Crisis Transmission in the Global Banking Network

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*The views expressed herein are those of the authors and should not be attributed to the Federal Reserve System, Fannie Mae, the IMF, their Executive Boards, or their management.

Motivation

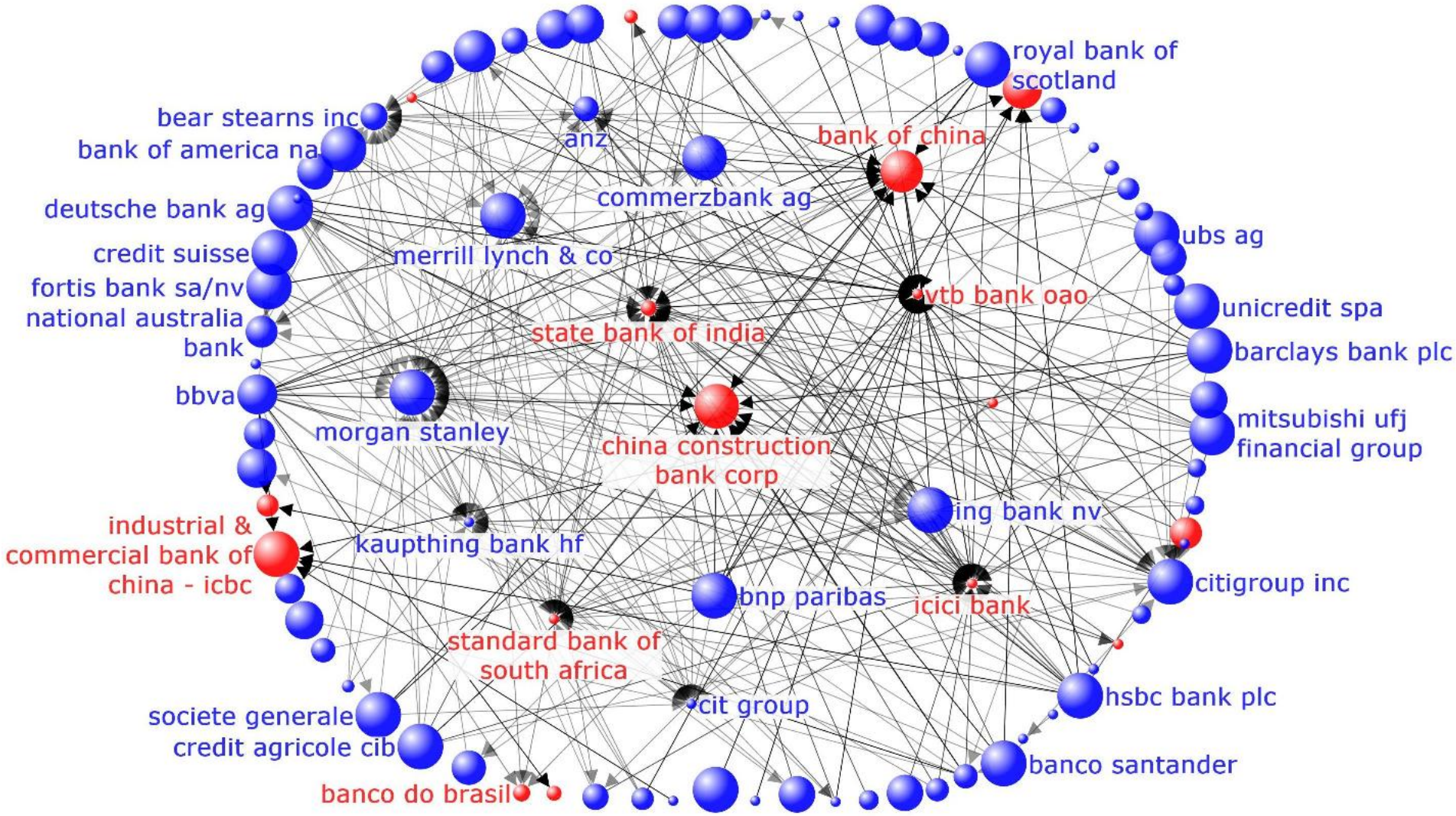
- It is often argued that interconnectedness has contributed to the severity of the global financial crisis (Dudley, 2012; Haldane, 2009)

- The complex web of interconnections among financial institutions raises questions about their ability to manage risk (Caballero and Simsek, 2013) and the stability of the global financial system during crises

- Connections among banks, especially across borders, can act as conduits of financial sector shocks

- We proxy for these connections with linkages formed on the global syndicated loan market

2007 global interbank network (subset of 100 biggest banks)



In 2007, Citigroup had syndicated loan exposures vis-à-vis 198 banks in 62 countries.

