

The Interbank Market Puzzle

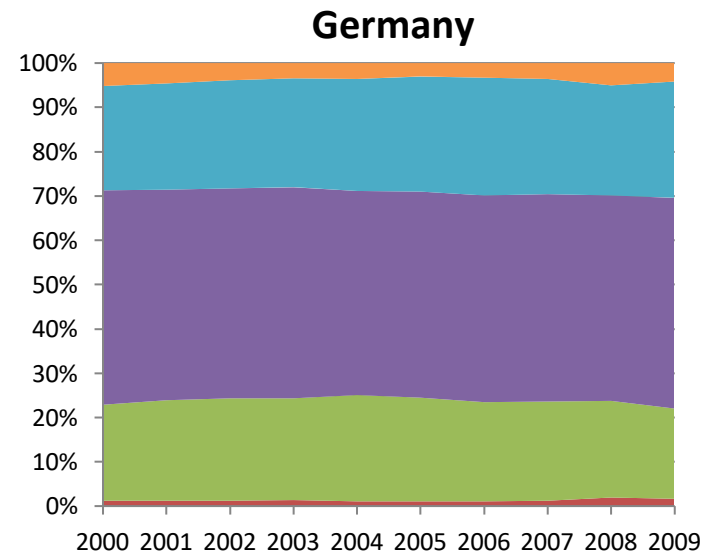
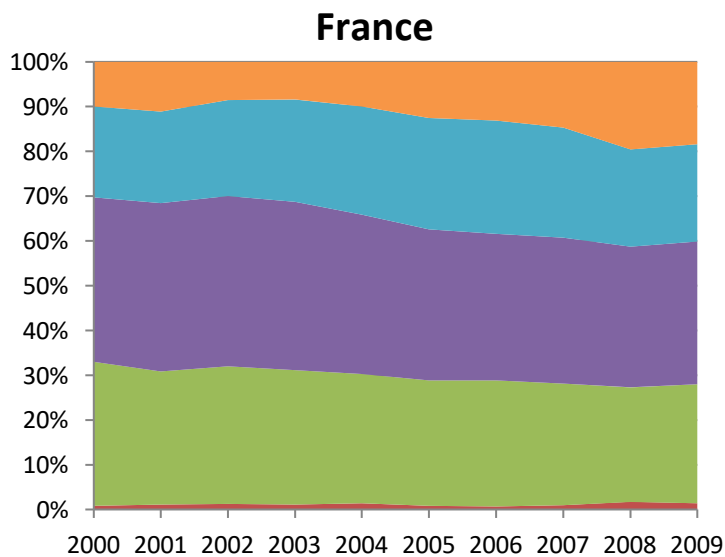
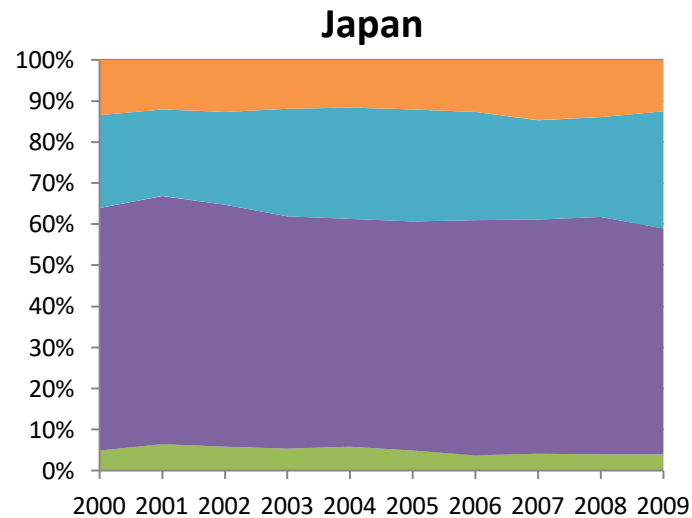
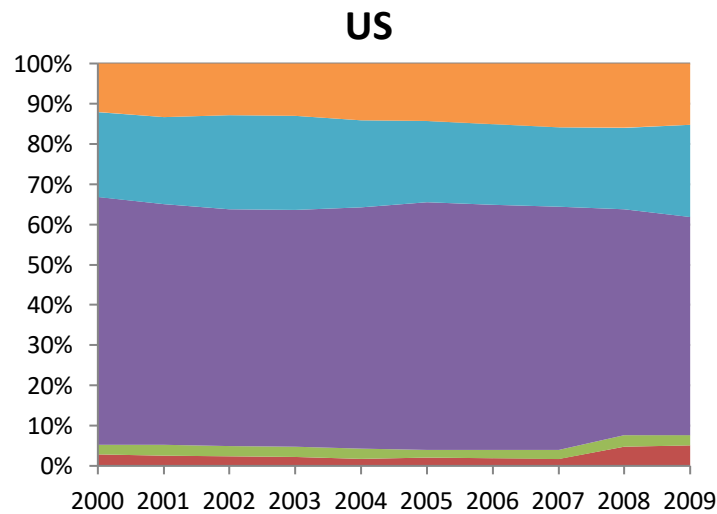
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The views and opinions expressed in this paper are those of the authors and do not necessarily represent those of the European Central Bank and Bank of England.

Structure of bank assets



- Other assets
- Securities
- Loans
- Interbank deposits
- Cash and balance with Central bank

Motivation

- Interbank market is **crucial** in financial systems
 - Efficient liquidity transfer between surplus and needy banks (risk-sharing) (Bhattacharya and Gale, 1987; Acharya et al., 2012)
 - Central bank's intervention to guide policy interest rates (Furfine, 2001)

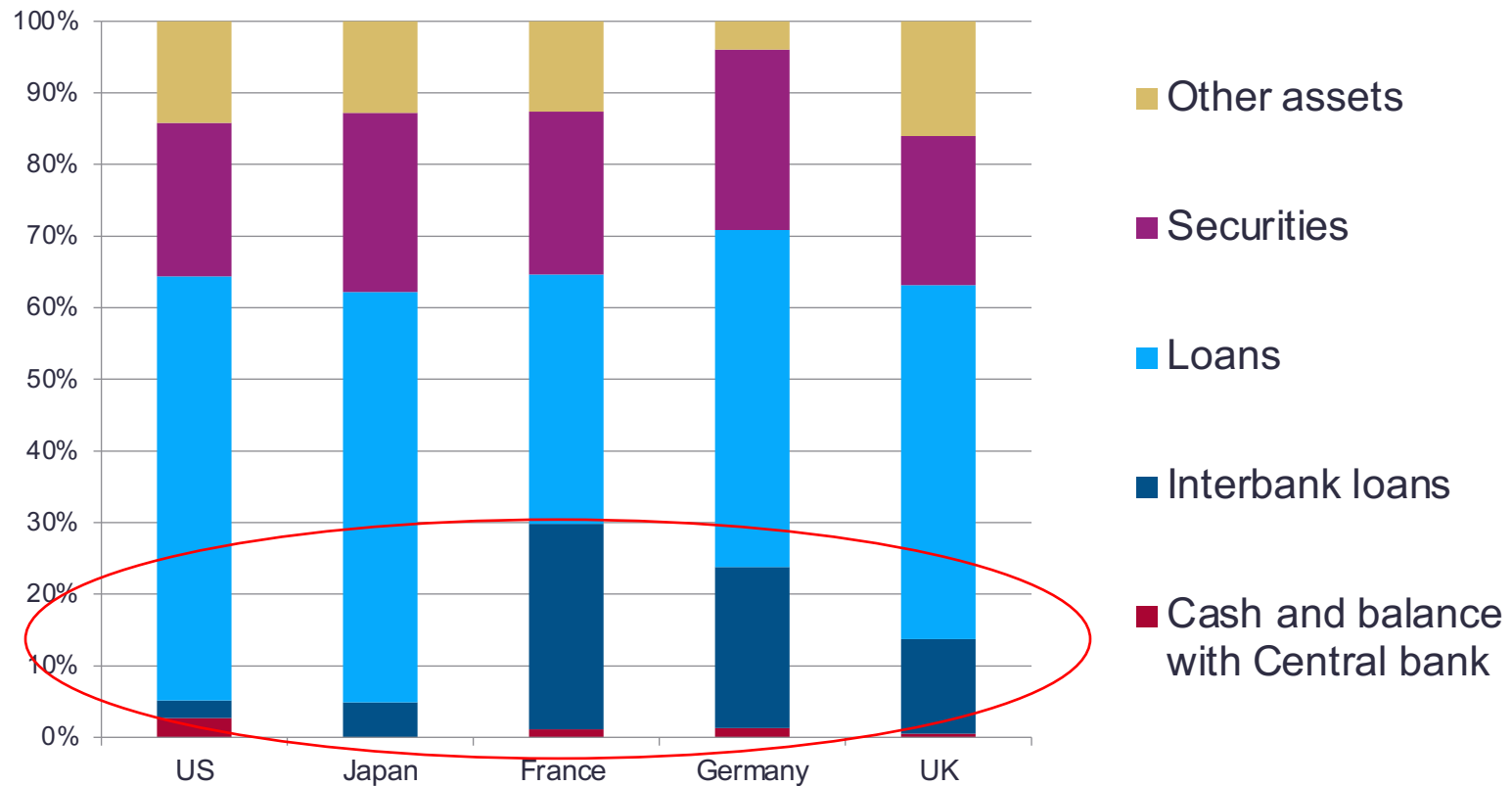
- Efficient risk sharing through interbank market may not occur **during crises**
 - Moral hazard and market frictions in this market
 - During the recent financial crisis, the interbank market froze up due to rising counterparty credit risk and precautionary liquidity hoarding
 - Afonso et al., 2011: US fed funds market
 - Gabrieli and Georg, 2017: European interbank market (via Euro payment system TARGET2)

