Intermediary Balance Sheet Constraints, Bond Mutual Funds' Strategies, and Bond Returns

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Background: Leverage Ratio Constraints and Asset Markets

As of 2015, international (non-US) banks and US GSIB are subject to the leverage ratio (LR) constraint, which mandates to maintain a minimum amount of **capital** against all on- and off-balance sheet exposures, **irrespective of their risk**.

Duffie (2018): *The regulation known as the Leverage Ratio has caused a distortionary reduction in the incentives for banks to intermediate markets for safe assets, especially the government securities repo market, without financial stability benefits.*

- These regulations are thought to have caused volatility in fixed income markets
- LR requirements **decrease bank-affiliated dealers' willingness** to accumulate inventories and provide liquidity in investment-grade bonds at quarter-ends (Rapp and Waibel, 2022).

What impact did the leverage ratio have on the strategies of unregulated (nonbank) intermediaries?

This Paper: Shedding Light on the Role of Unregulated Bond Market Participants

- We focus on the effects of the **leverage ratio** (LR) requirement on the strategies and performance of **bond mutual funds**.
  - Ex-ante, the sign of these effects is unclear and may depend on whether the fund pursues a liquidity-demanding or liquidity-supplying strategy.

- Are bond funds engaging in more liquidity provision since the introduction of the regulations?If so, which funds?
- How have the regulatory changes affected mutual funds' performance?
- Is this introducing new elements of fragility in the corporate bond market?
  A preliminary answer is yes!

Hypotheses and Identification

The design of the leverage ratio requirements helps to identify the effects of the regulation and distinguish it from other regulations introduced in the aftermath of the global financial crisis

- Do liquidity-supplying mutual (LS) funds provide more liquidity in investment-grade bonds (rather than high-yield bonds) at quarter ends (rather than in other months) after the introduction of the LR regulation?
- Differences used for identification:
  1. Variation across time (before and **after** the implementation of Basel III in 2015)
  2. Variation within the quarter (**quarter-ends** vs other months of the quarter)
     - Must be satisfied and reported at quarter-end by international banks.
     - US banks were subject to non-risk-weighted capital requirements already before 2015, but the requirements became more stringent for systemically important financial institutions.
  3. Variation across bond types (**IG** vs HY bonds).
  4. Variation across mutual funds (**LS** vs Non-LS funds).
     - Risk-weighted capital requirements were already in place for all banks
  5. Variation across bonds handled by less vs. **more by regulated dealers**.
     - Ideally, arising from exogenous demand shocks to noise traders.
     - Propensity scores to address dealers' exogenous selection.

Preview of the Results (1/2)

- **Fund level:** Following the introduction of the LR requirement in 2015 ...
  - At quarter-ends, mutual funds with liquidity-supplying strategies ("LS funds") provide more liquidity in investment-grade bonds that are more affected by the leverage ratio requirement ("constrained bonds").
  - Investment-grade focused mutual funds with liquidity-supplying strategies outperform other investment-grade focused mutual funds. The outperformance comes from the first month of each quarter.
  - Mutual funds supply less liquidity in corporate bonds following periods of outflows and poor performance, both at the individual and aggregate levels.

Preview of the Results (2/2)

- **Bond level:**
  - As a consequence, the liquidity and returns of investment-grade bonds have become more exposed to large outflows from the bond mutual fund industry.
  - Constrained bonds experienced a larger increase in illiquidity and a larger drop in price in March 2020.
    - The withdrawal of mutual funds from liquidity provision, when banks are also constrained, can help explain, at least in part, the large dislocations in the prices of investment-grade bonds at the onset of COVID-19 pandemic (Haddad, Moreira, Muir, 2021).

Data

- Mutual fund holdings from Morningstar.
- Mutual fund characteristics, including flows and returns, from Morningstar Direct and the CRSP Mutual Funds database.
- Bond characteristics from Mergent's Fixed Income Securities Database (FISD).
- Bond transactions from the regulatory version of FINRA's Trade Reporting and Compliance Engine (TRACE) database.
  - **Dealer identities** allow us to separate nonbank and bank-affiliated dealers.
  - We flag US bank-affiliated dealers that are subject to the supplementary leverage ratio as well as European and Japanese dealers as those most affected by the leverage ratio framework.
- Our sample period is from 1/2010 to 12/2019. Only funds with at least 20% in corporate bonds are included.

