EUROPEAN CENTRAL BANK

EUROSYSTEM

Bank Balance Sheet Constraints and Mutual Fund Fragility

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The views expressed are solely those of the authors.

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Board of Governors of the Federal Reserve System

The Federal Reserve, the central bank of the United States, provides the nation with a safe, flexible, and stable monetary and financial system.

Press release April 1, 2020:

"Federal Reserve announces temporary **change to its supplementary leverage ratio rule to ease strains in the Treasury market** resulting from the coronavirus and increase banking organizations' ability to provide credit to households and businesses."

https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200401a.htm

Does bank leverage ratio matter for mutual fund fragility?

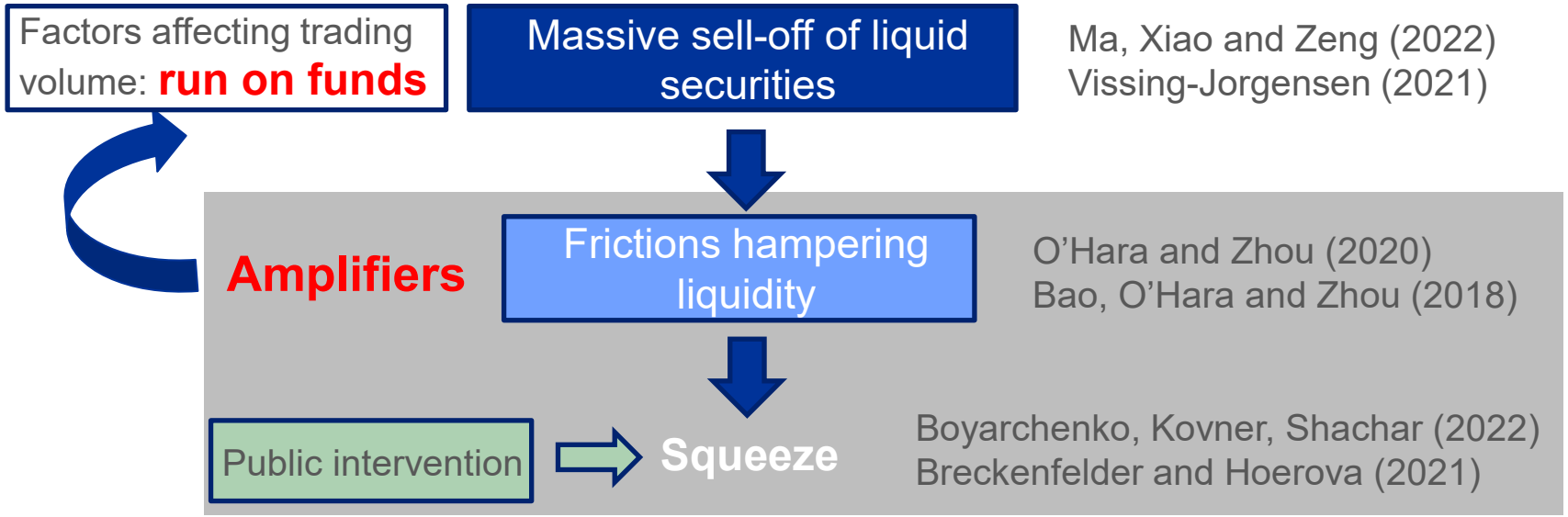
Connect **regulation of banks** to **fragility in non-banks**:

- channel: bond market (il)liquidity – banks are major dealers in bond markets and funds are major holders of bonds
- setting: March 2020 **large-scale run on funds** (e.g., Falato, Goldstein, Hortaçsu, 2021)
- methodology: micro-found matching bw dealers and individual corporate bonds based on a) **home advantage**; b) persistence of **past underwriting relationships**

Main findings: funds whose bond holdings were **more exposed to illiquidity due to dealers' constraints**…

- … **more affected by the run** (worse performance, larger outflows, severe selling pressure)
- … prioritized selling bonds that were *less* exposed to such constraints

March 2020 market turbulence



Our goal: tie amplifiers to bank **leverage ratio (LR)** & show that this fed into the run on funds

Contribution to the literature

Liquidity provision during the 2020 bond market distress

- closest paper: O'Hara and Zhou (2020) - transaction costs soared, dealers' inventories plummeted
- **this paper:** dealers constraints amplify fragility in non-banks

Impact of bank LR regulation

- closest paper: Adrian, Boyarchenko, Shachar (2017) - prior to GFC, bonds traded by more levered dealers were more liquid but this relationship reverses after the GFC
- other related papers: window-dressing (Du, Tepper, Verdelhan, 2018; Ranaldo, Schaffner, Vasios, 2021), market-making (Giannetti, Jotikasthira, Rapp, Waibel, 2024)
- **this paper:** LR of banks → bonds → mutual funds

Underwriter relationships

- closest paper: Dick-Nielson, Feldhutter, Lando (2012) - liquidity of bonds underwritten by Lehman & Bear Stearns
- **this paper**: micro-found dealer LR ↔ bond ties using a) LR constraints of *domestic* dealers; b) LR constraints of *past* bond underwriters (show that underwriting relations are sticky)

1

Data

Data: Combine bank, bond, and fund information

Focus on the euro area to exploit data advantages:

1. exploit euro area cross-country setting
2. LR introduced in 2013, unchanged until September 2020 (vs Fed: April 1, 2020)

Data sources:

1. Thomson Reuters Lipper database: detailed bond mutual fund-level data; security-level bond holdings
2. Bloomberg: identify underwriters
3. proprietary ECB Asset Purchase database: a) identify dealers and b) track secondary market trading by dealers
4. proprietary Supervisory statistics (SSM): confidential data on LRs of euro area banks to measure slack under the LR