The interbank market puzzle

- Very little is known
 - How the interbank market works
- The size of interbank market
 - The average ratio of interbank activities to total bank position has been quite stable over time from a long-run perspective (BIS, 1983)
 - There could be great variations between banks in their use of the interbank market
 - E.g. for the US, the average ratio of loans to depository institutions to total assets of insured commercial banks from 1934 to 2015 is 1.81%; while for Germany, the average ratio of interbank loans from 1950 to 2015 is 20.61%.

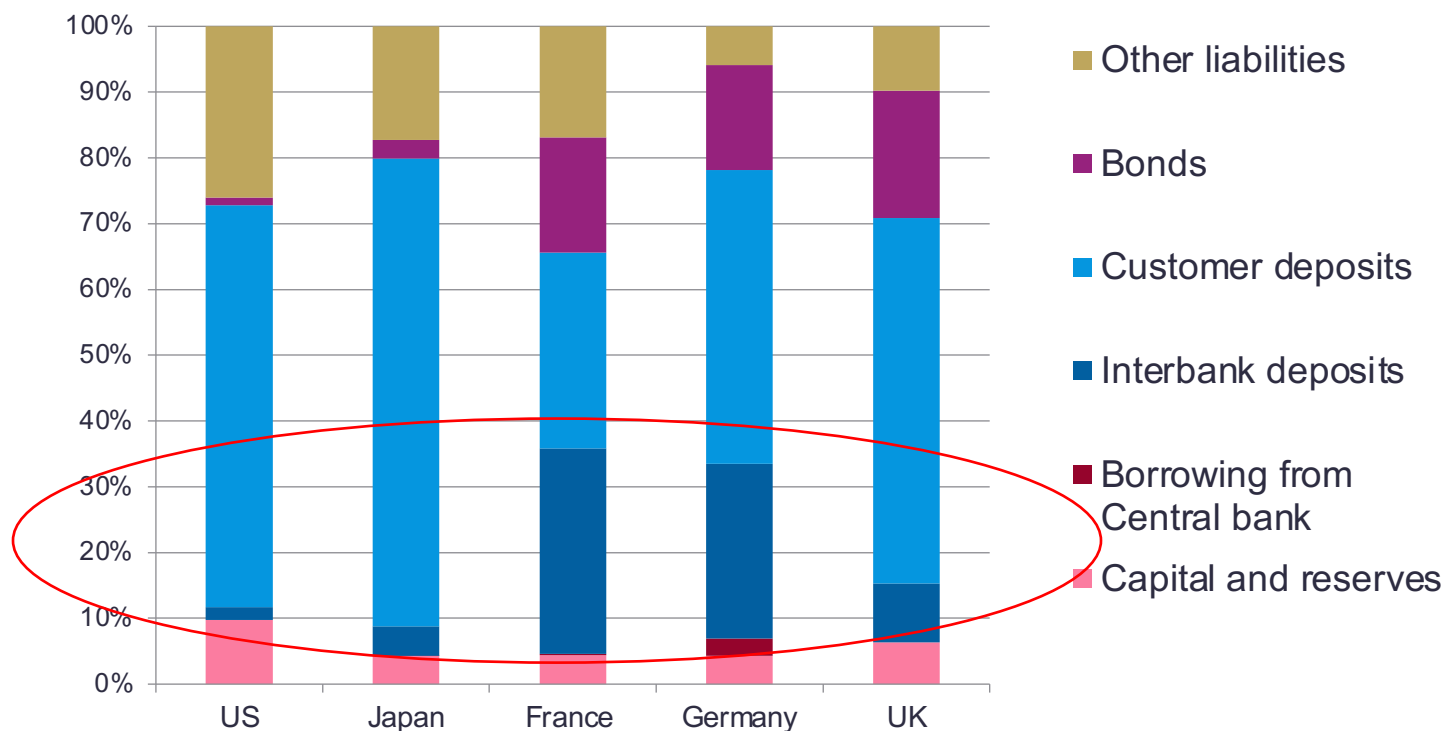
Breakdown of 10-year avg. bank assets

Assets: 10-year average (2000-2009)



Breakdown of 10-year avg. bank liability

Liabilities: 10-year average (2000-2009)



Comparative statistics: country-level

	Germany		France		UK		Japan		US	
	Interbank deposits	Interbank loans	Interbank deposits	Interbank loans	Interbank deposits	Interbank loans	Interbank deposits	Interbank loans	Interbank deposits	Interbank loans
2000	29.17%	25.52%	36.09%	32.00%	8.02%	13.22%	3.00%	3.94%	6.88%	4.43%
2001	28.94%	26.42%	34.84%	32.27%	8.52%	13.74%	2.56%	3.75%	7.05%	4.87%
2002	28.87%	27.80%	35.49%	32.62%	9.73%	14.38%	2.38%	5.21%	6.71%	5.01%
2003	28.29%	27.89%	34.08%	30.55%	9.54%	13.74%	1.97%	4.48%	5.91%	4.21%
2004	28.31%	28.48%	34.75%	30.70%	10.30%	13.94%	1.91%	4.25%	5.48%	4.13%
2005	28.45%	29.29%	34.85%	30.50%	10.44%	13.95%	1.81%	4.62%	4.66%	3.46%
2006	28.48%	29.94%	34.83%	29.37%	12.44%	16.06%	1.76%	3.86%	4.60%	3.81%
2007	29.21%	31.57%	36.01%	30.38%	5.68%	10.12%	2.78%	2.68%	4.84%	4.25%
2008	28.96%	32.14%	35.49%	29.53%	6.50%	10.97%	2.57%	3.04%	3.37%	2.63%
2009	26.56%	29.65%	33.32%	28.72%	9.05%	11.92%	3.97%	2.98%	2.46%	1.86%
2010	23.44%	26.12%	31.28%	28.18%	7.93%	8.04%	3.31%	2.96%	2.15%	1.57%
2011	21.83%	26.59%	32.07%	30.97%	8.87%	8.93%	4.90%	4.34%	1.17%	0.93%
2012	21.84%	26.46%	31.70%	30.45%	9.67%	9.76%	4.43%	3.76%	1.29%	0.98%
2013	21.64%	26.84%	30.84%	30.31%	11.27%	11.03%	3.38%	4.81%	1.06%	0.78%
2014	21.76%	26.21%	30.62%	30.03%	8.08%	7.86%	3.76%	10.45%	0.83%	0.55%
Average 2000-14	26.38%	28.06%	33.75%	30.44%	9.07%	11.84%	2.97%	4.34%	3.90%	2.90%

The interbank market puzzle

■ The Puzzle:

- Why is there such difference in the size of interbank market?
- What determines the interbank participation of banks?
- Is risk sharing better in those countries with larger interbank market size?