Question

- Study the role of **international interbank exposures** in the transmission of systemic banking crises across borders

- Estimate the impact of exposures to borrowers in countries experiencing financial crises ("**crisis exposures**") on bank profitability
    - Key dimension of banking system soundness
    - Good predictor of bank survival

Specifically,

- Examine several distinct ways in which crises may be transmitted through the global interbank market:
  - **Direct** crisis exposures
    - First-degree (1 step away) connections
  - **Indirect** crisis exposures
    - Second-degree (2 steps away) connections

Contribution

- First paper to build a large bank-level global network of interbank exposures ("GBN") from granular data and to empirically examine shock transmission through it
- Add to two strands of literature:
  - Contagion in financial networks
    - Emphasizes the benefits and risks of interconnectedness (risk sharing vs. contagion)
  - Stability of financial networks
    - Mostly based on simulations
    - When empirical, refers to domestic interbank markets

Steps

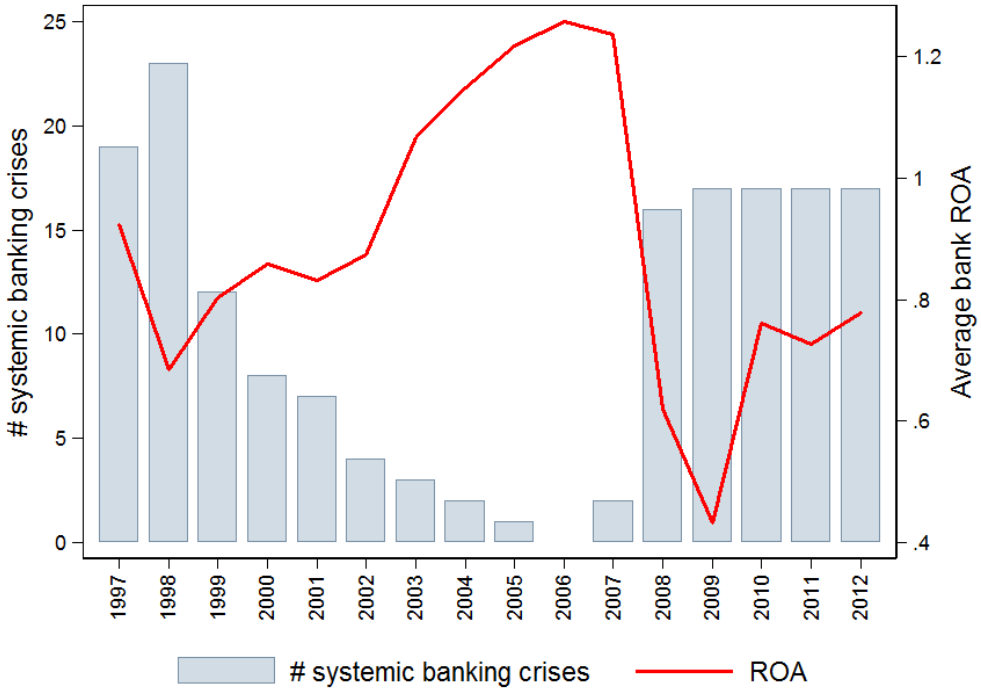
1. Construct GBN comprising >6,000 banks from 120+ countries

2. Compute bank-level measures of direct and indirect crisis exposures, and overall network position

3. Relate these measures to bank returns (>1,800 banks are linked to their financials during 1997-2012)

Negative correlation between crises and banks' ROA

There is a negative correlation between average bank returns and the # of crises worldwide; as well as the # of financial systems in crisis to which banks have direct exposures