2

Methodology: Bank-bond ties

Methodology: bank-bond ties

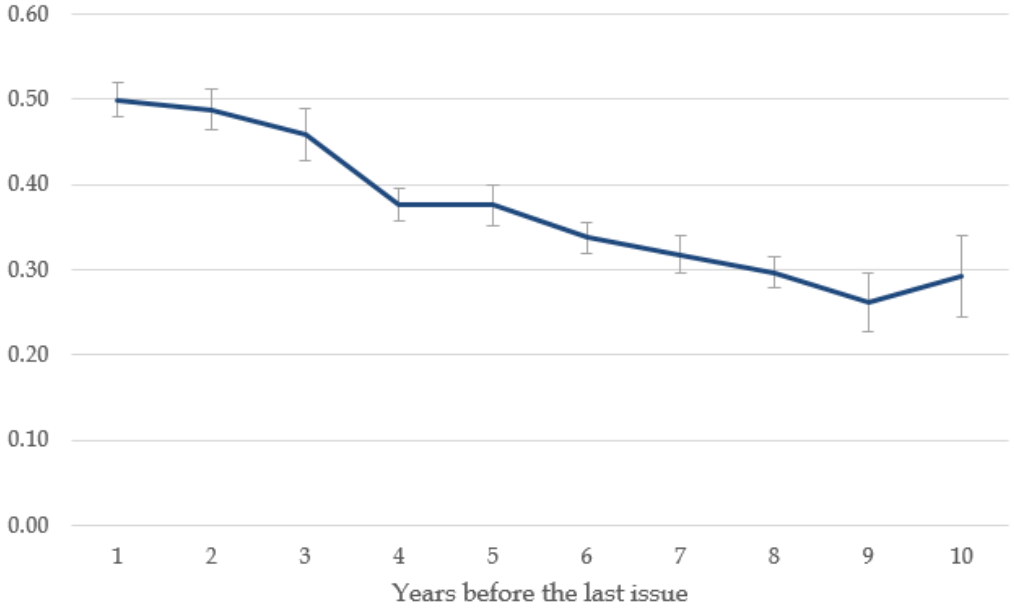
Challenge: how to identify the effect of bank LR on individual bond liquidity?

Our approach: Bond market is an OTC market → bank dealers play a key role → construct dealer-bond ties to identify a bond's exposure to dealer LR

1. Dealer-bond ties based on Home advantage
   - we document that local dealers are more likely to deal the bond
2. Dealer-bond ties based on Underwriting relationships
   - **Primary market**: we document that underwriters' relationships are "sticky" → can consider regulatory constraints of *past* underwriters
   - **Secondary market**: we document that *past* underwriters are more likely to *deal* the bond in the market

Individual dealer constraints matter for bond trading

Primary market: We show that underwriter relationships are *sticky* → can use *past* relations (we use past dominant underwriter over a window of years)



Related work: stickiness of underwriters appears to be grounded in the dealers' certification role for purposes of placement (Dick-Nielsen, Nielsen, Ruden, 2021; Gande, Puri, Saunders, Walter, 2015; Drucker and Puri, 2005)

Individual dealer constraints matter for bond trading

Secondary market: We show that underwriters are more likely to act as dealers of a specific bond, even several years post issuance

Dependent variable	Share of transaction volume		
	(1)	(2)	(3)
Dealer bank is underwriter	0.248***	0.252***	-0.093
	(0.076)	(0.075)	(0.120)
Underwriter * 1 year from issuance	--	--	0.557***
			(0.203)
Underwriter * 1-3 years from issuance	--	--	0.234*
			(0.119)
Log(amount outstanding)	-0.088**	-0.090**	-0.091**
	(0.043)	(0.043)	(0.044)
Fixed effect: Dealer/Years from issuance	Yes/--	Yes/Yes	Yes/Yes
Obs.	4,137	4,137	4,137
R-squared	0.0379	0.0387	0.0428

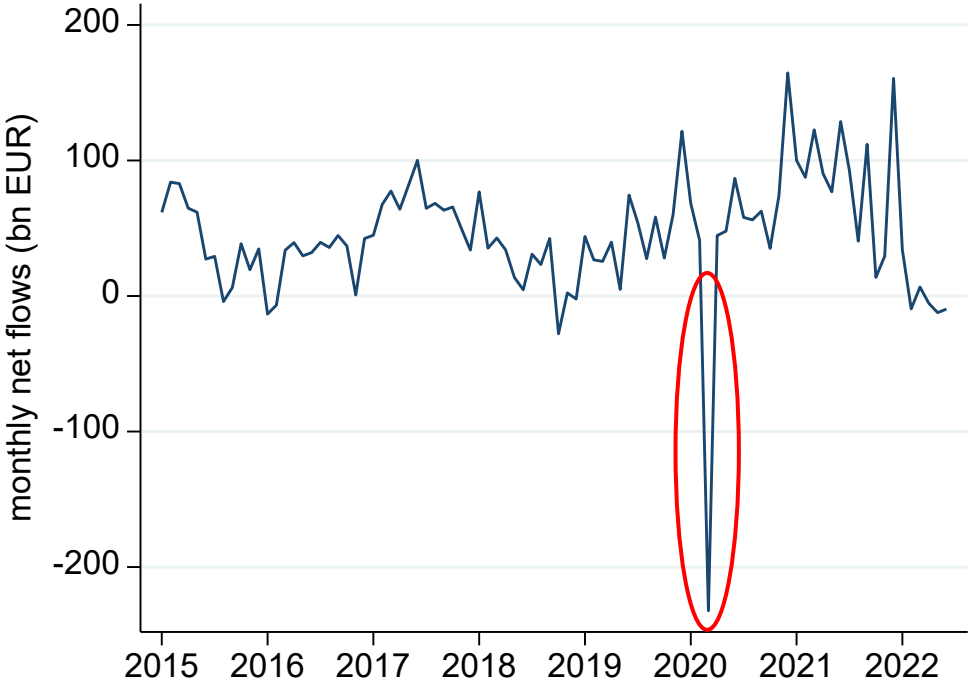
Related work: impact of an individual dealer's financial distress during the GFC (Bear Stearns, Lehman) on bond liquidity (Dick-Nielsen, Feldhutter, Lando, 2012)

→ We can rely on past underwriting relationships as a source of quasi-exogenous assignment

3

Bank LR constraints → Fund fragility

Mutual fund fragility: March 2020 large-scale run



Unprecedented redemptions in EA, largely from **bond funds** (€150 bn)

Large outflows also in US bond mutual funds (Falato, Goldstein, Hortaçsu, 2021)

Central bank interventions (direct and indirect) stopped the run (Breckenfelder and Hoerova, 2021)

Note: Net issues in the EA mutual fund sector (EUR bn).
Monthly data, 2015-2022.
Source: Investment Funds Balance Sheet Statistics.

