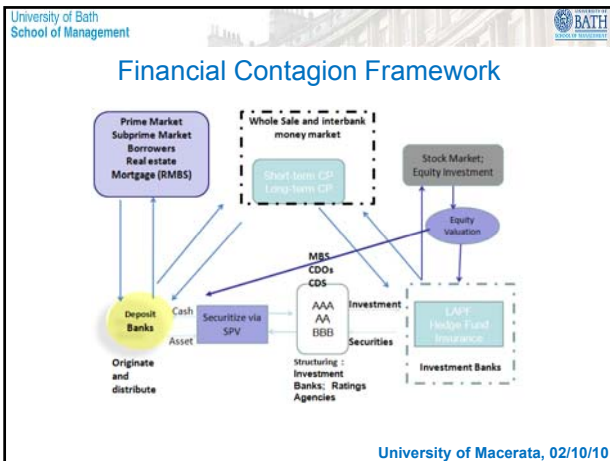
Financial Contagion and Systemic Risk

Systemic risk is defined by the Bank for International Settlements as "the risk that the failure of a participant to meet its contractual obligations may in turn cause other participants to default with a chain reaction leading to broader financial difficulties" (Bank for International Settlements. 64th annual report. Technical report, BIS, 1994.)

Modelling systemic risk:

- **bank runs**, where customers lose confidence in a bank and withdraw their deposits. Observing a run on one bank then undermines confidence in other banks who in turn may suffer a bank run, thus spreading the problems beyond the initially affected bank although no fundamental reason for this development is present.
- **common exogenous shock** that affects all banks, e.g. a currency crisis, who as a consequence of this common shock experience a large number of failures.

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Interbank Lending - Introduction

- The Idea:** One failing bank can lead to failures spreading → Systemic Risk
- Out Contribution:**
 - Use a network of heterogeneous banks
 - Different sizes, different interbank loans, different networks,....
 - Explore what determines the spread of failures
- Contagion Mechanism:**
 - Default – losses in assets.
 - Failure – losses in liabilities.
- Stress Test:**
 - We trigger exogenously some banks, each at the time, and report the Systemic effect
- Analysis:**
 - Regression analysis of the determinants of the crisis
 - Optimization techniques on Capital Requirements (in progress)

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Interbank Lending – The Model

- Banks are connected via interbank loans
- Bank sizes have **Powerlaw** distribution
- Scale-free** network of interbank loans (number of links proportional to size)

Assets (A_i)	Liabilities
Cash ($R_i = \rho_i A_i$)	Deposits ($D_i = \gamma_i A_i$)
Loans ($C_i = \beta_i A_i$)	Bank loans (L_i)
Bank loans (B_i)	Equity ($E_i = \alpha_i A_i$)

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Interbank Lending – Contagion Mechanism

- If a bank fails it is liquidated.
- It calls in all interbank loans given to other banks, called in loans are repaid not in full.

Assets (A_i)	Liabilities
Cash ($R_i = \rho_i A_i$)	Deposits ($D_i = \gamma_i A_i$)
Loans ($C_i = \beta_i A_i$)	Bank loans (L_i)
Bank loans (B_i)	Equity ($E_i = \alpha_i A_i$)
- To repay those called in loans, these banks need cash.
 - They raise cash by calling in interbank loans themselves (if cash reserves are not sufficient).
- If calling in loans does not raise enough cash, they default (and are liquidated).
 - If losses made from calling in loans exceeds equity, banks fail (and are liquidated).
- This process continues until all no banks are failing anymore

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Interbank Lending – Trigger Mechanism

- We **exogenously select** one bank who we assume makes losses equal to its equity and liquidate it
- Banks selected are **biggest, second biggest** and one from each size **decile** beyond that

Assets (A_i)	Liabilities
Cash ($R_i = \rho_i A_i$)	Deposits ($D_i = \gamma_i A_i$)
Loans ($C_i = \beta_i A_i$)	Bank loans (L_i)
Bank loans (B_i)	Equity ($E_i = \alpha_i A_i$)