Main Proxies (1/2): Funds' Liquidity Provision

- Bond mutual funds have different strategies that change little over time.
- We expect funds that are already specialized in liquidity provision to better take advantage of bank-affiliated dealers' regulatory constraints.
- Definition of a liquidity-supplying fund follows Anand et al. (2021):
  - A trade is liquidity-demanding if the fund sells (buys) when dealers experience positive (negative) inventory cycles.
  - A trade is liquidity-supplying if the fund buys (sells) when dealers experience positive (negative) inventory cycles.
- A fund's strategy depends on the aggregate of its trades, over a 24-month rolling window:

$$LS\ score = \frac{Liquidity\ supplied\ (\$) - Liquidity\ demanded\ (\$)}{Liquidity\ supplied\ (\$) + Liquidity\ demanded\ (\$) + Unclassified\ (\$)}$$

Main Proxies (2/2): Constrained Bonds

- **Which bonds are most affected by the leverage ratio constraint?**
- We expect that dealers most affected by the LR regulation, henceforth "constrained dealers", will attempt to shrink their inventories by unloading the largest bond positions they hold near the end of the quarter.

$$\text{Constr. Dealers' Inventory Holdings}_{j,m} = \frac{\sum_{d=1}^{N} \max\left\{\sum_{t_m=1}^{20} \mathit{Inventory}_{d,j,t_m}, 0\right\} \cdot \mathbb{1}_{d \in C}}{\mathit{Offering\ Amount}_j},$$

where d refers to a dealer active in bond j during month m. C denotes a subset of dealers that are defined as constrained, t_m indexes the calendar day in a given month, and $\mathit{Inventory}_{d,j,t_m}$ is the incremental inventory that dealer d takes on in bond j during day t_m.

- We define a bond as constrained if it is in the top quintile of Constr. Dealers' Inventory Holdings$_{j,m}$.
- Potentially endogenous as dealer choose between principal and agency trades, but results are robust if we use propensity scores

Determinants of Bond Constrainedness

$$ln(\frac{p}{1-p}) = \beta_0 + \beta_{Age}\, ln(1 + Bond\ Age_{j,t}) + \beta_{Maturity}\, ln(1 + Bond\ Maturity_{j,t}) + \beta_{Size}\, ln(1 + Issue\ Size_{j,t}) + \beta_{Rating}\, Rating_{j,t} + \beta_{Illiquidity}\, Illiquidity_{j,t} + \epsilon_{j,t}$$

Average Coefficients				
$\hat{\beta}_{Age}$	$\hat{\beta}_{Maturity}$	$\hat{\beta}_{Size}$	$\hat{\beta}_{Rating}$	$\hat{\beta}_{Illiquidity}$
-0.620***	0.301***	0.175*	0.152	-0.228***
(0.000)	(0.000)	(0.061)	(0.105)	(0.008)

Mutual Fund Trading (1/2): Before vs. After the Leverage Ratio

We run the following fund-bond-month regression:

$$\begin{aligned} \textit{Fund Position Change}_{i,j,t} = \beta_0 + \beta_1 \mathbb{1}[QE] + \beta_2 \mathbb{1}[\textit{Constr. Bond}] \\ + \beta_3 \mathbb{1}[QE] \times \mathbb{1}[\textit{Constr. Bond}] + \theta_1' \mathbf{M_{j,t}} + \theta_2' \mathbf{M_{i,t}} + \eta_j \times \lambda_y + \varepsilon_{i,j,t}. \end{aligned}$$

- $\textit{Fund Position Change}_{i,j,t}$, is the change in position in bond j of fund i in period t, relative to the fund's TNA at the end of the previous period ($TNA_{i,t-1}$), and is expressed in basis points.
- $\mathbb{1}[QE]$ is an indicator variable that equals one if the period is a quarter-end month (March, June, September, December) and zero otherwise.
- $\mathbb{1}[\textit{Constr. Bond}]$ is an indicator variable that equals one if the bond is defined as constrained and zero otherwise.
- $\eta_j \times \lambda_y$ represents bond-year fixed effects.