Bank LR constraints → bonds → mutual fund fragility

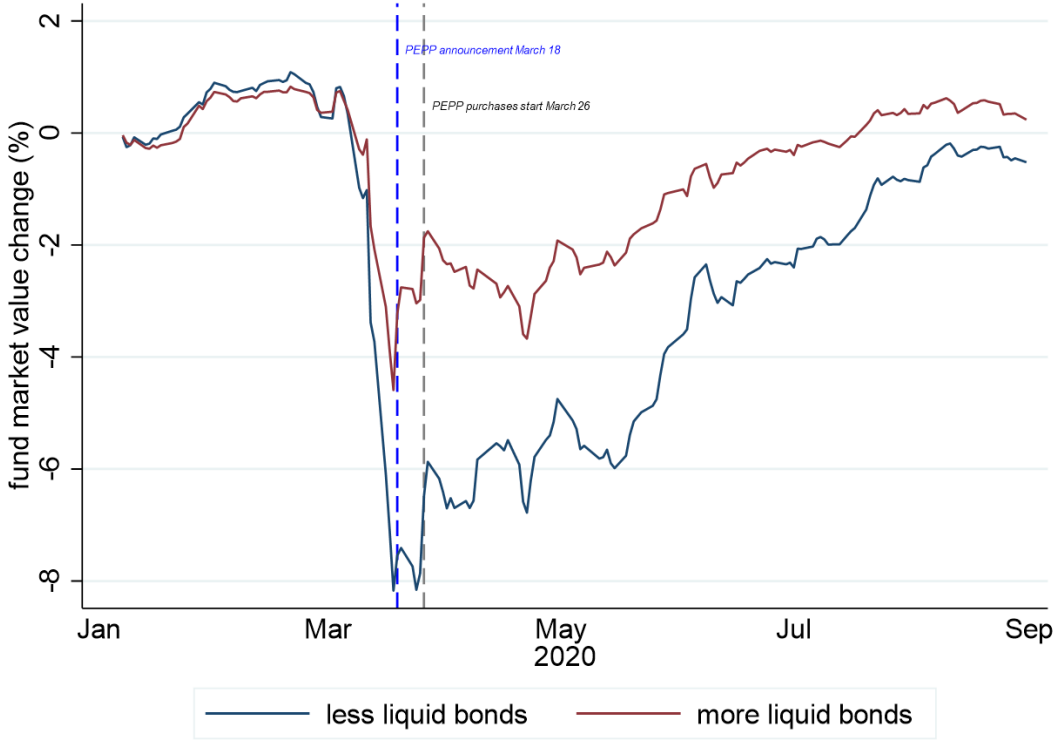
Approach: take bank-bond ties and a fund bond portfolio → construct exposure to bank LR constraints on a fund level

- use fund portfolio weights as of January 2020, before the COVID shock
- funds with above-median exposure defined as **illiquidity-exposed**

Hypothesis: Funds that were relatively more exposed to dealers with lower LR (= lower market making-capacity) faced higher sell-off pressures

- in line with other studies, we measure sell-off pressure by comparing funds' exits from their most liquid positions

Illiquidity-exposed Funds had worse performance



Illiquidity-exposed Funds faced higher outflows

Regression results: Domestic dealers' constraints

$$\Delta\, Liquid\ bonds_{k,t} = \alpha_1 Illiquidity\ exposure_k * COVID\ Shock_t + \delta_k + \epsilon_{k,t}$$

Sample (funds)	Exposed	Less exposed	All
	(1)	(2)	(3)
Illiquidity exposure * COVID Shock	--	--	-0.051**
			(0.025)
COVID Shock (March 2020)	-0.061***	-0.006	-0.007
	(0.016)	(0.020)	(0.020)
Fund cash position	0.001	-0.009**	-0.005*
	(0.005)	(0.004)	(0.003)
Fixed effect: Fund	Yes	Yes	Yes
Obs.	2,109	1,377	3,486
R-squared	0.6227	0.5798	0.6084

Interpretation: Liquid bonds holdings decline by 5.1% more for illiquidity-exposed funds

Illiquidity is measured at the fund level in Dec 2019

Regression results: Underwriting relationships

$$\Delta\, Liquid\ bonds_{k,t} = \alpha_1 Illiquidity\ exposure_k * COVID\ Shock_t + \delta_k + \epsilon_{k,t}$$

Sample (funds)	Exposed	Less exposed	All
	(1)	(2)	(3)
Illiquidity exposure * COVID Shock	--	--	-0.050**
			(0.022)
COVID Shock (March 2020)	-0.044**	0.001	0.003
	(0.022)	(0.021)	(0.020)
Fund cash position	0.012	-7.665	-4.952
	(0.403)	(7.935)	(4.448)
Fixed effect: Fund/Bond/Rating	Yes/Yes/-	Yes/Yes/-	Yes/Yes/-
Obs.	598	248	858
R-squared	0.3738	0.4047	0.3315

Interpretation: Liquid bonds holdings decline by 5.0% more for illiquidity-exposed funds

Illiquidity is measured at the fund level in Dec 2019

4 Additional results

Impact of LR introduction in the EA on bond liquidity

Diff-in-diff analysis around December 31, 2013 (+/- 2 years), the cutoff date for the ECB's Comprehensive Assessment of bank health:

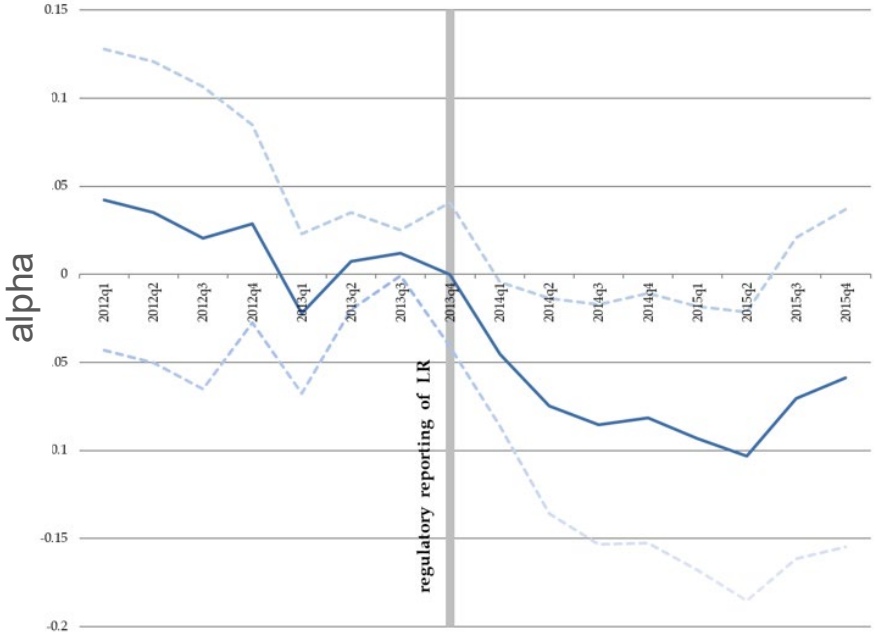
- based on info provided in this exercise, several banks were asked to come out with a plan to ramp up their capitalization program
- data publicly disclosed in 2014, after remedy measures were in place

Note: test sample does not overlap with the ECB Corporate Bond Purchase Program

Main result: **Dealer bank constraints affected bond liquidity negatively following the introduction of the LR in the euro area**

Impact of LR introduction graphically

$$Bid\text{-}ask\ spread_{i,t} = \sum_{t=2012:Q1}^{2015:Q4} \alpha_{1,t}\, BankConstraint_I * Quarter_t + Controls + \epsilon_{i,t}.$$



Interpretation: Bonds tied to better-capitalized (higher LR) banks have lower bid-ask spreads following the introduction of the LR

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Summary

Does bank leverage ratio matter for mutual fund fragility?

YES! Leverage Ratio of dealer banks $\xrightarrow{1.}$ individual bonds $\xrightarrow{2.}$ mutual fund fragility

1. Micro-found connections bw dealer banks and individual corporate bonds

2. Show that funds whose bond holdings were **more exposed to illiquidity** due to dealers' constraints…

- … **more affected by the run**: worse performance, larger outflows, more severe selling pressure
- … prioritized selling bonds that were less exposed to such constraints

THANK YOU!

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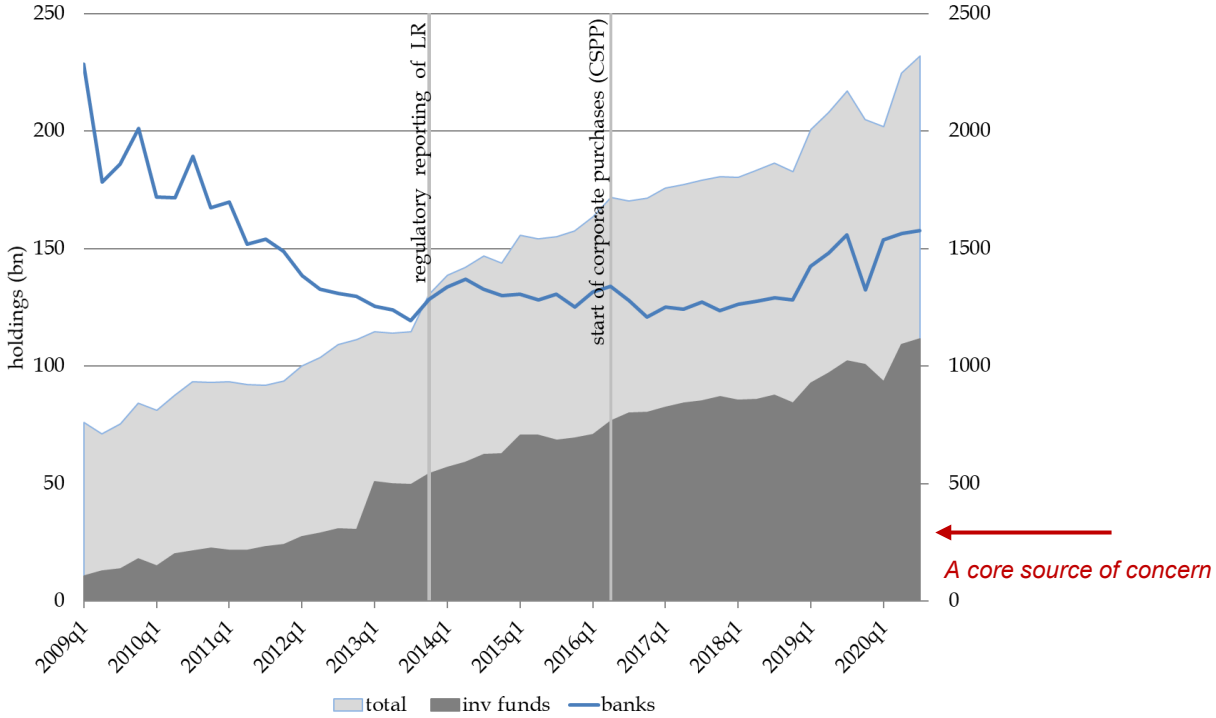
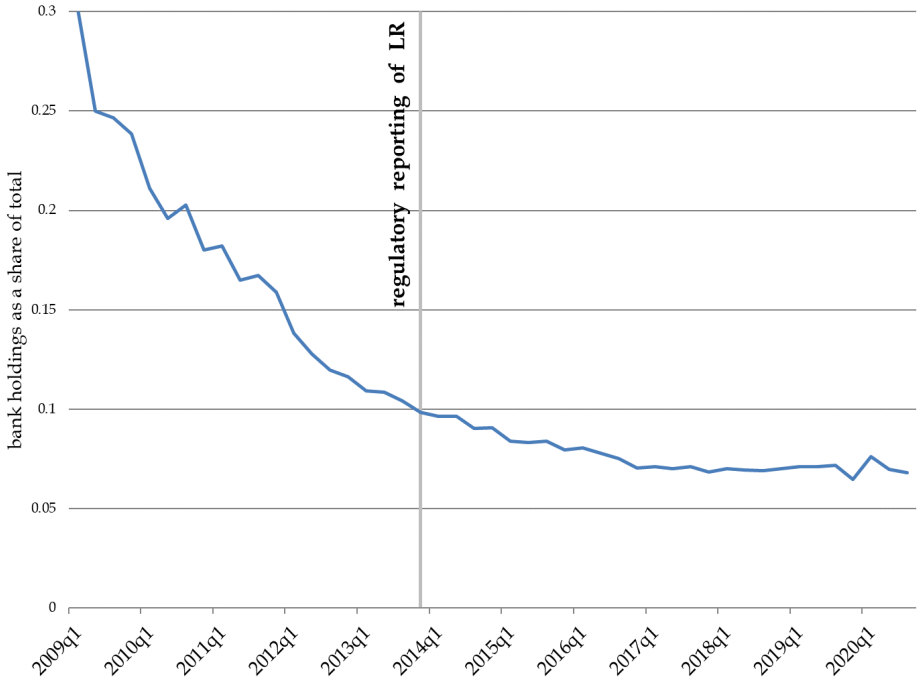
BACKGROUND SLIDES