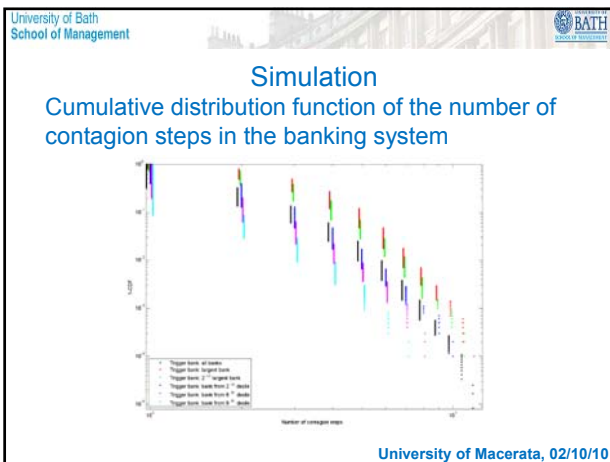
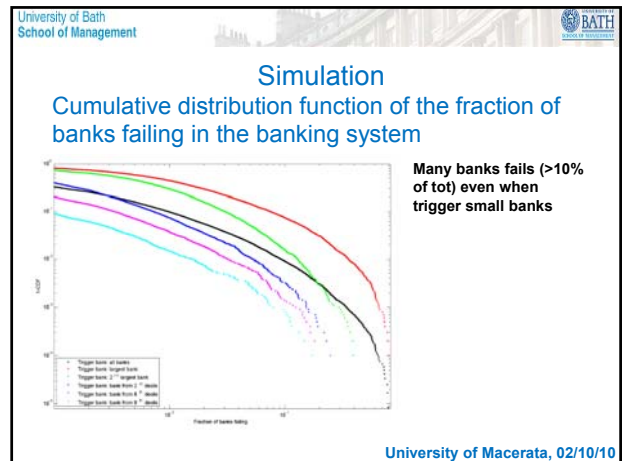
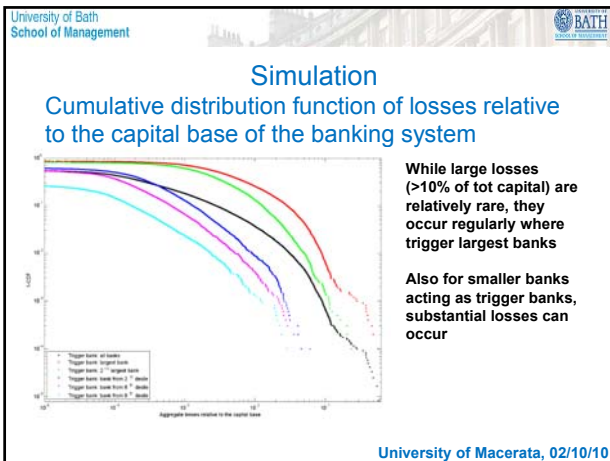
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Simulation – Parameters used

- Banking system: [12; 1; 000] banks
- Asset value: [100; 100,000,000,000]
- Tail index of size distribution: [1;5; 5]
- Recovery rate of loans: [0; 1]
- Fraction equity: $\alpha = [0; 0.25]$
- Fraction deposits: $[0; 1 - \alpha]$
- Fraction cash: $[0; 0.25]$
- Fraction loans to public $[0; 1]$

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Simulation

OLS regressions of the existence and size of systemic risk

	FULL-BANKY SYSTEM: 1. CONTAGION WHEN BANKS FAILING: LOGGED			
	CONSTANT	LOG(SIZE)	LOG(NBANKS)	LOG(LEVERAGE)
Minimum about structure	0.0000	0.0000	0.0000	0.0000
EQUITY	-0.0000	0.0000	0.0000	0.0000
REVENUES	0.0000	0.0000	0.0000	0.0000
LIABILITIES	0.0000	0.0000	0.0000	0.0000
LIQUIDITY	0.0000	0.0000	0.0000	0.0000
NET ASSETS	0.0000	0.0000	0.0000	0.0000
NET EQUITY	0.0000	0.0000	0.0000	0.0000
NET LIABILITIES	0.0000	0.0000	0.0000	0.0000
NET ASSETS	0.0000	0.0000	0.0000	0.0000
NET EQUITY	0.0000	0.0000	0.0000	0.0000
NET LIABILITIES	0.0000	0.0000	0.0000	0.0000
Other variables	0.0000	0.0000	0.0000	0.0000
INTEREST	0.0000	0.0000	0.0000	0.0000
PROFIT	0.0000	0.0000	0.0000	0.0000
ROE	0.0000	0.0000	0.0000	0.0000
Sample size	10000	10000	10000	10000

Determinants of contagion:

- Balance sheet
- Network structure

Not/less relevant:

- Interbank loan structure
- Banking system properties

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Simulation

Regressions of failure of individual banks

	Full-bank failure log(Losses)	
	CONSTANT	LOG(SIZE)
Minimum about structure	0.0000	0.0000
EQUITY	-0.0000	0.0000
REVENUES	0.0000	0.0000
LIABILITIES	0.0000	0.0000
LIQUIDITY	0.0000	0.0000
NET ASSETS	0.0000	0.0000
NET EQUITY	0.0000	0.0000
NET LIABILITIES	0.0000	0.0000
Other variables	0.0000	0.0000
INTEREST	0.0000	0.0000
PROFIT	0.0000	0.0000
ROE	0.0000	0.0000
Sample size	10000	10000

Determinants of contagion:

- Balance sheet
- Interbank loan structure
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Not/less relevant:

- Banking system properties

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Concluding Remarks

- Failure of small banks can occasionally lead to widespread failure
- For failures balance sheet, network and interbank loans relevant
- "One-size-fits-all" capital requirements are not appropriate

ONGOING TESTS:

- Stress test US banks (FDIC data)
- Optimize capital requirement policies

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