■ This paper

- The role of **country-specific trust** in the bank system; interbank network structure
- **New data**
- **Why Trust?**
 - Interbank deposits and loans are not insured and often uncollateralized (Furfine, 2001)
 - Main criteria for participation: creditworthy, not constrained by domestic regulations
 - Government intervention might affect the likelihood of bank failure, and peer monitoring (Rochet and Tirole, 1996)

Preview of results

- Trust is crucial in determining the interbank market size
 - **Proxy for trust:** length of banking crises and the assets of bank failures in the history
 - If a bank is located in a country that has experienced longer periods of crises or more failures with higher bank assets in the past, the trust can be weaker and support less interbank activities given the counterparty credit risk and possible adverse selection in this market
 - One more year experience of banking crisis could reduce interbank borrowing by **4.6%**.

Preview of results

- The impact of **network structure of interbank markets**
 - Features of the European Interbank market
 - 13 communities in the interbank market
 - French banks have the highest global/local importance in the EA interbank network
 - Network structure matters
 - Core banks acting as interbank intermediaries more significantly influenced by trust
 - Being more exposed in a community can mitigate the negative effect of low trust
- **Legal and regulatory institutions** also play an important role in explaining the difference in interbank market participation at the country-level.
 - The institutional factors can mitigate the adverse effect of crises on interbank activities and help to strengthen/rebuild up trust in this market
 - Strengthening in legal enforcement can mitigate the impact of crises on the association between market discipline and interbank borrowings.
- Trust is not a proxy for other determinants, esp. the key bank characteristics.

Related literature

- Lending relationship in the interbank market
 - Concentrated interbank relationship is an important determinant of interbank activities, and can mitigate the effect of shocks
 - Afonso, Kovner and Scholar, 2013;
 - Cocco et al. 2009;
 - Bräuning and Fecht, 2017 ;
 - Craig and Ma, 2019; Das et al., 2019;

- Interbank liquidity during crisis
 - Borrowers' counterparty risk during crises (Freixas and Jorge, 2008; Bruche and Suarez, 2010; Afonso et al., 2011)
 - Lenders' liquidity hoarding (Allen, Carletti and Gale, 2009; Caballero and Krishnamurthy, 2008; Acharya and Merrouche, 2011; Iyer and Peydro, 2011)
 - Iyer et al. (2014)

Related literature (cont.)

■ Network

• Interbank network

- Systemic risk (Das, Mitchener and Vossmeier, 2019)
- Contagion (Mitchener and Richardson, 2019; Brunetti et al., 2019)
- Liquidity (Gabrieli and Georg, 2017; Gofman, 2014; Farboodi, 2017; Glode and Opp, 2016)

• Other types of economic network

- Venture capital network (Hochberg et al., 2007; Bubna, Das and Prabhala, 2019)
- Product-market network (Ahern and Harford, 2014)
- Equity ownership network (Allen et al., 2019)
- Social network (Larcker, So, Wang, 2013; Ahern, 2017, etc.)

Outline of the rest of the talk

- Data and sample
 - Domestic banks around the globe
 - Large exposures of Euro Area banks
- Summary statistics
- Methodology
- Baseline results and robustness checks
- The role of network structure: Euro Area interbank market
 - Shock: the Insolvency of an Italian bank (Veneto Banca)
- Conclusion

International evidence: domestic interbank market

■ Our sample

- 11,412 domestic banks over 96 countries (1995-2015)
- Exclude the banks operated in the form of subsidiaries/branches
- Exclude foreign banks
- Exclude the countries with no more than 5 banks in the dataset

■ Data sources

- Bank-level data: Bankscope/Bankfocus
- Regulation: Worldwide Governance Indicator (WGI), Kaufmann et al. (1999, 2010, 2017)
- Legal origins: Djankov et al.(2007)
- Systemic banking crises: Laeven and Valencia (2013)

Euro Area banks: Large Exposures Data

- Data sources
 - ECB's confidential large exposures data
- Our sample
 - EU introduced the large exposure regime in 2014
 - Large exposures of EA banks, from 2014-2018 (different from TARGET2)
 - The most comprehensive and up-to-date (on a quarterly basis) dataset capturing granular bank and exposure level information of the euro area banking system vis-à-vis banks located worldwide
 - Large exposure definition: An exposure is considered to be large when before applying credit mitigations and exemptions, it is 10% or more of an institution's eligible capital; exposures with a value above or equal to EUR 300 million
 - Coverage: captures 90% of the EA banks' risk weighted assets vis-à-vis credit institutions (Covi, Gorpe and Kok, 2019; Covi, Montagna and Torri, 2019)
 - In 2018Q4, this sample covers borrowing and lending among 1,362 banks (793 EA banks and 569 non-EA banks)

Variable definition

Variable	Definitions	Source
<i>Measures of trust in the banking system</i>		
Crisis length	The length of banking crises occurred in each country till year t	Laeven and Valencia (2012) and own computation
Bank failure	Standardized value of total assets of failed banks in each country till year t	BankScope/Bank Focus
Bank z-score	Ratio of return on assets plus capital-asset-ratio to the standard deviation of return on assets	Global Finance Database (2016)
<i>Bank level variables</i>		
Interbank borrowing	Borrowing and deposits from banks divided by total assets	
LtD	Bank's gross nonfinancial loans divided by nonfinancial deposits	
Securities	Securities to total assets	BankScope/Bank Focus
Equity	Equity to total assets	
ROA	Return on assets	
Size	Bank's total assets divided to gross domestic product of the country in which the bank is licensed	

Variable definition

Variable	Definitions	Source
<i>Country level variables</i>		
Common law	Equals to 1 if the legal origin of the country is common law.	Djankov et al. (2007)
Rule of law	The index of rule of law	
Reg. quality	The index of regulation quality	
Gov. effect	The index of government effectiveness	Worldwide Governance Indicator Database (2016)
Private credit	Private credit by deposit money banks divided by GDP	
Market cap.	Stock market capitalization divided by GDP	
Concentration	Assets of three largest commercial banks as a share of total commercial banking assets.	World Bank, Global Finance Database (2016)
Central Bank	Central bank total assets divided by GDP	
Bank z-score	Ratio of return on assets plus capital-asset-ratio to the standard deviation of return on assets	Global Finance Database (2016)