Structural equation

- Bank performance Y_i is affected by vector of bank characteristics X_i and by home country crises C_i as well as the performance of banks to which it is exposed (directly or indirectly):

$$Y_i = X_i\beta + \lambda C_i + \gamma \sum_j E_{ij} Y_j$$

- Expanding repeatedly (no loops):

$$Y_i = X_i\beta + \lambda C_i + \gamma \sum_j E_{ij_1} X_{j_1}\beta + \gamma \sum_{j_1} E_{ij_1}\lambda C_{j_1} + \gamma^2 \sum_{j_2} E_{ij_1}E_{j_1j_2}X_{j_2}\beta + \gamma^2 \sum_{j_2} E_{ij_1}E_{j_1j_2}\lambda C_{j_2}$$
$$+ \ldots + \gamma^n \sum_{j_n} E_{ij_1}E_{j_1j_2}\ldots E_{j_{n-1}j_n}X_{j_n}\beta + \gamma^n \sum_{j_n} E_{ij_1}E_{j_1j_2}\ldots E_{j_{n-1}j_n}\lambda C_{j_n},$$

Empirical specification

- The structural equation translates into the following empirical specification:

$$Y_{iht} = \alpha_{ht} + X_{iht}\beta + \lambda C_{iht} + \sum_{j} E_{ij_1t} X_{j_1t}\beta' + \lambda' \sum_{j_1} E_{ij_1t} C_{j_1t}$$

$$+ \sum_{j_2} E_{ij_1t} E_{j_1j_2t} X_{j_2t}\beta' + \lambda' \sum_{j_2} E_{ij_1t} E_{j_1j_2t} C_{j_2t} + \varepsilon_{iht},$$

Dataset Construction

- Data on 170,274 individual syndicated loans extended during 1990-2012 from *Dealogic Loan Analytics*
  - Clean up bank names, adjust for bank name changes, mergers and acquisitions, etc. – **locational approach**
  - Using lender and borrower identifiers, loan amount and maturity, construct interbank exposures as dollar values and **counts (# links)**
- Data on bank balance sheets from *Bankscope*
- Data on systemic banking crises: *Laeven and Valencia* (2013)

Example: Syndicated loan to a British investment bank

Participating banks (15):

BayernLB; Bank of Montreal (London); Bank of Tokyo-Mitsubishi UFJ Ltd; Commerzbank International Luxembourg SA;
Dresdner Kleinwort Wasserstein;
HSH Nordbank AG (London); ING Bank NV;
KBC; Lloyds TSB Bank plc;
Mizuho Corporate Bank Ltd;
Royal Bank of Scotland plc; SG Corporate & Investment Banking;
Standard Chartered Bank; Sumitomo Mitsui Banking Corp Europe Ltd; Wachovia Bank NA

Nationalities (7):

Germany, UK, Japan, Luxembourg, Netherlands, Belgium, France

Borrower:
Investec Bank (UK) Ltd.

