Strategic complementarity in banks' funding liquidity choices and financial stability

André Silva

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Cass Business School
CITY UNIVERSITY LONDON

Motivation

- *Insufficient bank liquidity buffers* were one of the *main causes of the financial crisis* (Brunnermeier, JEP 2009).

- *Funding liquidity risk is inherently systemic* – one agent's liquid asset is another agent's liquid liability → funding arrangements link banks with other financial institutions and the non-financial sector.

- *Liquidity requirements* in most regulatory initiates (e.g., Basel III LCR/NSFR) are *idiosyncratic in nature* → abstract from any formal or informal interconnections between banks.

- Competitors matter for *bank liquidity* (Bonfim and Kim, 2014), *bank credit* (Rajan, QJE 1994; Uchida and Nakagawa, JFI 2007), *capital structure* (Leary and Roberts, JF 2014), *compensation* (Shue, RFS 2013), *investment policies* (Dougal et al., JF 2015).

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Research Questions

1. **Why and how are liquidity holding choices of a bank influenced by the behaviour of its peers?**
   - *Why?* Learning i.e., free-riding in information acquisition (Banerjee, QJE 1992)? Or collective moral-hazard arising from LOLR bailout commitment (Ratnovski, JFI 2009; Farhi and Tirole, AER 2012)?
   - *How?* Through direct responses to peers' liquidity decisions? Or through changes in other peers' characteristics?

2. **Do strategic funding liquidity risk management decisions have an impact on financial stability?**
   - Collective risk-taking increases likelihood that banks fail altogether due to higher correlation of defaults (Allen et al., JFE 2012).

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Main Findings and Contribution

1. *Strategic liquidity risk management decisions increase (i) individual banks' default risk and (ii) overall systemic risk.*
   - To the best of my knowledge, no study so far empirically examine the impact of banks' strategic balance-sheet decisions on financial stability.

2a. *While large banks' liquidity decisions are only sensitive to their large counterparts, small banks' liquidity choices are affected by the decisions of both small and large banks.*

2b. *Banks' liquidity choices are determined directly by the decisions of competitors and, to a lesser extent, their other characteristics.*

- Bonfim and Kim (2014) find strong evidence of competitors affecting individual banks' liquidity risk management policies → *But are silent on how and why these peer effects materialise.*

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Data

- Sample: 17,831 bank-year observations corresponding to 2,058 commercial banks in 32 OECD countries from 1999 to 2013.
- Banks' balance-sheets and income statements → Bankscope
  - Restrict coverage to largest 100 commercial banks in each country i.e., exclude smaller (mostly regional) banks in the US and Japan.
- Bank ownership data → manually collected from various sources:
  - BvD ownership database, banks' annual reports and websites, newspaper articles. Data is further cross-checked with the Claessens and van Horen (2014, 2015) bank ownership database.
- Daily stock prices and no. shares outstanding → Datastream
- Country/sector equity market indices → MSCI
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Empirical Model 1

Baseline model to capture peer effects

$$Liq_{i,j,t} = \omega + \beta \overline{Liq}_{-i,j,t} + \lambda' \bar{X}_{-i,j,t-1} + \gamma' X_{i,j,t-1} + \eta' Z_{j,t-1} + \mu_i + v_t + \varepsilon_{i,j,t}$$

- Peer effects are captured by coefficient $\beta \rightarrow$ influence of peer banks' funding liquidity choices on those of bank i.
- $Liq_{i,j,t}$ is either the Liquidity Ratio (Acharya and Mora, JF 2015) or the Berger and Bowman (RFS 2009) Liquidity Creation measure.

- **Endogeneity problem:** *if peers liquidity choices affect the liquidity decisions of a specific bank, the decision of this bank may also in turn affect the choice made by the peers (Manski, RES 1993).*

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Identification strategy

- **Solution:** explore systematic differences in peer group composition to identify peer effects (Bramoullé et al., JE 2009) $\rightarrow$ heterogeneity allows to use liquidity holdings of the "peer's peer" as an instrument, thus extracting the exogenous part of the variation.
  - Strategy solves reflection problem and causes potential bias from weak instruments to fall away (Angrist, LE 2014).
- **How?**
  - Large cross-border banking groups manage liquidity on a global scale (e.g., Cetorelli and Goldberg, JF 2012).
  - *Identifying assumption:* in addition to liquidity choices of its direct competitors, a foreign-owned subsidiary also takes into account the funding liquidity risk management policies of its parent bank-holding group when determining its own.