Summary statistics

Panel A: Summary statistics: Bank-level full sample

	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Interbank borrowing	74,572	0.0775	0.1107	0.0000	1.0000
LtD	74,572	0.9271	0.5621	0.0657	5.4421
Securities	74,572	0.2135	0.1494	0.0000	0.9903
Equity	74,572	0.0947	0.0534	0.0147	0.3309
ROA	74,572	0.0054	0.0103	-0.0606	0.0727
Bank Size	74,572	5.6665	1.4427	2.0175	11.2559
Crisis length (years)	74,572	2.8842	2.4051	0.0000	10.0000
Bank failure	74,572	5.6841	7.4056	-0.1304	16.3184
Bank Z-score	74,195	2.9905	2.7138	-0.3123	11.4330
Common law	73,860	0.3517	0.4775	0.0000	1.0000
Rule of law	72,245	1.2728	0.7560	-1.8900	2.1200
Reg. quality	72,212	1.1628	0.5810	-2.1500	2.2500
Gov. effect	72,212	1.3133	0.6904	-1.7100	2.3600
Private credit	73,535	0.7884	0.3481	0.0115	2.6246
Market Cap.	72,803	0.7471	0.4832	0.0001	8.5733
Central Bank	73,556	0.0643	0.0737	0.0000	1.1358
Concentration	69,682	0.5515	0.2084	0.2228	1.0000

Summary statistics

Panel B: Comparison of bank characteristics: longer vs shorter periods of banking crisis country

	<i>Long</i>	<i>Obs.</i>	<i>Short</i>	<i>Obs.</i>	<i>Diff</i>
Interbank borrowing	0.020 (0.000)	33,966	0.123 (0.001)	33,966	0.103*** (0.001)
LtD	0.862 (0.003)	33,966	0.993 (0.003)	33,966	0.131*** (0.004)
Securities	0.216 (0.000)	33,966	0.214 (0.001)	33,966	-0.002 (0.001)
Equity	0.114 (0.000)	33,966	0.083 (0.000)	33,966	-0.031*** (0.000)
ROA	0.006 (0.000)	33,966	0.004 (0.000)	33,966	-0.002* (0.000)

Determinants of interbank borrowing: baseline

- Banks with higher liquidity mismatch tend to borrow more from interbank market.
- Larger banks are more likely to be borrowers in the interbank market, consistent with Cocco et al. (2009)
- One more year experience of banking crisis would reduce interbank borrowing by **4.6%** (0.00353/0.0775); 1% increase in *Bank failure* is associated with **2.4%** (0.00183/0.0775) decrease in interbank borrowing size.

Dep Var.	<i>Interbank borrowing</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
Trust measure						
Crisis length	-0.00353*** (0.000311)	-0.00362*** (0.000311)	-0.00349*** (0.000312)			
Bank Failure				-0.00183*** (0.000266)	-0.000989*** (0.000277)	-0.00203*** (0.000262)
Bank characteristics						
LtD	0.0681*** (0.00179)	0.0662*** (0.00177)	0.0682*** (0.00179)	0.0696*** (0.00177)	0.0674*** (0.00175)	0.0696*** (0.00177)
Securities	0.0862*** (0.00347)	0.0862*** (0.00349)	0.0865*** (0.00348)	0.0895*** (0.00345)	0.0893*** (0.00347)	0.0900*** (0.00345)
Equity	-0.194*** (0.0102)	-0.210*** (0.0102)	-0.188*** (0.0102)	-0.208*** (0.0100)	-0.226*** (0.0100)	-0.201*** (0.0101)
ROA	0.0479 (0.0413)	0.0242 (0.0413)	0.0351 (0.0412)	0.0269 (0.0411)	0.0119 (0.0412)	0.00708 (0.0412)
Size	0.0101*** (0.000287)	0.00991*** (0.000289)	0.0101*** (0.000287)	0.00952*** (0.000285)	0.00952*** (0.000286)	0.00946*** (0.000284)

Determinants of interbank borrowing: baseline

- Both institutional factors and financial structure are important determinants of interbank market size
 - Private credit; concentration of banking sector
 - Stock market cap
 - Central bank assets

Dep Var.	<i>Interbank borrowing</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Country characteristics</i>						
Common law	0.0344*** (0.00242)	0.0440*** (0.00238)	0.0365*** (0.00239)	0.0531*** (0.00391)	0.0550*** (0.00401)	0.0582*** (0.00393)
Rule of law	0.0218*** (0.000902)			0.0265*** (0.00104)		
Reg. quality		0.0200*** (0.00112)			0.0239*** (0.00135)	
Gov. effect			0.0265*** (0.00103)			0.0320*** (0.00117)
Private credit	0.0106*** (0.00248)	0.0190*** (0.00243)	0.00782*** (0.00248)	0.00942*** (0.00253)	0.0202*** (0.00249)	0.00602** (0.00253)
Mkt. cap.	-0.0479*** (0.00207)	-0.0476*** (0.00203)	-0.0508*** (0.00217)	-0.0472*** (0.00210)	-0.0479*** (0.00209)	-0.0503*** (0.00219)
Central bank	-0.287*** (0.0115)	-0.275*** (0.0113)	-0.285*** (0.0116)	-0.300*** (0.0116)	-0.285*** (0.0114)	-0.296*** (0.0117)
Bank Zscore	-0.00120*** (0.000145)	-0.00118*** (0.000146)	-0.00117*** (0.000146)	-0.000989*** (0.000144)	-0.00100*** (0.000145)	-0.000947*** (0.000145)
Concentration	0.119*** (0.00492)	0.128*** (0.00489)	0.120*** (0.00490)	0.107*** (0.00515)	0.121*** (0.00518)	0.107*** (0.00511)
Cons.	0.0344*** (0.00242)	0.0440*** (0.00238)	0.0365*** (0.00239)	0.0531*** (0.00391)	0.0550*** (0.00401)	0.0582*** (0.00393)
Year FE	YES	YES	YES	YES	YES	YES
# of obs.	66854	66854	66854	66854	66854	66854
Adj. R2	0.440	0.436	0.442	0.439	0.434	0.442

Matched sample

- $Treated=1$ if the bank is allocated in a country with a history of banking crisis longer than 5 years in total;
- Banks can reduce interbank borrowing by **up to 26%** (0.0201/0.0775) if they are located in a *treated* country (having longer periods of crisis in the past) but has similar financial structure.

Dep. Var	<i>Interbank borrowing</i>		
	(1)	(2)	(3)
Treated	-0.0201*** (0.00169)	-0.0166*** (0.00167)	-0.0231*** (0.00171)
LtD	0.0643*** (0.00187)	0.0621*** (0.00186)	0.0643*** (0.00186)
Securities	0.0726*** (0.00628)	0.0736*** (0.00634)	0.0727*** (0.00628)
Equity	-0.168*** (0.0153)	-0.195*** (0.0153)	-0.158*** (0.0155)
ROA	-0.0521 (0.0858)	-0.0949 (0.0859)	-0.0931 (0.0855)
Banksize	0.0145*** (0.000429)	0.0141*** (0.000430)	0.0143*** (0.000426)
Rule of law	0.0312*** (0.00114)		
Reg. quality		0.0301*** (0.00148)	
Gov. effect			0.0362*** (0.00129)
Other controls	YES	YES	YES
Year FE	YES	YES	YES
# of obs.	38337	38337	38337
<i>Adj. R2</i>	0.288	0.279	0.290

The mitigating role of institutional factor

- A current systemic banking crisis has a much larger negative effect on interbank transactions than crises in the past;
- In countries with better legal enforcement, regulatory quality or stronger govt effectiveness, the marginal effect of the occurred banking crisis would be mitigated.