Industry: Private sector bank

Signing date: March 28, 2006

Deal type: Investment grade

Maturity: 3 years

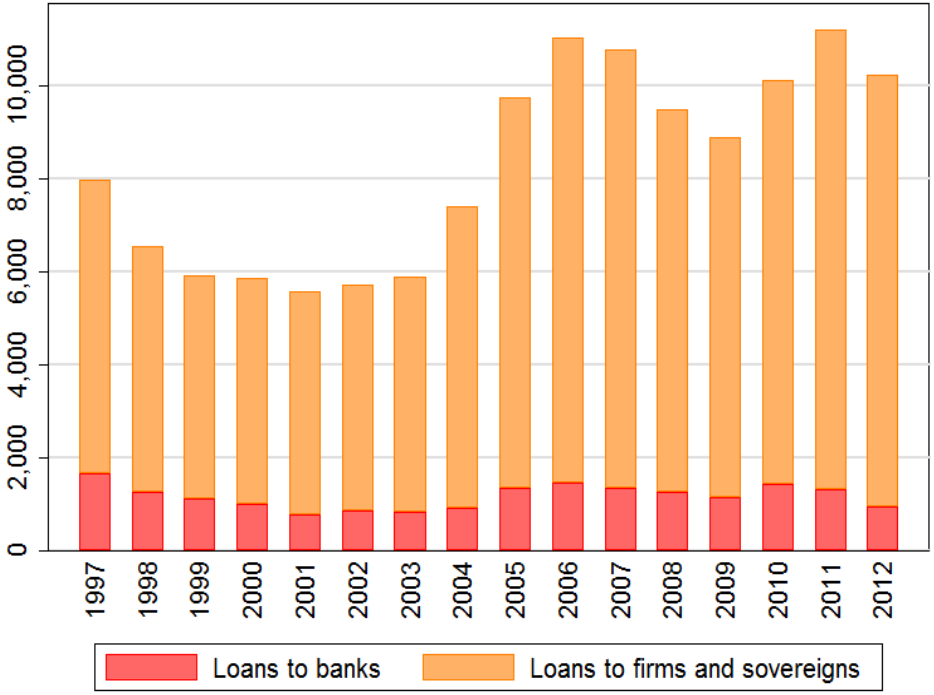
Amount: GBP 445 million

Interest rate: LIBOR + 120bps

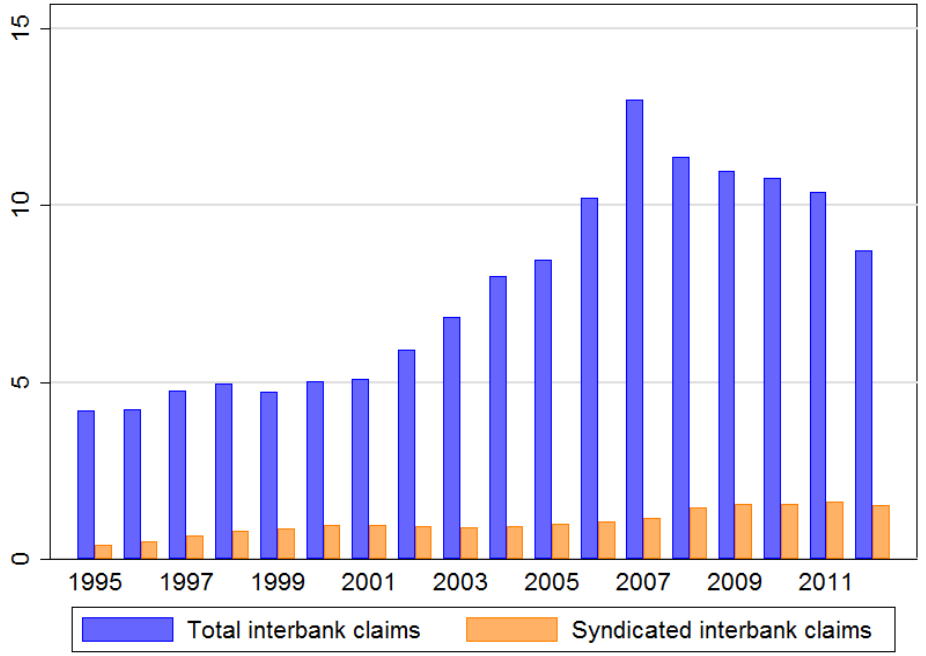
Source: Dealogic Loan Analytics

How important are syndicated interbank loans?