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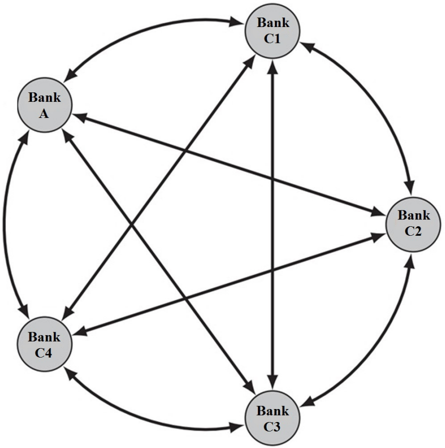

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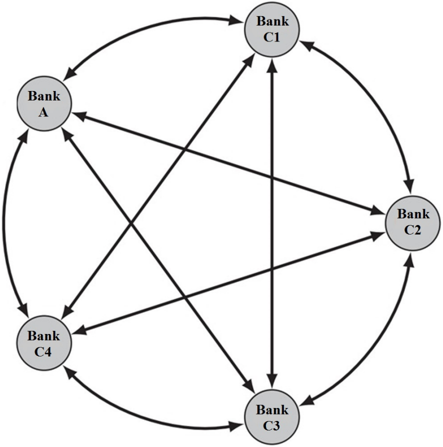

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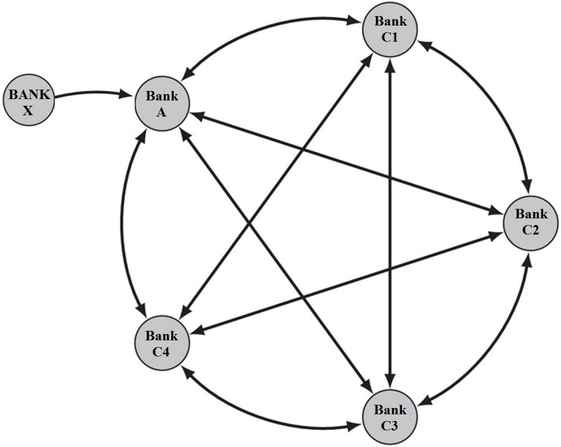

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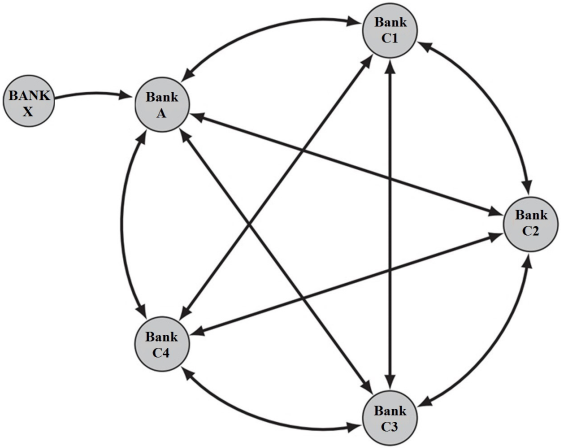

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Criteria to specify peer groups

1. *Country and Year:*
   - Within-country banks expected to have higher incentives to mimic their peers since they share same LOLR (Acharya, JFS 2009).
   - Learning also more likely to occur within countries where information for bank managers is more accessible.

2. *Business Model:* only commercial banks included in the sample
   - Most cooperative and saving banks are domestically owned.

3. *Bank Size:* each peer group in each country j in each year t has a maximum of 20 banks in the benchmark case
   - We need to have at least 1 foreign-owned subsidiary within the 20 banks to identify the remaining 19.
   - Bizjak et al. (JFE 2011) $\rightarrow$ average peer group size when setting executive compensation is 17.3 for S&P 500 firms.