Dep. Var	<i>Interbank borrowing</i>		
	(1)	(2)	(3)
Crisis length	-0.00293*** (0.000327)	-0.00273*** (0.000328)	-0.00291*** (0.000328)
Crisis	-0.0281*** (0.00284)	-0.0382*** (0.00344)	-0.0248*** (0.00298)
Rule of law	0.0213*** (0.00110)		
Rule of law*Crisis	0.0235*** (0.00172)		
Reg. quality		0.0177*** (0.00148)	
Reg. quality*Crisis		0.0309*** (0.00248)	
Gov. effect			0.0268*** (0.00125)
Gov. effect*Crisis			0.0250*** (0.00186)
Other controls	YES	YES	YES
Year FE	YES	YES	YES
# of obs.	42527	42527	42527
Adj. R2	0.305	0.298	0.307

Robustness: EA banks and large vs small banks

- Our results are not affected by the central bank policy (using only EA banks as a sample)
- Large banks' interbank borrowing tends to be more impacted by the trust (e.g. Cocco et al. (2009)-large banks tend to be net borrowers in the market)
- Large* is defined as one for the upper quartile and zero for the lower quartile based on total bank assets

Dep. Var	<i>Interbank borrowing</i>		
	(1)	(2)	(3)
	EU11	EU19	EU19
Crisis length	-0.0158*** (0.00111)	-0.0168*** (0.00114)	-0.0117*** (0.00136)
Large			0.0377*** (0.00211)
Crisis length* Large			-0.00680*** (0.000649)
LtD	0.133*** (0.00259)	0.131*** (0.00261)	0.137*** (0.00331)
Securities	0.154*** (0.00649)	0.144*** (0.00655)	0.128*** (0.00840)
Equity	-0.339*** (0.0227)	-0.356*** (0.0232)	-0.400*** (0.0264)
ROA	-0.219 (0.145)	-0.273* (0.145)	-0.169 (0.195)
Banksize	0.00794*** (0.000490)	0.00856*** (0.000491)	
Other controls	YES	YES	YES
Year FE	YES	YES	YES
# of obs.	27721	27814	13871
Adj. R2	0.452	0.442	0.497

Robustness: IV

- **Instrument:** *whether the country has introduced the deposit insurance scheme (Explicit_DI), or the power of insurance scheme (DI_power)*
- Both variables from Barth, Caprio and Levine (2013)
- 14 countries introduced the explicit DI since 2008, and almost all countries with EX DI that experienced a banking crisis increased the statutory coverage limit in their DI scheme. (Demirguc- Kunt et al., 2013)

Dep. Var	Crisis length	Interbank	Crisis length	Interbank
	(1)	(2)	(3)	(4)
ExDI	1.069*** (0.102)	-0.0394*** (0.00363)		
DI power			0.127*** (0.0223)	-0.00174* (0.000944)
F-stats	108.96**		32.54***	
Other controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
# of obs.	64493	64493	30871	30871
Adj. R2	0.720	0.499	0.654	0.399

More robustness

- Sample excl. US banks
- Sample excl. US banks and financial centres (UK, HongKong, and Singapore)
- Further control for bond market cap/GDP in addition to equity market cap/GDP

The role of interbank network: Euro Area

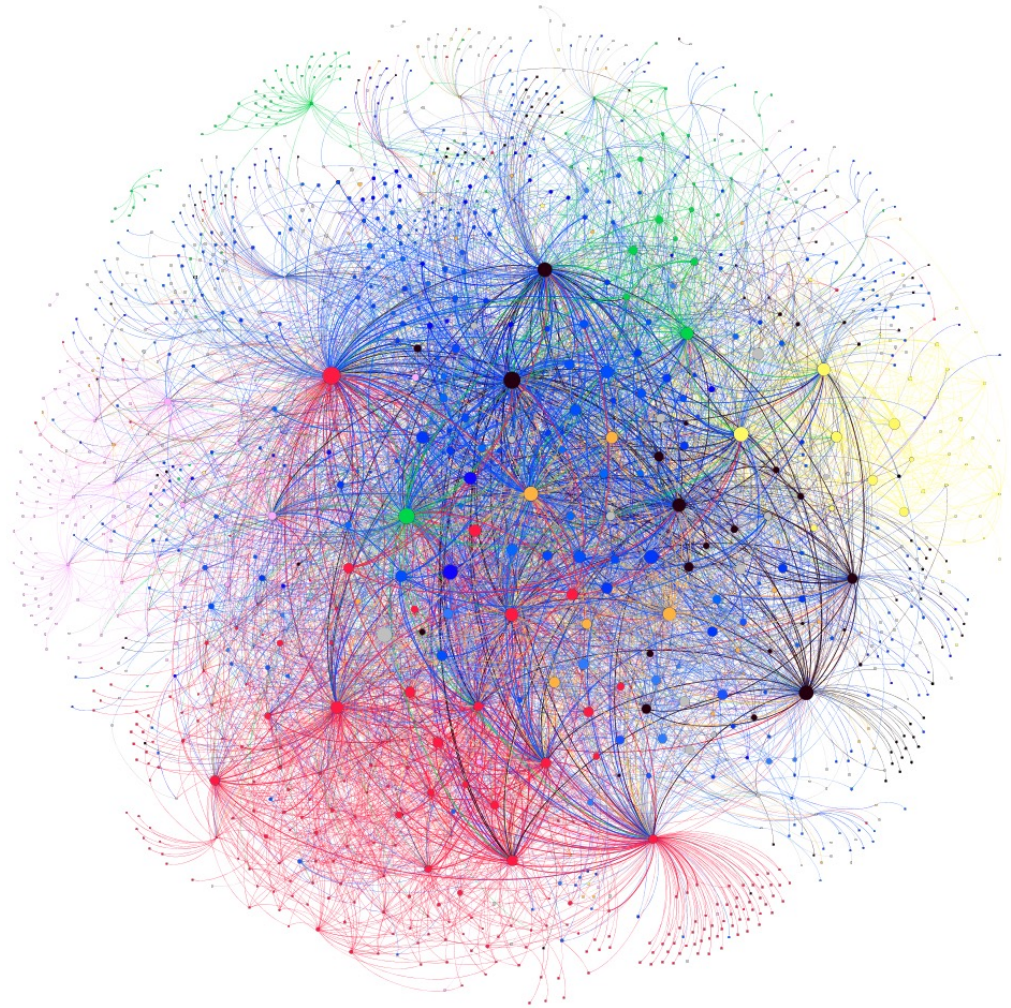
■ Community detection

- Community of borrowing and lending
 - A community is essentially a group of nodes that have strong connections to each other
 - Choose the number of groups, the size of each group, to max *Modularity*
- Modularity
 - The difference between actual incidence of in-community links minus its expected value across all communities
 - Reflect whether the linkage between two banks through interbank is strong or not