About 10% of total syndicated loan counts and loan deal volumes



12.5% of total cross-border loan exposures of BIS reporting banking systems

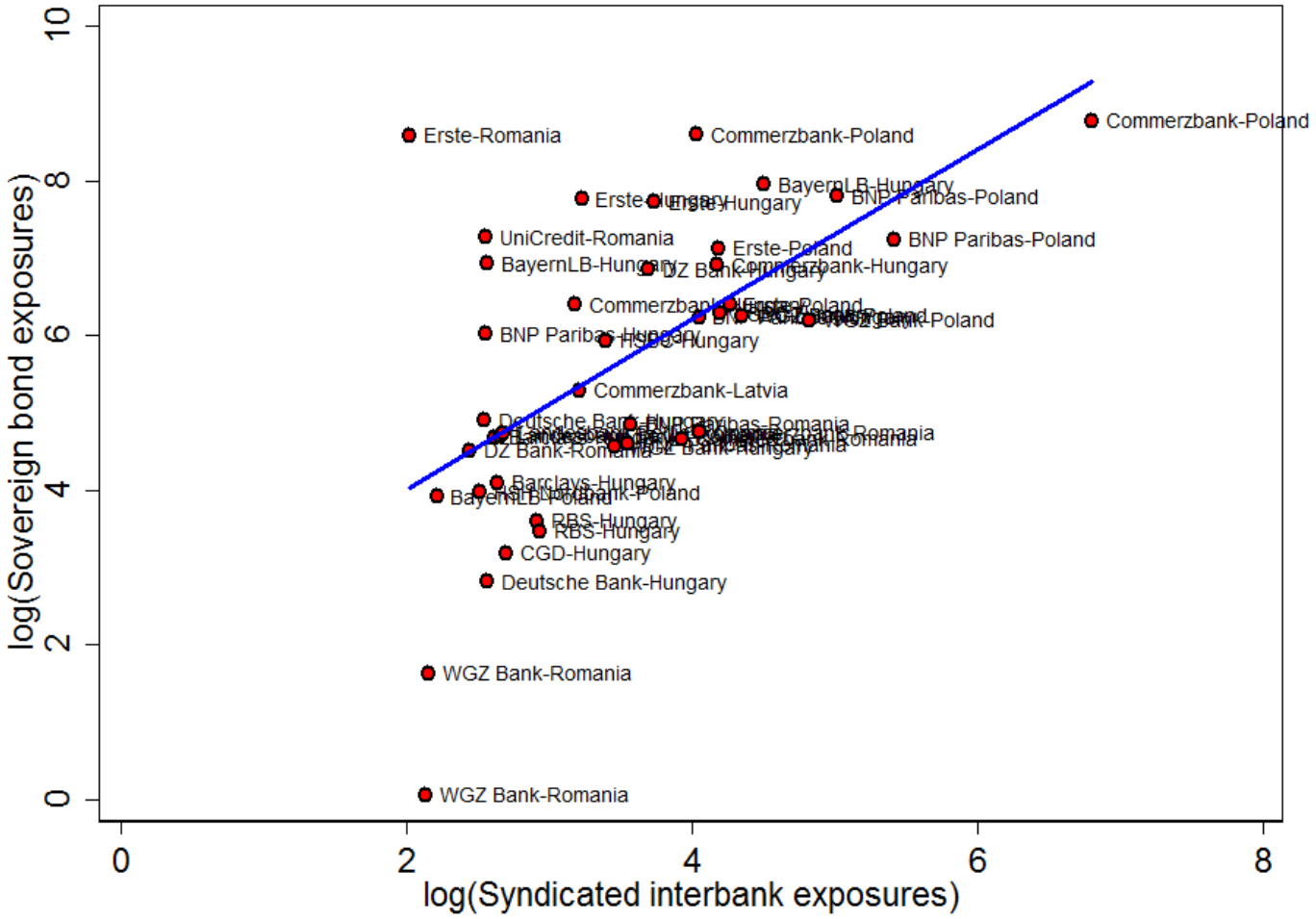


Estimates obtained based on methodology in Cerutti, Hale, and Minoiu (forthcoming)

U.S. banks – syndicated loan exposures *to banks* proxy well for total exposure and trade finance exposure

	Full total		Letters of credit	
Log(Syndicated loan exposure on banks)	0.113***		0.131***	
	(0.016)		(0.022)	
Log(Syndicated loan exposure on non-banks)	0.025**		0.056***	
	(0.012)		(0.017)	
Number of direct exposures to banks		0.404***		0.513***
		(0.081)		(0.104)
Number of direct exposures to non-banks		0.014		0.020
		(0.017)		(0.018)
Observations	6,970	6,970	7,298	7,298
R-squared	0.727	0.726	0.728	0.727
p-value (coeff on banks > coeff on non-banks)	1.000	1.000	0.995	1.000

European banks: syndicated loan exposures to banks correlate with sovereign bond holdings