Mutual Fund Trading (2/2): Before vs. After the Leverage Ratio

Pre-Leverage Ratio Period

Fund Type	Non-LS Funds			LS Funds		
Bond Type	All	IG	HY	All	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[QE]$	0.061	0.072	0.041	0.036	-0.047	0.220
	(0.052)	(0.059)	(0.064)	(0.068)	(0.057)	(0.142)
$\mathbb{1}[Constr.\ Bond]$	0.157***	0.080	0.240***	0.274***	0.207**	0.428***
	(0.047)	(0.047)	(0.067)	(0.080)	(0.079)	(0.096)
$\mathbb{1}[QE] \times \mathbb{1}[Constr.\ Bond]$	-0.009	0.023	-0.046	0.026	0.018	-0.021
	(0.077)	(0.095)	(0.101)	(0.078)	(0.080)	(0.117)
R-Squared	0.11	0.11	0.13	0.16	0.15	0.17
Observations	2,391,166	1,308,657	1,082,392	714,569	472,683	241,671

Leverage Ratio Period

Fund Type	Non-LS Funds			LS Funds		
Bond Type	All	IG	HY	All	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[QE]$	0.036	0.046	0.026	0.068*	0.045	0.146
	(0.028)	(0.030)	(0.040)	(0.039)	(0.029)	(0.097)
$\mathbb{1}[Constr.Bond]$	0.072*	0.065*	0.076	0.071*	0.044*	0.157**
	(0.036)	(0.032)	(0.047)	(0.038)	(0.025)	(0.062)
$\mathbb{1}[QE] \times \mathbb{1}[Constr.Bond]$	0.018	-0.012	0.051	**0.105****	**0.095****	0.107
	(0.047)	(0.050)	(0.053)	**(0.050)**	**(0.041)**	(0.069)
R-Squared	0.08	0.08	0.09	0.10	0.09	0.11
Observations	3,277,419	1,818,402	1,458,881	1,792,554	1,365,942	426,452

Note: Regressions include bond x year FE, bond controls, and fund controls

Mutual Fund Trading (2/2): Before vs. After the Leverage Ratio

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Increased quarter-end purchases for constrained IG bonds equivalent to about **25% of the average change** in the fund's position size

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$\mathbb{1}[Constr.Bond]$	0.072*	0.065*	0.076	0.071*	0.044*	0.157**
	(0.036)	(0.032)	(0.047)	(0.038)	(0.025)	(0.062)
$\mathbb{1}[QE] \times \mathbb{1}[Constr.Bond]$	0.018	-0.012	0.051	**0.105****	**0.095****	0.107
	(0.047)	(0.050)	(0.053)	**(0.050)**	**(0.041)**	(0.069)
R-Squared	0.08	0.08	0.09	0.10	0.09	0.11
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Note: Regressions include bond x year FE, bond controls, and fund controls