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Empirical Model 2

Baseline model to examine impact of peer effects on financial stability

Step 1:

$$Liq_{i,j,t} = \omega + \beta_{j,t}\overline{Liq}_{-i,j,t} + \lambda'\bar{X}_{-i,j,t-1} + \gamma' X_{i,j,t-1} + \eta' Z_{j,t-1} + \mu_i + \upsilon_t + \varepsilon_{i,j,t}$$

- $\beta_{j,t}$ is now allowed to vary across countries and over time.
- e.g., UK in 2010:

$$Liq_{i,j,t} = \omega + [\beta_0 + (\beta_1 \times I_{UK} \times I_{2010})]\overline{Liq}_{-i,j,t} + \lambda'\bar{X}_{-i,j,t-1} + \gamma' X_{i,j,t-1} + \eta' Z_{j,t-1} + \mu_i + \upsilon_t + \varepsilon_{i,j,t}$$

Step 2:

$$Stability_{i,j,t} = \kappa + \delta\hat{\beta}_{j,t} + \gamma' X_{i,j,t-1} + \nu_{j,t} + u_{i,j,t}$$

- $Stability_{i,j,t}$ is a measure of (i) individual banks' financial stability: Z-Score or Merton's Distance-to-Default; or (ii) systemic risk: MES or SRISK (Acharya et al., 2010, 2012).

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$$Liq_{i,j,t} = \omega + \beta_{j,t}\overline{Liq}_{-i,j,t} + \lambda'\bar{X}_{-i,j,t-1} + \gamma' X_{i,j,t-1} + \eta' Z_{j,t-1} + \mu_i + \upsilon_t + \varepsilon_{i,j,t}$$

- $\beta_{j,t}$ is now allowed to vary across countries and over time.
- e.g., UK in 2010:

$$Liq_{i,j,t} = \omega + [\beta_0 + (\beta_1 \times I_{UK} \times I_{2010})]\overline{Liq}_{-i,j,t} + \lambda'\bar{X}_{-i,j,t-1} + \gamma' X_{i,j,t-1} + \eta' Z_{j,t-1} + \mu_i + \upsilon_t + \varepsilon_{i,j,t}$$

Step 2:

$$Stability_{i,j,t} = \kappa + \delta\hat{\beta}_{j,t} + \gamma' X_{i,j,t-1} + \nu_{j,t} + u_{i,j,t}$$

- $Stability_{i,j,t}$ is a measure of (i) individual banks' financial stability: Z-Score or Merton's Distance-to-Default; or (ii) systemic risk: MES or SRISK (Acharya et al., 2010, 2012).

Empirical Model 2

Baseline model to examine impact of peer effects on financial stability

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Result 1: Peer effects in banks' liquidity choices

Dep Var: Liquidity Creation				
Peer Banks' Liquidity Creation	0.455**	0.522***	0.532***	0.462***
	(0.222)	(0.134)	(0.194)	(0.157)
Peer Banks' Total Assets	0.004	0.009**	0.004	0.007**
	(0.005)	(0.003)	(0.004)	(0.003)
Peer Banks' Capital Ratio	0.110	0.123**	0.121**	0.084
	(0.068)	(0.051)	(0.062)	(0.053)
Peer Banks' Return-on-Assets	0.093	0.195	0.053	-0.035
	(0.374)	(0.291)	(0.373)	(0.278)
Peer Banks' Provisions	-0.009	0.030	0.004	0.043*
	(0.030)	(0.026)	(0.027)	(0.026)
...				
Bank-level controls	Y	Y	Y	Y
Country-level controls	Y	Y	-	-
Year FE	Y	Y	N	N
Country FE	Y	-	N	-
Bank FE	N	Y	N	Y
Country-Year FE	N	N	Y	Y
IV (1st stage)	0.129***	0.160***	0.141***	0.125***
	(0.013)	(0.014)	(0.013)	(0.011)

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Result 1: Peer effects in banks' liquidity choices