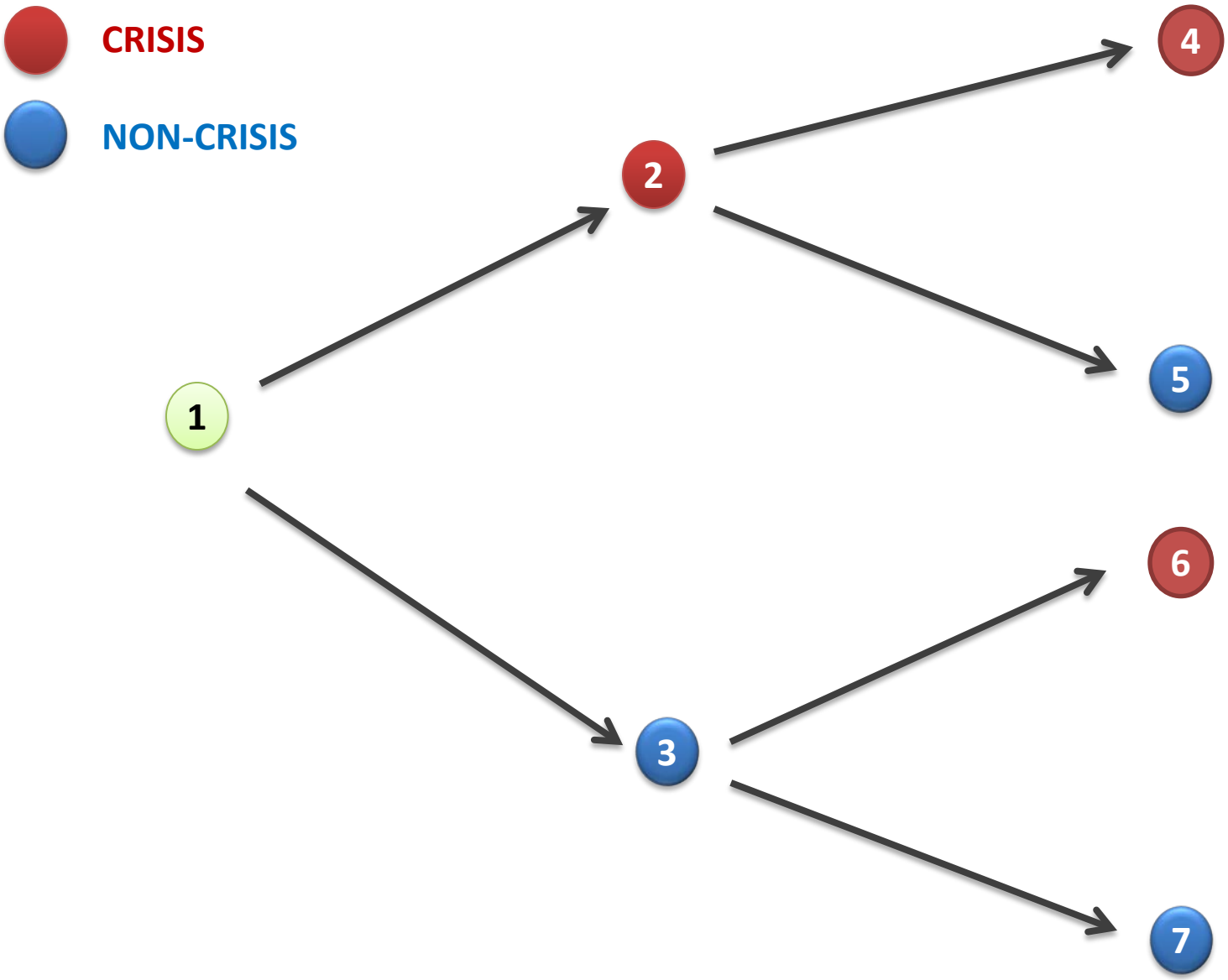


Sources: Dealogic Loan Analytics and European Banking Authority

Empirical framework

- **Regression Dataset**: 1,875 banks from 110 countries over 1997-2012
- **Dependent variables**: **ROA**, NIM, z-score
- **Controls**:
  - Bank size (log-assets)
  - Capital (equity/assets)
  - Bank type
  - Bank business model
  - Country - Year fixed effects
  - Total exposures (# links)
- **Regressors of interest**:
  - **Direct crisis exposures** (# links or out-degree)
  - **Indirect crisis exposures**: (# links or out-degree of first-degree connections)