Mutual Fund Trading (3/3): Triple Differences

Regulatory Period	Pre-Leverage Ratio			Leverage Ratio		
Bond Rating	All	IG	HY	All	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[QE]$	0.072	0.085	0.047	0.029	0.034	0.029
	(0.055)	(0.062)	(0.064)	(0.028)	(0.029)	(0.041)
$\mathbb{1}[LS\ Fund]$	0.106*	0.076	0.101	0.063**	0.037	0.116**
	(0.056)	(0.063)	(0.076)	(0.029)	(0.025)	(0.050)
$\mathbb{1}[Constr.\ Bond]$	0.149***	0.073	0.236***	0.052	0.049	0.067
	(0.044)	(0.045)	(0.066)	(0.036)	(0.036)	(0.046)
$\mathbb{1}[LS\ Fund] \times \mathbb{1}[QE]$	-0.022	-0.122*	0.183	0.063	0.036	0.118
	(0.081)	(0.069)	(0.137)	(0.040)	(0.026)	(0.102)
$\mathbb{1}[Constr.\ Bond] \times \mathbb{1}[QE]$	-0.010	0.021	-0.043	0.022	-0.004	0.057
	(0.077)	(0.092)	(0.099)	(0.046)	(0.048)	(0.052)
$\mathbb{1}[LS\ Fund] \times \mathbb{1}[Constr.\ Bond]$	0.149	0.147	0.209***	0.056	0.018	0.120**
	(0.095)	(0.127)	(0.071)	(0.068)	(0.077)	(0.045)
$\mathbb{1}[LS\ Fund] \times \mathbb{1}[Constr.\ Bond] \times \mathbb{1}[QE]$	0.041	0.003	0.009	0.083*	**0.092****	0.039
	(0.051)	(0.058)	(0.089)	(0.046)	**(0.038)**	(0.059)
R-Squared	0.11	0.10	0.13	0.08	0.08	0.09
Observations	3,108,437	1,783,226	1,325,127	5,071,782	3,185,688	1,886,009

Note: Regressions include bond x year FE, bond controls, and fund controls

Mutual Fund Trading (3/3): Triple Differences

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$\mathbb{1}[QE]$	0.072	0.085	0.047	0.029	0.034	0.029
	(0.055)	(0.062)	(0.064)	(0.028)	(0.029)	(0.041)
$\mathbb{1}[LS\ Fund]$	0.106*	0.076	0.101	0.063**	0.037	0.116**
	(0.056)	(0.063)	(0.076)	(0.029)	(0.025)	(0.050)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
$\mathbb{1}[Constr.\ Bond] \times \mathbb{1}[QE]$	-0.010	0.021	-0.043	0.022	-0.004	0.057
	(0.077)	(0.092)	(0.099)	(0.046)	(0.048)	(0.052)
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Increased quarter-end purchases for constrained IG bonds equivalent to about **25% of the average change** in the fund's position size

Note: Regressions include bond x year FE, bond controls, and fund controls

Mutual Fund Alpha and Liquidity Provision by Regulatory Period

$$\textit{Fund Alpha}_{i,t} = \beta_0 + \beta_1 \mathbb{1}[LR] + \beta_2 \mathbb{1}[\textit{LS Fund}] + \beta_3 \mathbb{1}[LR] \times \mathbb{1}[\textit{LS Fund}] + \theta' \mathbf{M_{i,t}} + \eta_i \times \lambda_t + \varepsilon_{i,t}.$$

Fund specialization	All Funds	IG-Focused Funds		HY-Focused Funds	
	(1)	(2)	(3)	(4)	(5)
$\mathbb{1}[\textit{LS Fund}]$	0.006	-0.000	-0.003	0.021	0.029
	(0.009)	(0.009)	(0.010)	(0.019)	(0.019)
$\mathbb{1}[\textit{LS Fund}] \times \mathbb{1}[LR]$	0.008	**0.022****	**0.025****	-0.012	-0.019
	(0.010)	**(0.011)**	**(0.011)**	(0.020)	(0.021)
R-Squared	0.41	0.44	0.45	0.41	0.41
Observations	66,510	41,297	39,252	25,031	23,767

Note: Regressions include fund-category x period FE, and fund controls.
Columns 3 and 5 exclude the Taper Tantrum period

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$$\textit{Fund Alpha}_{i,t} = \beta_0 + \beta_1 \mathbb{1}[LR] + \beta_2 \mathbb{1}[\textit{LS Fund}] + \beta_3 \mathbb{1}[LR] \times \mathbb{1}[\textit{LS Fund}] + \theta' \mathbf{M_{i,t}} + \eta_i \times \lambda_t + \varepsilon_{i,t}.$$

Fund specialization	All Funds	IG-Focused Funds		HY-Focused Funds	
	(1)	(2)	(3)	(4)	(5)
$\mathbb{1}[\textit{LS Fund}]$	0.006	-0.000	-0.003	0.021	0.029
	(0.009)	(0.009)	(0.010)	(0.019)	(0.019)
$\mathbb{1}[\textit{LS Fund}] \times \mathbb{1}[LR]$	0.008	**0.022****	**0.025****	-0.012	-0.019
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After the introduction of the leverage ratio, outperformance of investment grade LS funds, relative to non-LS funds, amounts to **0.26% per annum**