Bond Market Size and Bank Holdings



Bank Holdings as a Share of Total



Focus: Leverage Ratio

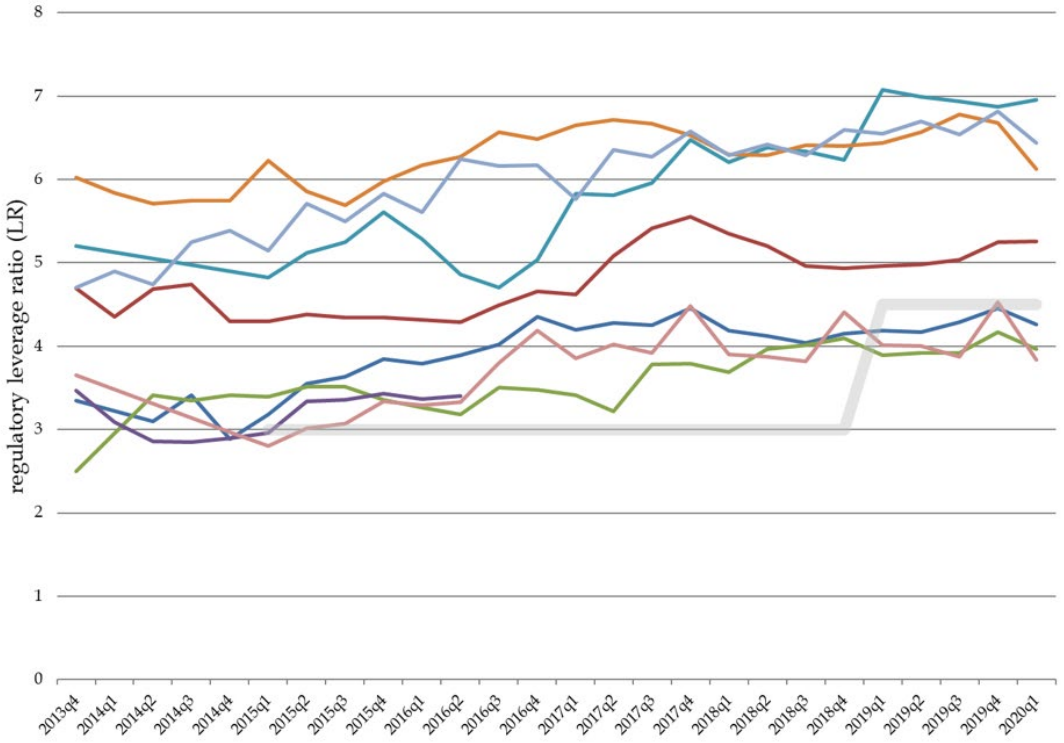
Practitioners and policy-makers have specifically cited the Basel III leverage ratio and the Volcker Rule in the U.S., as key drivers of reduced market liquidity

- The latter is not relevant for Eurozone banks (our setting)

The essence of the problem: tax on the side of the balance sheet

Because of its non-risk weighted nature the LR—which requires banks to maintain a minimum equity capital as a fraction of its assets—makes it less profitable for banks to engage in low margin activities