Direct and indirect crisis/non-crisis exposures



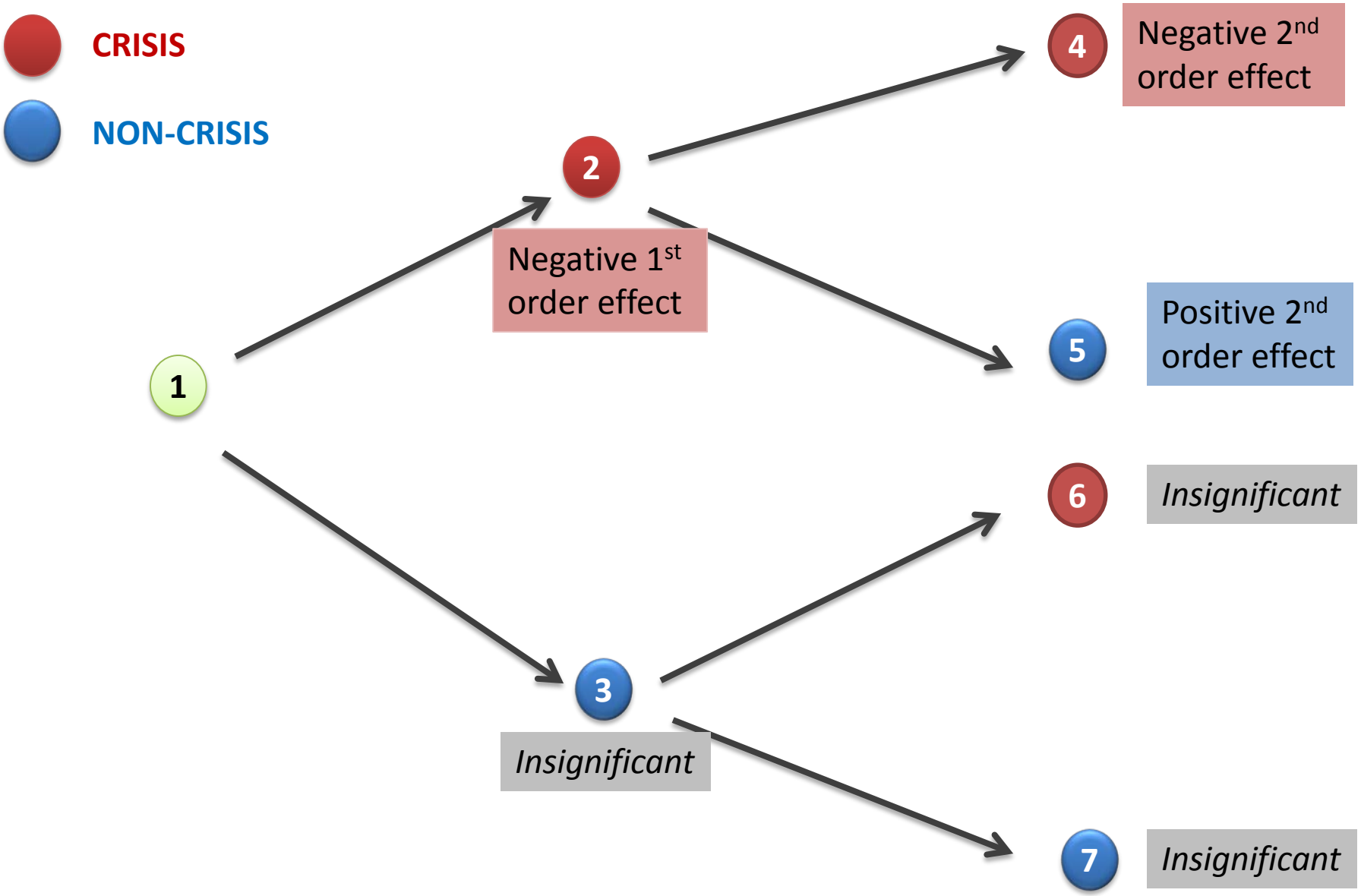
Effect of direct and indirect crisis exposures on bank ROA (**controls**)