■ Centrality calculation

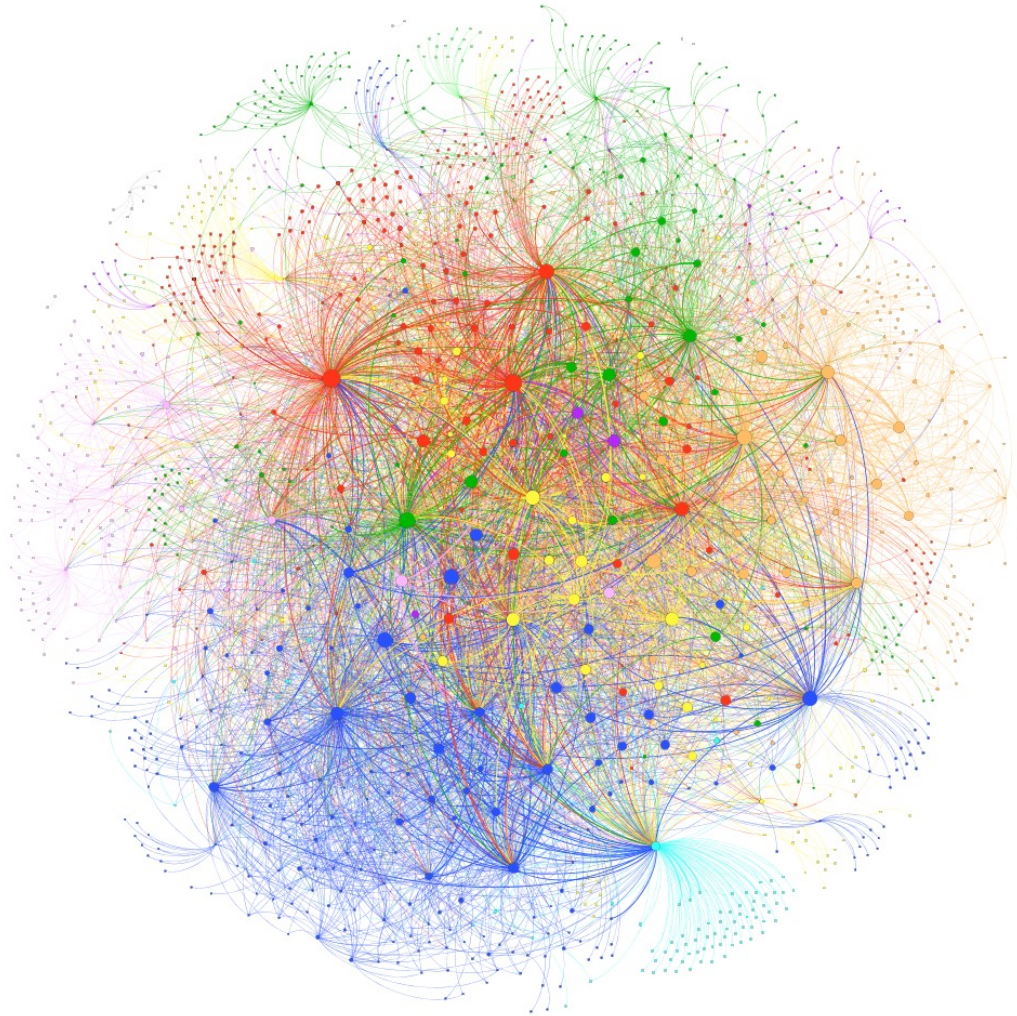
- Local centrality: (Weighted) in-degree, (Weighted) out-degree,
- Global centrality: Eigenvector, Page rank

Euro Area interbank network



- **Node size:** eigenvector centrality;
- **Edge colour:** the country receiving exposures
- **Node colour (Banks' home country)**
- Red: Germany; Blue: Non-EA Banks; Black: France; Green: Italy; Yellow: Spain; Orange: Netherlands; Pink: Austria.
- **Layout algorithm:** *Multigravity Force Atlas 2*

Euro Area interbank network



- **Node size:** eigenvector centrality;
- **Edge colour:** the country receiving exposures
- **Node colour:**
- Communities detected using *Modularity*
- **Layout algorithm:** *Multigravity Force Atlas 2*

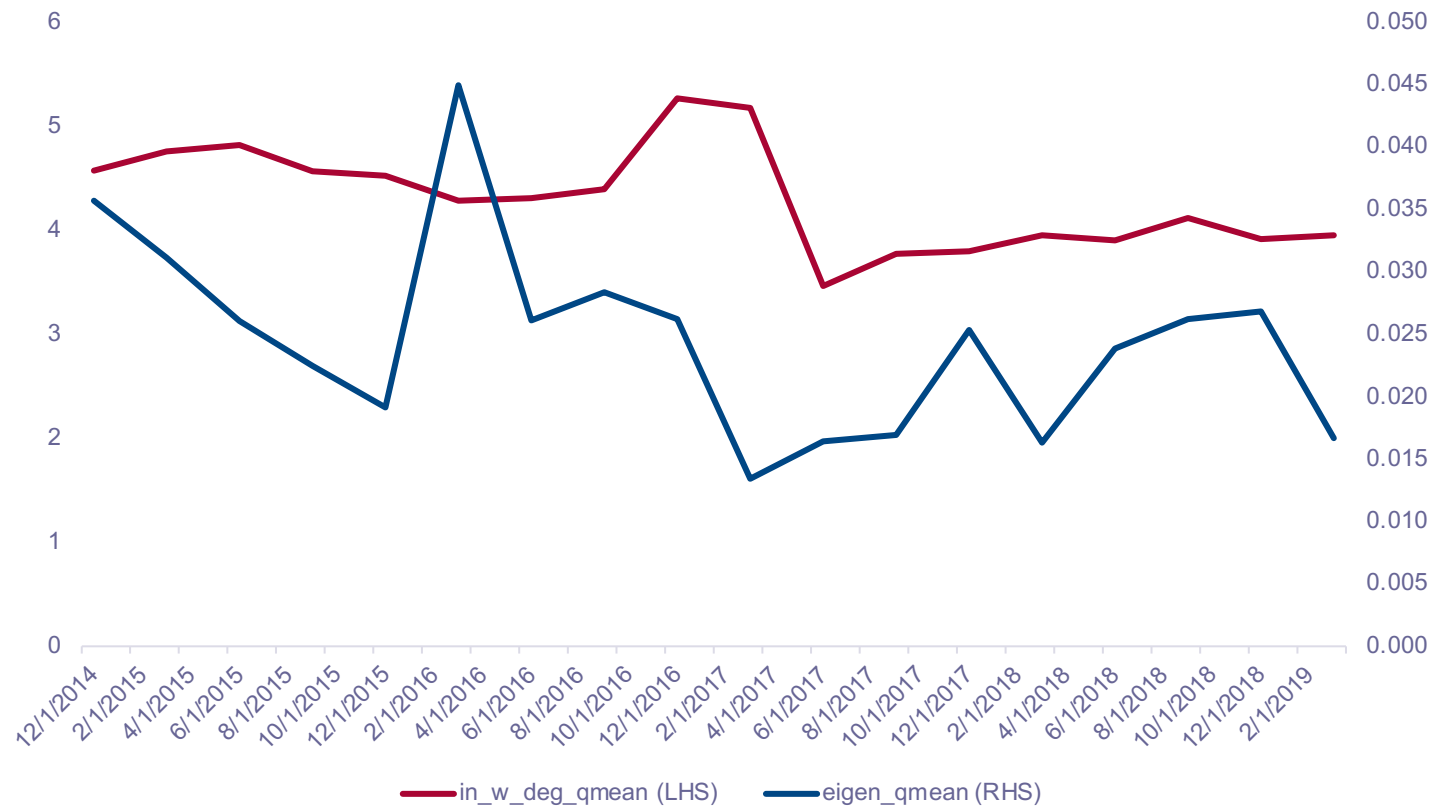
Distribution of country/community of interbank network

- A community is essentially a group of nodes that have strong connections to each other.
- To do community detection, we use *Modularity*, which reflects whether the linkage between two banks through interbank market is strong or not.

Country	Community													Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	
Austria	1	2	0	5	0	6	7	0	5	0	0	0	88	114
Belgium	0	0	3	0	3	0	1	0	10	0	0	0	0	17
Cyprus	0	0	1	0	0	2	1	0	0	1	0	0	0	5
Estonia	0	0	0	2	2	0	0	0	0	0	0	0	1	5
Finland	1	0	0	0	10	0	0	1	4	0	0	0	1	17
France	4	0	22	4	12	20	2	1	11	1	0	0	0	77
Germany	1	0	3	218	7	10	4	1	4	0	0	0	1	249
Greece	0	0	0	0	0	0	0	0	4	0	2	0	0	6
Ireland	1	0	4	0	1	2	1	7	7	0	0	0	1	24
Italy	1	0	1	1	0	3	85	2	0	0	0	10	0	103
Latvia	0	0	0	1	1	4	1	0	1	0	0	0	6	14
Lithuania	0	0	0	1	2	1	0	0	0	0	0	0	0	4
Luxembourg	3	0	3	2	11	6	3	2	6	0	0	0	1	37
Malta	0	0	0	0	0	1	0	0	3	0	0	0	0	4
Netherlands	2	0	1	1	8	8	6	6	20	0	0	0	0	52
NonEA	59	0	57	30	75	175	72	1	68	0	0	0	32	569
Portugal	11	0	1	0	1	0	0	0	0	0	0	0	0	13
Slovenia	0	0	0	1	0	0	4	0	0	0	0	0	0	5
Spain	38	0	1	0	0	1	2	1	3	0	0	0	1	47
Total	122	2	97	266	133	239	189	22	146	2	2	10	132	1,362

Average centrality over time: 2014-2019

- The quarterly mean value of weighted in-degree and eigenvector centrality of the network of total exposure, from 2014 to 2019.