Realization of Mutual Fund Alpha within the Quarter

Month of Quarter	Month 1			Month 2 & 3		
Fund specialization	All	IG-Focused	HY-Focused	All	IG-Focused	HY-Focused
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[LS\ Fund]$	0.018*	0.010	0.035	0.001	-0.007	0.016
	(0.010)	(0.012)	(0.023)	(0.011)	(0.010)	(0.021)
$\mathbb{1}[LS\ Fund] \times \mathbb{1}[LR\ Period]$	0.017	**0.033****	-0.012	0.004	0.016	-0.013
	(0.012)	**(0.016)**	(0.027)	(0.012)	(0.012)	(0.023)
R-Squared	0.38	0.44	0.36	0.42	0.44	0.43
Observations	21,692	13,325	8,306	45,348	28,324	16,896

Note: Regressions include fund-category x period FE, and fund controls

Do Bank-Affiliated Liquidity-Supplying Funds Engage More in Liquidity Provision?

Fund Type	LS Funds		
Bond Type	All	IG	HY
	(1)	(2)	(3)
$\mathbb{1}[QE]$	0.094**	0.059*	0.223**
	(0.042)	(0.034)	(0.093)
$\mathbb{1}[Constr.\ Bond]$	0.080	0.054	0.177**
	(0.047)	(0.034)	(0.065)
$\mathbb{1}[Bank-aff.]$	0.002	-0.056	0.268
	(0.131)	(0.132)	(0.195)
$\mathbb{1}[QE] \times \mathbb{1}[Constr.\ Bond]$	**0.112****	**0.096****	0.103
	(0.053)	**(0.042)**	(0.073)
$\mathbb{1}[QE] \times \mathbb{1}[Bank-aff.]$	-0.312	-0.204	-0.656***
	(0.213)	(0.205)	(0.195)
$\mathbb{1}[Constr.\ Bond] \times \mathbb{1}[Bank-aff.]$	-0.105	-0.110	-0.156**
	(0.084)	(0.088)	(0.073)
$\mathbb{1}[QE] \times \mathbb{1}[Constr.\ Bond] \times \mathbb{1}[Bank-aff.]$	-0.024	0.022	0.042
	(0.095)	(0.102)	(0.103)
R-Squared	0.10	0.09	0.11
Observations	1,780,885	1,354,832	425,893

Note: Regressions include bond x year FE, bond controls, and fund controls

Fund Performance by Bank-Affiliated Liquidity-Supplying Funds and Regulatory Period

Regulatory Period	Pre-Leverage Ratio			Leverage Ratio		
Fund specialization	All	IG-Focused Funds	HY-Focused Funds	All	IG-Focused Funds	HY-Focused Funds
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[LS\ Fund]$	0.010	0.001	0.022	0.011**	0.011*	0.012
	(0.009)	(0.010)	(0.019)	(0.005)	(0.006)	(0.010)
$\mathbb{1}[Bank - aff.]$	0.037*	0.020	0.070*	-0.001	-0.008	0.003
	(0.022)	(0.022)	(0.036)	(0.014)	(0.009)	(0.035)
$\mathbb{1}[LS\ Fund] \times \mathbb{1}[Bank - aff.]$	0.016	0.017	0.016	-0.005	**0.034****	-0.059
	(0.023)	(0.021)	(0.054)	(0.011)	**(0.017)**	(0.037)
R-Squared	0.43	0.47	0.41	0.39	0.42	0.41
Observations	29,686	18,950	10,665	36,616	22,175	14,330

Note: Regressions include fund x category FE and fund controls

Net Liquidity Supply over Mean Dealer Inventories in Investment-Grade Bonds

Panel A: Bonds Traded by Liquidity-Supplying Funds

Bond	Pre-Leverage Ratio		Leverage Ratio	
	Non-Quarter-End Month	Quarter-End Month	Non-Quarter-End Month	Quarter-End Month
Constrained	9.46***	7.49*	-0.11	16.28***
	(3.52)	(4.42)	(2.54)	(4.91)
Unconstrained	6.61	2.56	-1.21	-12.93
	(4.35)	(4.30)	(3.58)	(7.98)