Dep Var: Liquidity Ratio				
Peer Banks' Liquidity Ratio	0.574***	0.474***	0.596***	0.250**
	(0.152)	(0.102)	(0.159)	(0.110)
Peer Banks' Total Assets	-0.018	0.011	-0.010	0.018
	(0.027)	(0.019)	(0.025)	(0.019)
Peer Banks' Capital Ratio	0.456	-0.181	0.639*	-0.233
	(0.358)	(0.249)	(0.357)	(0.251)
Peer Banks' Return-on-Assets	3.841*	0.581	3.722*	1.837
	(1.982)	(1.486)	(2.005)	(1.418)
Peer Banks' Provisions	-0.046	-0.283**	-0.069	-0.264**
	(0.176)	(0.140)	(0.163)	(0.132)
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Bank-level controls	Y	Y	Y	Y
Country-level controls	Y	Y	-	-
Year FE	Y	Y	N	N
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Bank FE	N	Y	N	Y
Country-Year FE	N	N	Y	Y
IV (1st stage)	0.216***	0.202***	0.203***	0.178***
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- *Peer banks play an important role in determining individual banks' liquidity holding policies:*
  - e.g., one standard deviation change in peers' liquidity creation (0.15) is associated with change in liquidity creation of bank i of 0.07-0.08.
- Banks' liquidity decisions are in large part *direct responses to the liquidity choices of peer banks* and, to a lesser extent, to changes in their characteristics.
- These peer effects are *one of the most important determinants for liquidity holding determination* $\rightarrow$ together with the bank-specific capital and loans as a percentage of total assets (untabulated).

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Result 1: Peer effects in banks' liquidity choices - robustness

1. *Alternative peer group definitions:*
   - Form peer groups using peer-weighted averages based on size similarity - inverse of Euclidean distance i.e., the smaller the distance between two banks, the more weight it has.
   - Split within-country-year banks into small and large banks; small, medium and large banks; or groups of 25 banks by size, . . .

2. *Alternative econometric specifications:*
   - Include lagged liquidity ratio or liquidity creation as an explanatory variable and estimate the model with S-GMM, . . .

3. *Alternative IVs:*
   - Regress liquidity holdings of parent bank-holding group with country-level characteristics and country and time FE $\rightarrow$ use the residual to instrument peer firms' liquidity choices.
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Result 2.1: Which banks strategically mimic their peers?

	Peer Effect: Liq. Creation		Peer Effect: Liq. Ratio	
Low Capital Ratio	0.898***	1.114***	0.383**	0.444**
	(0.337)	(0.400)	(0.195)	(0.177)
High Capital Ratio	0.354*	0.194	0.203	0.154
	(0.207)	(0.203)	(0.199)	(0.185)
Low Profitability	0.476**	0.497**	0.426**	0.503***
	(0.217)	(0.217)	(0.204)	(0.166)
High Profitability	0.342	0.447**	0.073	0.188
	(0.214)	(0.213)	(0.201)	(0.189)
Low share of wholesale funding	0.374**	0.292	0.191	0.241
	(0.188)	(0.179)	(0.217)	(0.194)
High share of wholesale funding	0.942***	1.085***	0.544***	0.521***
	(0.302)	(0.313)	(0.196)	(0.185)
Low loan-to-assets ratio	0.374**	0.354**	0.212	0.201
	(0.175)	(0.175)	(0.190)	(0.189)
High loan-to-assets ratio	0.675***	0.743***	0.801***	0.928***
	(0.200)	(0.224)	(0.250)	(0.226)
Foreign-owned banks	0.182	0.410	0.174	0.310*
	(0.313)	(0.288)	(0.195)	(0.159)
Non-foreign-owned banks	0.739***	0.663***	0.485***	0.565***
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Result 2.2: Who mimics who?