Network measures by country

- **Degree centrality** (both in-degree and out-degree): captures the direct connections, and therefore, local importance;
- **Eigenvector/PageRank**: extend beyond the direct connections and show global influence.
- **Cluster coefficient**: captures how complete the neighborhood of a bank node is.
- **Average path length**: captures the degree of intermediation.

Country	<i>Eigenvector</i>	<i>Indegree</i>	<i>Outdegree</i>	<i>Weighted indegree</i>	<i>Weighted outdegree</i>	<i>Page rank</i>	<i>Cluster coefficient</i>	<i>Average path length</i>
France	0.139	26.869	56.364	34.095	25.165	0.0023	0.365	31.852
Belgium	0.040	11.061	20.602	3.739	14.477	0.0008	0.417	112.627
Ireland	0.037	2.351	9.090	2.146	4.425	0.0007	0.332	26.094
Germany	0.036	13.831	25.322	5.469	8.932	0.0014	0.480	38.554
Spain	0.024	9.907	14.884	2.950	6.374	0.0011	0.379	28.693
Netherlands	0.022	11.666	21.018	5.214	8.185	0.0008	0.322	26.939
Italy	0.014	7.452	13.764	1.963	4.880	0.0009	0.411	25.554
Finland	0.004	4.908	6.376	0.658	2.508	0.0007	0.295	418.157
Austria	0.003	4.775	9.479	1.192	1.864	0.0010	0.308	63.153
Portugal	0.002	2.511	6.669	0.277	0.814	0.0006	0.194	35.588
Greece	0.001	1.435	8.978	0.055	3.335	0.0005	0.388	341.234
Luxembourg	0.000	0.939	10.902	0.097	2.199	0.0005	0.258	131.741
Malta	0.000	0.719	6.475	0.054	0.417	0.0005	0.168	36.929
Estonia	0.000	0.290	2.301	0.028	0.366	0.0005	0.235	51.944
Slovenia	0.000	0.312	5.269	0.059	0.313	0.0005	0.455	28.046
Slovakia	0.000	0.306	3.375	0.007	0.083	0.0005	0.377	44.276
Lithuania	0.000	0.211	1.859	0.025	0.642	0.0005	0.223	64.298
Cyprus	0.000	0.155	5.549	0.006	0.664	0.0004	0.179	86.503
Latvia	0.000	0.234	4.133	0.005	0.323	0.0005	0.266	91.605

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Interbank market participation: network measures

- Interbank market participation measured by interbank network centrality
- Cluster=1*, if the cluster coefficient of a bank node is above median, or zero otherwise.

Dep. Var	<i>Log inwdeg</i>	<i>Log page rank</i>	<i>Log eigen</i>	<i>Log inwdeg</i>	<i>Log page rank</i>	<i>Log eigen</i>
	(1)	(2)	(3)	(4)	(5)	(6)
	Total exposures			Exposures within Euro area		
Crisis length	-0.0277* (0.0154)	-0.0000905*** (0.0000290)	-0.00563*** (0.00141)	-0.0289* (0.0157)	-0.000329*** (0.0000767)	-0.00564*** (0.00145)
Failure ratio	-2.914* (1.525)	-0.00375 (0.00259)	-0.339*** (0.118)	-1.576 (1.558)	-0.00843 (0.00659)	-0.268** (0.125)
Cluster	-0.652*** (0.0464)	-0.00120*** (0.0000964)	-0.0278*** (0.00307)	-0.708*** (0.0468)	-0.00180*** (0.000170)	-0.0227*** (0.00302)
LtD	-0.134*** (0.0465)	-0.000453*** (0.0000837)	-0.0209*** (0.00341)	-0.204*** (0.0447)	-0.00133*** (0.000171)	-0.0256*** (0.00362)
Securities	-0.775*** (0.243)	-0.00119*** (0.000448)	-0.0170 (0.0188)	-0.669*** (0.235)	-0.000452 (0.000899)	-0.00845 (0.0192)
ROA	10.04*** (2.768)	0.0141** (0.00565)	0.139 (0.158)	4.802* (2.819)	0.0136 (0.0103)	-0.0464 (0.166)
Equity	-2.077*** (0.755)	-0.00118 (0.00112)	-0.0362 (0.0385)	-0.170 (0.683)	0.00531*** (0.00203)	0.0417 (0.0402)
Size	0.501*** (0.0153)	0.000743*** (0.0000380)	0.0278*** (0.00179)	0.495*** (0.0163)	0.00172*** (0.0000925)	0.0288*** (0.00191)
Other controls	YES	YES	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES	YES	YES
# of obs.	1124	1124	1124	1092	1092	1092
Adj. R2	0.664	0.476	0.482	0.678	0.530	0.477

The role of core vs. periphery network positions

- The lack of trust in intermediary banks can spill over to affect their borrowers' access to interbank funding
- *Central*=1 if eigenvector centrality is in the upper quartile, or 0 if in the lower quartile.

Dep. Var	<i>Log inwdeg</i>			
	(1)	(2)	(3)	(4)
	Total exposures		Exposures within Euro area	
Crisis length	0.0381 (0.0246)	0.0335 (0.0241)	0.00574 (0.0241)	-0.00218 (0.0232)
Failure ratio	0.348 (1.985)	0.496 (1.923)	1.836 (1.934)	0.918 (1.884)
Central	1.505*** (0.236)	1.413*** (0.223)	1.440*** (0.223)	1.383*** (0.209)
Crisis length * Central	-0.120*** (0.0296)	-0.111*** (0.0285)	-0.0959*** (0.0285)	-0.0883*** (0.0268)
Failure ratio* Central	-5.995** (2.491)	-5.649** (2.389)	-6.538** (2.559)	-6.166** (2.444)
Cluster	-0.630*** (0.0663)	-0.614*** (0.0650)	-0.508*** (0.0682)	-0.489*** (0.0670)
Log avg length		-18.89*** (4.159)		-25.47*** (4.653)
Size	0.449*** (0.0238)	0.441*** (0.0233)	0.448*** (0.0238)	0.426*** (0.0234)
Other controls	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES
# of obs.	714	714	697	697
Adj. R2	0.725	0.735	0.735	0.746

The role of clustering

- $Cluster=1$, if the cluster coefficient of a bank node is above median, or zero otherwise.
- Being more exposed in a community tends to mitigate the negative effect of low trust
 - Being in a community might provide an additional source of funding due to community relationship