1. Substantial heterogeneity in LR levels across dealer banks



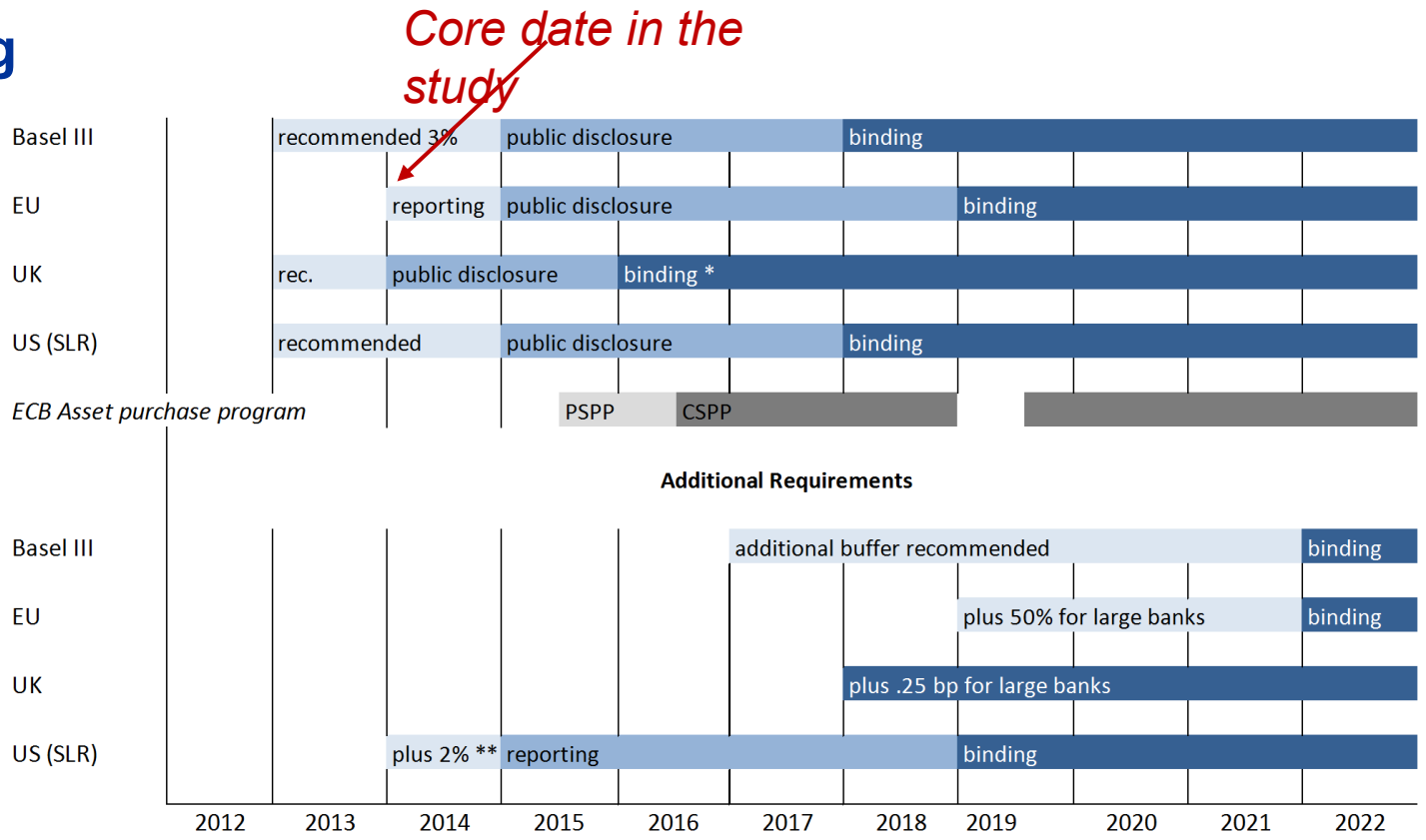
Identifying Dealer Banks

Two approaches:

Definition #1 categorizes dealer banks as banks that engage as dealers with the Eurosystem in the corporate bond market for the Corporate Sector Purchase Program (CSPP)

Definition #2 categorizes dealer banks as banks that engage as dealers with the Eurosystem in the sovereign bond market for the Public Sector Purchase Program (PSPP)

Timing


Core date in the study
Basel III
recommended 3%
public disclosure
binding
EU
reporting
public disclosure
binding
UK
rec.
public disclosure
binding *
US (SLR)
recommended
public disclosure
binding
ECB Asset purchase program
PSPP
CSPP
Additional Requirements
Basel III
additional buffer recommended
binding
EU
plus 50% for large banks
binding
UK
plus .25 bp for large banks
US (SLR)
plus 2% **
reporting
binding
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

Methodology: persistent dealer-bond connections

- Let's say that there is no fundamental information in (secondary market) dealership; it is all about information extraction from order flow
- Keep in mind that this is a quote-driven, over-the-counter (OTC) market, i.e., it is a non-centralized and non-standardized market

"Despite the launch of several corporate bond trading platforms since spring 2012, the market is unlikely to ever resemble cash equities or even foreign exchange."

McKinsey&Company and Greenwich Associates, 2013

Does Individual Dealer Constraint Matter?

I.e., Is There Dealer-Bond "Stickiness"

- How the bond dealer is chosen in the secondary trade:
  - You enter Bloomberg and type issuer, maturity, coupon; you learn that BofA, Citi and JPM are quoting stuff to sell (not binding, other than through repeated interactions). JPM is flagged us the underwriter. Who to call?
    - Quoted price matters
    - But out of BofA, Citi and JPM, JPM is the one that knows "where the bodies are buried"

→ Most frequently, you will end up calling JPM

- Note that the example above didn't even require network connections between the dealer and institutional investors
- However, institutional investors' connections are real (e.g., Benveniste and Spindt, 1989) which likely makes dealer-bond connections even stronger

1. Introduction of the leverage ratio in the euro area

Diff-in-diff analysis around December 31, 2013 (+/- 2 years), the cutoff date for the ECB's Comprehensive Assessment

- based on info provided in this exercise several banks were asked to come out with a plan to ramp up their capitalization program
- data publicly disclosed in 2014 (after remedy measures were in place); faced substantial scrutiny

Notes:

- euro area banks still under substantial stress following the sovereign debt crisis
- test sample does **not** overlap with the ECB corporate purchasing programs
- ultimately, we cannot separate LR vs. other regulatory reforms

Methodology: dealer-bond connections

Challenge: how to identify the effect of bank regulatory leverage constraint on individual bond liquidity?

Our approach (novel): exploit **dealer-bond connections**

Bond market: quote-driven, over-the-counter market

How is the bond dealer chosen in the **primary market**?

- You want to buy a new bond, JPM is the lead underwriter
  - JP Morgan has whole bunch of it → call JP Morgan

Methodology

Challenge: how to identify the effect of bank regulatory leverage constraint on individual bond liquidity?

Our approach: dealer-bond connections

Bond market: quote-driven, over-the-counter market, dealers play a key role

How is the bond dealer chosen in the **secondary trade** (same bond)?

- You enter Bloomberg and type issuer, maturity, coupon; you learn that BofA, Citi and JP Morgan are posting sell quotes. JP Morgan is flagged as the underwriter. Whom to call?
  - quoted price matters but out of BofA, Citi and JP Morgan, JP Morgan is the one that knows "where the bodies are buried" → most frequently, you will call JP Morgan
  - there may be additional sources of dealer-bond connections, e.g., due to relations bw dealers and investors

Methodology: dealer-bond connections

Bond market: quote-driven, over-the-counter market

How is the bond dealer chosen in the **secondary trade** (same bond)?