	Peer Effect: Liq. Creation		Peer Effect: Liq. Ratio	
Large banks → Large banks	0.981***	0.773***	0.909**	1.185***
	(0.164)	(0.179)	(0.396)	(0.327)
Large banks → Small banks	0.227	0.045	-0.059	0.218
	(0.300)	(0.293)	(0.212)	(0.173)
Small banks → Small banks	1.332***	0.803**	0.943***	0.428**
	(0.379)	(0.373)	(0.285)	(0.209)
Small banks → Large banks	0.765***	0.886***	1.155**	1.178***
	(0.211)	(0.192)	(0.530)	(0.453)
Peer Characteristics	Y	Y	Y	Y
Bank-level controls	Y	Y	Y	Y
Country-level controls	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	-	Y	-
Bank FE	N	Y	N	Y

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Bank FE	N	Y	N	Y

Result 3.1: Peer effects and default risk

ln(Z-Score) – 3-year window: $\ln[(E/A + ROA)/\sigma(ROA)_{3y}]$				
Peer Effect:	-0.319**	-0.360**		
Liq. Creation - $\widehat{\beta^{LC}_{j,t}}$	(0.142)	(0.144)		
Peer Effect:			-0.442***	-0.366***
Liq. Ratio - $\widehat{\beta^{LR}_{j,t}}$			(0.132)	(0.118)
No. observations	10,051	10,051	10,049	10,049
No. banks	1,406	1,406	1,407	1,407
Adj. R^2	0.269	0.126	0.269	0.127
Bank-level controls	Y	Y	Y	Y
Country-level controls	Y	-	Y	-
Year FE	Y	N	Y	N
Bank FE	N	Y	N	Y
Country FE	Y	-	Y	-
Country-Year FE	N	Y	N	Y

- Conclusions do not change when using a 5-year window to compute Z-Scores, or the market-based Merton Distance-to-Default.

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Country-level controls	Y	-	Y	-
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Bank FE	N	Y	N	Y
Country FE	Y	-	Y	-
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- Conclusions do not change when using a 5-year window to compute Z-Scores, or the market-based Merton Distance-to-Default.

Result 3.2: Peer effects and systemic risk

	Marginal Expected Shortfall		SRISK	
Peer Effect:	1.761***		1.945*	
Liq. Creation - $\widehat{\beta_{j,t}^{LC}}$	(0.492)		(1.005)	
Peer Effect:		0.598***		0.698**
Liq. Ratio - $\widehat{\beta_{j,t}^{LR}}$		(0.175)		(0.283)
No. observations	2,201	2,207	2,092	2,098
No. banks	316	317	313	314
Adj. R^2	0.161	0.157	0.245	0.243
Bank-level controls	Y	Y	Y	Y
Country-level controls	-	-	-	-
Bank FE	Y	Y	Y	Y
Country-Year FE	Y	Y	Y	Y

Result 3.2: Peer effects and systemic risk

	Marginal Expected Shortfall		SRISK	
Peer Effect:	1.761***		1.945*	
Liq. Creation - $\widehat{\beta_{j,t}^{LC}}$	(0.492)		(1.005)	
Peer Effect:		0.598***		0.698**
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No. observations	2,201	2,207	2,092	2,098
No. banks	316	317	313	314
Adj. R^2	0.161	0.157	0.245	0.243
Bank-level controls	Y	Y	Y	Y
Country-level controls	-	-	-	-
Bank FE	Y	Y	Y	Y
Country-Year FE	Y	Y	Y	Y

Summary

1. Liquidity holding *choices* of competitor banks *do matter* for funding liquidity risk management policies of individual banks.

2. Both learning and collective moral-hazard seem to be at play.
   - A well functioning resolution and bail-in framework is essential to mitigate banks' bail-out expectations.

3. *Strategic liquidity risk management decisions increase (i) individual banks' default risk and (ii) overall systemic risk.*
   - The effect is economically significant e.g., one standard deviation increase in peer effect (0.24 to 0.30) leads to a decrease in the Z-score of bank i of 0.08 to 0.14 (where mean of Z-Score is 3.46).
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Thank you

Any comments or suggestions are more than welcome.

andre.silva.3@cass.city.ac.uk

"When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing."

Chuck Prince, former chief executive of Citigroup - FT, July 2007