Dep. Var	<i>Log windeg</i>	<i>Log page rank</i>	<i>Log eigen</i>	<i>Log windeg</i>	<i>Log page rank</i>	<i>Log eigen</i>
	(1)	(2)	(3)	(4)	(5)	(6)
	Total exposures			Exposures within Euro area		
Crisis length	-0.0583*** (0.0190)	-0.000250*** (0.0000419)	-0.0112*** (0.00201)	-0.0592*** (0.0185)	-0.000574*** (0.000101)	-0.00928*** (0.00194)
Failure ratio	-6.355*** (1.696)	-0.0180*** (0.00328)	-0.727*** (0.148)	-4.947*** (1.809)	-0.0355*** (0.00839)	-0.610*** (0.160)
Cluster	-1.107*** (0.150)	-0.00339*** (0.000314)	-0.0993*** (0.0127)	-1.192*** (0.157)	-0.00571*** (0.000688)	-0.0786*** (0.0123)
Crisis length * Cluster	0.0509** (0.0202)	0.000273*** (0.0000398)	0.00987*** (0.00173)	0.0597*** (0.0205)	0.000485*** (0.0000900)	0.00743*** (0.00164)
Failure ratio * Cluster	9.178*** (1.742)	0.0367*** (0.00358)	0.945*** (0.138)	8.148*** (1.864)	0.0654*** (0.00789)	0.799*** (0.151)
Size	0.504*** (0.0152)	0.000754*** (0.0000373)	0.0281*** (0.00175)	0.501*** (0.0167)	0.00177*** (0.0000934)	0.0292*** (0.00194)
Other controls	YES	YES	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES	YES	YES
# of obs.	1124	1124	1124	1092	1092	1092
Adj. R2	0.670	0.506	0.503	0.682	0.554	0.489

Robustness: non-securities and short-term exposures

- Excluding exposures of securities contracts
- Excluding exposures of long-term contracts

Dep. Var	<i>Log windeg</i>	
	(1)	(2)
	Exposures excl. securities	Short-term exposures
Crisis length	0.000734 (0.0250)	-0.0141 (0.0114)
Failure ratio	3.759 (2.302)	1.214 (1.088)
Central	2.278*** (0.207)	0.741*** (0.0918)
Cluster	-1.236*** (0.214)	-0.542*** (0.106)
Crisis length * Central	-0.170*** (0.0279)	-0.0601*** (0.0115)
Failure ratio * Central	-17.17*** (2.420)	-6.817*** (1.062)
Crisis length * Cluster	0.102*** (0.0298)	0.0363*** (0.0135)
Failure ratio * Cluster	9.370*** (2.597)	5.385*** (1.225)
Log avg length	-0.0299 (0.0711)	-0.0544 (0.0742)
Other controls	YES	YES
Quarter FE	YES	YES
# of obs.	558	1008
Adj. R2	0.701	0.584

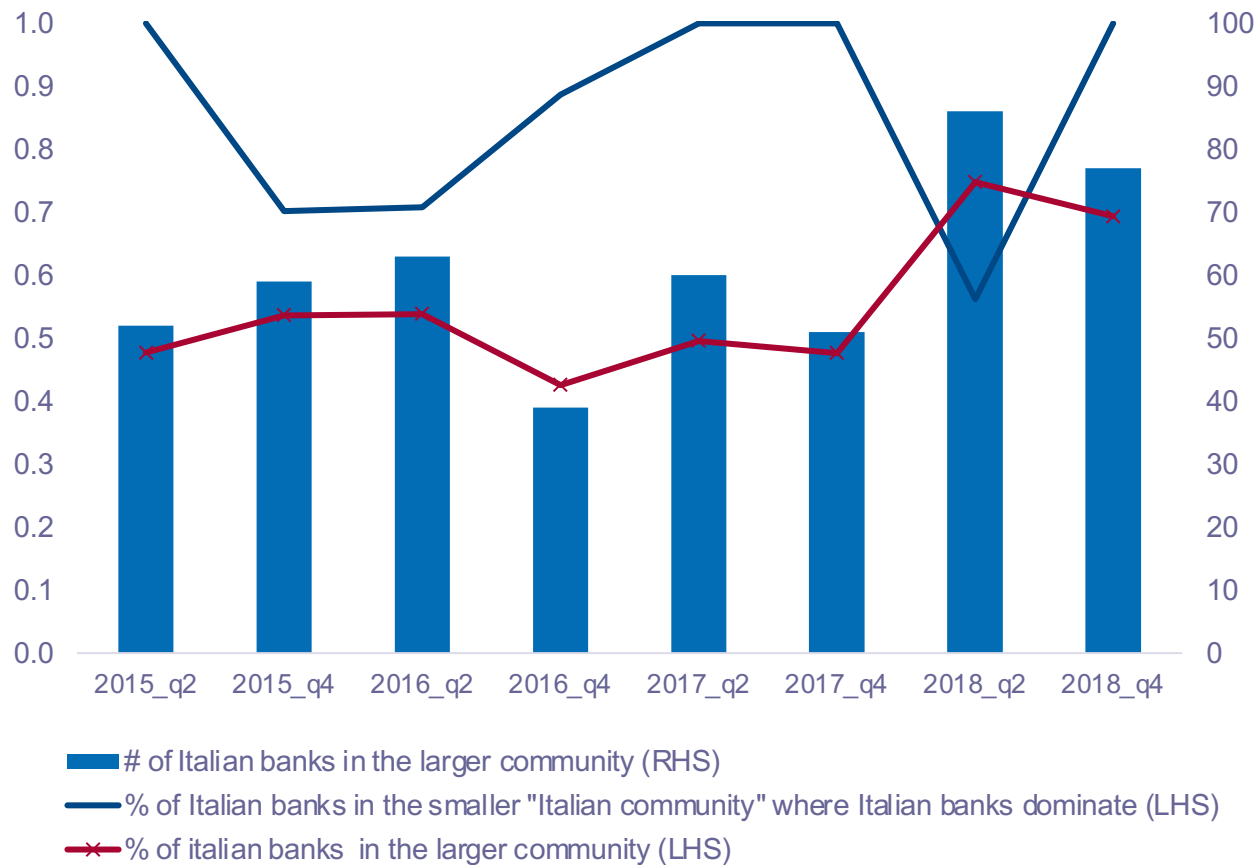
Shock: the insolvency of an Italian bank

- The insolvency of an Italian bank (*Veneto Banca*)
- *Shock VB* is defined as one for 8 quarters after June 2017, and zero for 8 quarters before June 2017. *Treated VB* is defined as one for either Italian banks or banks connected to *Veneto Banca*, i.e. either borrowing from or lending to *Veneto Banca* via interbank markets within the 2 years (8 quarters) before the shock in June 2017.

Dep. Var	<i>Log page rank</i>	<i>Log eigen</i>	<i>Log page rank</i>	<i>Log eigen</i>
	(1)	(2)	(3)	(4)
	Full sample		Matched sample	
Shock VB* Treated VB	-0.00106*** (0.000330)	-0.0333* (0.0196)	-0.000954*** (0.000361)	-0.0337* (0.0183)
Treated VB	0.00204*** (0.000278)	0.104*** (0.0141)	0.00183*** (0.000307)	0.0765*** (0.0133)
Cluster	-0.00104*** (0.0000770)	-0.0245*** (0.00244)	-0.00103*** (0.000155)	-0.0287*** (0.00734)
Cons.	-0.00668*** (0.000479)	-0.275*** (0.0173)	-0.00921*** (0.000843)	-0.459*** (0.0427)
Other bank controls	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES
# of obs.	1285	1285	343	343
Adj. R2	0.476	0.546	0.712	0.709

Communities of Italian banks in the EA interbank networks

- Since 2018, more Italian banks are switching to the larger community.



Conclusion

- **Trust** is crucial in determining the interbank market size.
 - Higher trust helps to obtain liquidity in the unsecured interbank market through mitigating info asymmetries
 - If a bank is located in a country with longer periods of banking crisis or more bank failures in the past, trust can be weaker and support less interbank activities.
- The effect of trust relies on the **structure of interbank markets**
 - **Core banks** acting as interbank intermediaries are more significantly influenced by trust
 - **Being more exposed in a community** can mitigate the negative effect of low trust
- **Institutional factors** such as legal enforcement/regulation quality matter, and can further mitigate the impact of banking crises or failures.
 - Law and institutions may play as a **substitute** for market discipline in the interbank market.

The Interbank Market Puzzle

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The views and opinions expressed in this paper are those of the authors and do not necessarily represent those of the European Central Bank and Bank of England.