- You enter Bloomberg and type issuer, maturity, coupon; you learn that BofA, Citi and JP Morgan are posting sell quotes. JP Morgan is flagged as the underwriter. Whom to call?
  - quoted price matters but out of BofA, Citi and JP Morgan, JP Morgan is the one that knows "where the bodies are buried" → most frequently, you will call JP Morgan
  - there may be additional sources of dealer-bond connections, e.g., due to relations bw dealers and investors

Does Individual Dealer Constraint Matter?

Empirical fact #2: “Home country bias” (euro area—i.e., multi-country setting—comes in handy)

	Home		Foreign (largest)				
Date	Mean	SD	Mean	SD	Diff		Obs.
2009q1	0.612	0.009	0.043	0.003	0.569	***	2,436
2009q2	0.573	0.010	0.044	0.003	0.530	***	2,176
2009q3	0.650	0.009	0.034	0.002	0.616	***	2,498
2009q4	0.642	0.009	0.033	0.002	0.609	***	2,587
2010q1	0.639	0.009	0.031	0.002	0.608	***	2,664
2010q2	0.653	0.008	0.032	0.002	0.621	***	2,852
2010q3	0.647	0.008	0.032	0.002	0.615	***	3,070
2010q4	0.646	0.008	0.029	0.002	0.617	***	3,275
2011q1	0.648	0.008	0.031	0.002	0.617	***	3,237
2011q2	0.616	0.008	0.031	0.002	0.586	***	3,071
2011q3	0.591	0.008	0.034	0.002	0.557	***	2,864
2011q4	0.589	0.009	0.030	0.002	0.559	***	2,810
2012q1	0.586	0.008	0.028	0.002	0.558	***	2,909
2012q2	0.573	0.008	0.028	0.002	0.545	***	2,937

Rationale: connections to institutional investors’ networks are likely to carry a heavy domestic bias

1. Introduction of the leverage ratio in the euro area

Diff-in-diff analysis around December 31, 2013 (+/- 2 years), the cutoff date for the ECB's Comprehensive Assessment

- based on info provided in this exercise several banks were asked to come out with a plan to ramp up their capitalization program
- data publicly disclosed in 2014 (after remedy measures were in place); faced substantial scrutiny

Note:

- test sample does **not** overlap with the ECB corporate bond purchasing programs

1. Results: Past underwriters' constraints

Dependent variable	Bid-ask spread				
	(1)	(2)	(3)	(4)	(5)
Bank constraint × Post	-0.050	-0.032**	-0.031**	-0.032**	-0.040**
	(0.035)	(0.014)	(0.014)	(0.014)	(0.017)
Post	0.198	0.033	--	--	--
	(0.199)	(0.075)			
Bank constraint	-0.005	--	--	--	--
	(0.019)				
Residual bond maturity	--	--	--	0.010	-0.039
				(0.030)	(0.071)
Δ Log(Local GDP)	--	--	--	--	0.387
					(0.503)
Δ Log(Local equity index)	--	--	--	--	-0.761*
					(0.423)
Δ Log(Local bank index)	--	--	--	--	0.361*
					(0.212)
Δ Log(Local volatility index)	--	--	--	--	1.724
					(1.538)
Δ Log(Local government spread, 10Y)	--	--	--	--	-0.005
					(0.103)
Δ Log(Local government spread, 5Y)	--	--	--	--	0.415*
					(0.215)
Δ Log(Local government spread, 3Y)					-0.300
					(0.184)
Δ Log(Local government spread, 1Y)					-0.128*
					(0.075)
Fixed effects: Bond	--	Yes	Yes	Yes	Yes
Fixed effects: Day	--	--	Yes	Yes	Yes
Obs.	141,417	141,417	141,417	138,037	138,037
R-squared	0.0058	0.8375	0.8423	0.8434	0.8460

$$Bid\text{-}ask\ spread_{i,t} = \alpha_1 Bank\ constraint_i * Post_t + \delta_i + X_{i,t} + \epsilon_{i,t}$$

If the bond dealer with underwriting ties is 1 percentage points closer to the regulatory requirement, the bid-ask spread of the bond increases by 4 b.p. (6.8% of the mean)

Alternatively, a one standard deviation change in the underwriter constraint alters the bid-ask spread by about 7.2 b.p. (12.4% of the mean)

Results based on domestic dealers' constraints in the paper

Regression results

Dependent variable	Bid-ask spread				
	(1)	(2)	(3)	(4)	(5)
Bank constraint x Post	-0.099***	-0.062***	-0.055**	-0.055**	-0.080***
	(0.032)	(0.022)	(0.022)	(0.022)	(0.019)
Post	0.034	-0.073***	--	--	--
	(0.032)	(0.018)			
Bank constraint	0.041	--	--	--	--
	(0.035)				
Residual bond maturity	--	--	--	0.012	-0.004
				(0.021)	(0.023)
Δ Log(Local GDP)	--	--	--	--	0.201
					(0.159)
Δ Log(Local equity index)	--	--	--	--	0.586***
					(0.203)
Δ Log(Local bank index)	--	--	--	--	-0.119*
					(0.064)
Δ Log(Local volatility index)	--	--	--	--	1.472***
					(0.419)
Δ Log(Local government spread, 10Y)	--	--	--	--	-0.201***
					(0.043)
Δ Log(Local government spread, 5Y)	--	--	--	--	0.264***
					(0.085)
Δ Log(Local government spread, 3Y)	--	--	--	--	-0.065
					(0.043)
Δ Log(Local government spread, 1Y)	--	--	--	--	-0.138***
					(0.041)
Fixed effects: Bond	--	Yes	Yes	Yes	Yes
Fixed effects: Day	--	--	Yes	Yes	Yes
Obs.	1,368,161	1,368,161	1,368,161	1,368,161	1,033,192
R-squared	0.0017	0.8003	0.8050	0.8050	0.7486