	(1)	(2)	(3)
Equity/Assets	0.055***	0.055***	0.055***
	(0.007)	(0.007)	(0.007)
Log-assets	0.069***	0.069***	0.069***
	(0.012)	(0.012)	(0.012)
Business model: Commercial bank	0.150*	0.150*	0.147*
	(0.080)	(0.080)	(0.080)
Business model: Investment bank	0.166	0.165	0.162
	(0.148)	(0.148)	(0.148)
Bank type: Subsidiary	0.152***	0.152***	0.153***
	(0.057)	(0.057)	(0.057)
Bank type: Global ultimate owner	0.231***	0.231***	0.231***
	(0.051)	(0.051)	(0.051)
p-value test that characteristics of vis-à-vis banks do not matter	0.199	0.305	0.289
Observations	14,483	14,483	14,483
R-squared	0.441	0.441	0.441

Effect of direct and indirect crisis exposures on bank ROA (**variables of interest**)

	(1)	(2)	(3)
DIRECT EXPOSURES			
# exposures to all banks	-0.002	-0.002	-0.001
	(0.004)	(0.004)	(0.004)
# exposures to crisis banks	**-0.030*** **	**-0.031*** **	**-0.026*** **
	(0.009)	**(0.010)**	**(0.010)**
INDIRECT EXPOSURES			
# exposures to all banks		-0.000	
		(0.001)	
# exposures to crisis banks		0.001	
		(0.002)	
# exposures through crisis banks to crisis banks			**-0.006** **
			(0.003)
# exposures through crisis banks to non-crisis banks			**0.003** **
			(0.001)
# exposures through non-crisis banks to crisis banks			0.003
			(0.002)
# exposures through non-crisis banks to non-crisis banks			-0.001
			(0.001)
Observations	14,483	14,483	14,483
R-squared	0.441	0.441	0.441

Direct and indirect crisis/non-crisis exposures



Potential mechanisms

1. Losses due to borrower defaults or loan restructurings
    - Syndicated loan market exhibits lower default rates and higher loan recovery rates than other segments of the credit market
    - Troubled loans are typically renegotiated and restructured
    - => effect on NIMs
2. Losses in the securities portfolio
    - Would occur if syndicated loans were designated as “held for trading” and marked-to-market
    - => may affect z-scores

Indeed, NIMs and z-scores are affected by exposures to banks in crisis countries

	(1)	(2)	(3)	(4)
	Net interest margins		**Z-score**	
DIRECT EXPOSURES				
# exposures to all banks	-0.002	-0.001	0.004	0.001
	(0.002)	(0.003)	(0.005)	(0.005)
# exposures to crisis banks	**-0.022****	**-0.018***	**-0.041***	**-0.034**
	(0.009)	**(0.010)**	**(0.023)**	**(0.025)**
INDIRECT EXPOSURES				
# exposures through crisis banks to crisis banks		**-0.004***		0.001
		(0.002)		(0.005)
# exposures through crisis banks to non-crisis banks		0.001		-0.002
		(0.001)		(0.003)
# exposures through non-crisis banks to crisis banks		0.002		0.002
		(0.002)		(0.006)
# exposures through non-crisis banks to non-crisis banks		-0.001		**0.004****
		(0.001)		**(0.002)**
Observations	14,350	14,350	13,927	13,927
R-squared	0.631	0.631	0.324	0.326

Conclusions

- We empirically traced the transmission of financial crises through a global network of interbank exposures using exposures on the syndicated loan market as a proxy
- Results:
    - Direct exposures to crises reduce bank profitability (ROA, NIM) and stability (z-score)
    - Indirect exposures to crises through crisis banks further reduce profitability
    - Indirect exposures to non-crises through crisis banks dampen the negative direct crisis effect
- Losses/restructuring of troubled loans are a likely mechanism