Aggregate constraint is weighted by total assets (robust to several alternative aggregations – next slide)

Interpretation: -0.08 indicates that for countries where banks are 1 pp closer to the regulatory requirement (about once SD) the bid-ask spread is 8 bps higher (vs. mean of 0.59% , and median of 0.37%)

Regression results

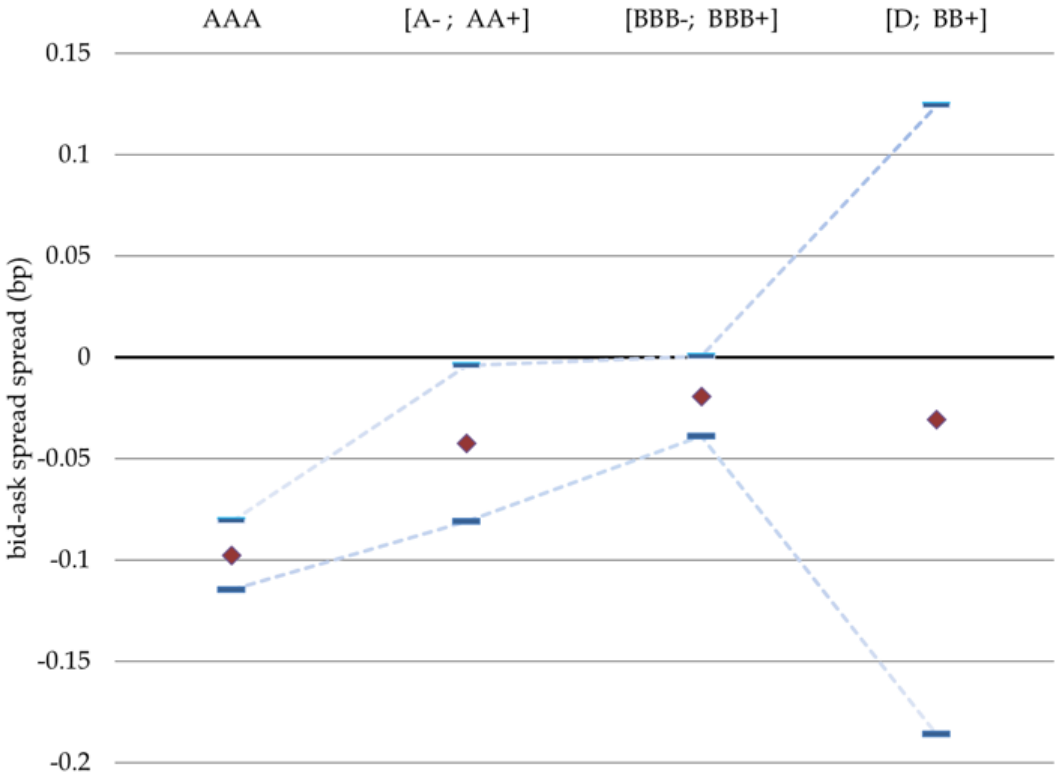
Dependent variable	Bid-ask spread			
	(1)	(2)	(3)	(4)
Bank constraint x Post	-0.016	-0.003	-0.002	-0.010
	(0.013)	(0.007)	(0.007)	(0.008)
Post	-0.010	-0.116***	--	--
	(0.026)	(0.016)		
Bank constraint	0.059***	--	--	--
	(0.013)			
Residual bond maturity	--	--	--	-0.005
				(0.023)
Δ Log(Local GDP)	--	--	--	0.289*
				(0.155)
Δ Log(Local equity index)	--	--	--	0.755***
				(0.218)
Δ Log(Local bank index)	--	--	--	-0.146**
				(0.066)
Δ Log(Local volatility index)	--	--	--	1.618***
				(0.435)
Δ Log(Local government spread, 10Y)	--	--	--	-0.177***
				(0.044)
Δ Log(Local government spread, 5Y)	--	--	--	0.259***
				(0.086)
Δ Log(Local government spread, 3Y)	--	--	--	-0.071
				(0.044)
Δ Log(Local government spread, 1Y)	--	--	--	-0.124***
				(0.041)
Fixed effects: Bond	--	Yes	Yes	Yes
Fixed effects: Day	--	--	Yes	Yes
Obs.	1,368,161	1,368,161	1,368,161	1,033,192
R-squared	0.0057	0.8000	0.8048	0.7480

"Placebo": non-dealer home banks

Leverage Ratio of Dealer Banks (aggregated at the country level)

			Dealer banks		Non-dealer banks ("placebo")	
		Obs.	Mean	SD	Mean	SD
Dealer banks: Banks acting as dealers in the corporate bond purchase program						
(i)	Weighted by assets	9	1.08	0.81	1.99	1.71
(ii)	Weighted by trading volume	9	1.14	0.95	1.99	1.71
(iii)	Top-1 dealer	9	1.07	1.14	1.99	1.71
(iv)	Top-2 dealers	9	1.12	0.99	1.99	1.71
Dealer banks: Banks acting as dealers in the sovereign bond purchase program						
(i)	Weighted by assets	15	1.96	1.55	3.53	3.70
(ii)	Weighted by trading volume	15	1.93	1.48	3.53	3.70
(iii)	Top-1 dealer	15	1.76	1.59	3.53	3.70
(iv)	Top-2 dealers	15	1.86	1.51	3.53	3.70

Regression results



Regression results

Dependent variable	Bid-ask spread		
Sample	NIG bonds	IG bonds	All
	(1)	(2)	(3)
Bank constraint * IG bond * Post	--	--	-0.095**
			(0.043)
Bank constraint * Post	-0.027	-0.060***	0.046
	(0.055)	(0.018)	(0.048)
Bank constraint * IG bond	--	--	0.039
			(0.109)
IG bond* Post	--	--	0.357**
			(0.169)
IG bond	--	--	-0.367
			(0.448)
Macro controls (Table 3, column (5))	Yes	Yes	Yes
Fixed effect: Bond/Day	Yes/Yes	Yes/Yes	Yes/Yes
Obs.	46,901	394,608	441,509
R-squared	0.8812	0.7823	0.7923