Panel B: Bonds Traded by All Mutual Funds

Bond	Pre-Leverage Ratio		Leverage Ratio	
	Non-Quarter-End Month	Quarter-End Month	Non-Quarter-End Month	Quarter-End Month
Constrained	4.51***	1.82	-0.13	7.57***
	(1.47)	(1.51)	(1.37)	(2.91)
Unconstrained	1.48	-0.25	-2.23	-10.23
	(1.85)	(1.10)	(1.72)	(4.20)

Bond Illiquidity and Redemptions from the Bond Mutual Fund Industry

$$Illiquidity_{j,t} = \beta_0 + \beta_1 \mathbb{1}[QE] + \beta_2 \mathbb{1}[Flow \in [0\%, 20\%]] + \beta_3 \mathbb{1}[QE] \times \mathbb{1}[Flow \in [0\%, 20\%]] + \theta' \mathbf{M_{j,t}} + \eta_s + \lambda_q + \varepsilon_{j,t}.$$

Bond Constraints	Unconstrained Bonds				Constrained Bonds			
Regulatory Period	Pre-Leverage Ratio		Leverage Ratio		Pre-Leverage Ratio		Leverage Ratio	
Bond Type	IG	HY	IG	HY	IG	HY	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}[QE]$	-1.317	0.791	-1.523*	-1.275	0.224	-0.439	-1.340*	-1.499*
	(1.233)	(1.198)	(0.752)	(0.902)	(1.252)	(1.082)	(0.690)	(0.862)
$\mathbb{1}[Flow \in [0\%, 20\%)]$	-0.359	-1.078	1.769	0.586	-0.372	-3.810	1.698	-0.145
	(3.440)	(1.811)	(2.425)	(2.274)	(2.181)	(2.492)	(2.391)	(2.061)
$\mathbb{1}[QE] \times \mathbb{1}[Flow \in [0\%, 20\%)]$	7.155	0.837	1.266	5.638	4.617	**7.221****	**6.180*****	**5.953****
	(4.655)	(3.086)	(3.259)	(3.363)	(4.305)	**(3.106)**	**(2.066)**	**(2.581)**
R-Squared	0.51	0.53	0.47	0.54	0.45	0.45	0.40	0.50
Observations	131,227	54,587	185,754	68,571	33,245	20,145	44,398	27,268

Note: Regressions **control for flows** and include issuer FE, quarter FE, and bond controls.

Bond Illiquidity and Redemptions from the Bond Mutual Fund Industry

$$Illiquidity_{j,t} = \beta_0 + \beta_1 \mathbb{1}[QE] + \beta_2 \mathbb{1}[Flow \in [0\%, 20\%]] + \beta_3 \mathbb{1}[QE] \times \mathbb{1}[Flow \in [0\%, 20\%]] + \theta' \mathbf{M_{j,t}} + \eta_s + \lambda_q + \varepsilon_{j,t}.$$

Bond Constraints	Unconstrained Bonds				Constrained Bonds			
Regulatory Period	Pre-Leverage Ratio		Leverage Ratio		Pre-Leverage Ratio		Leverage Ratio	
Bond Type	IG	HY	IG	HY	IG	HY	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}[QE]$	-1.317	0.791	-1.523*	-1.275	0.224	-0.439	-1.340*	-1.499*
	(1.233)	(1.198)	(0.752)	(0.902)	(1.252)	(1.082)	(0.690)	(0.862)
$\mathbb{1}[Flow \in [0\%, 20\%)]$	-0.359	-1.078	1.769	0.586	-0.372	-3.810	1.698	-0.145
	(3.440)	(1.811)	(2.425)	(2.274)	(2.181)	(2.492)	(2.391)	(2.061)
$\mathbb{1}[QE] \times \mathbb{1}[Flow \in [0\%, 20\%)]$	7.155	0.837	1.266	5.638	4.617	**7.221****	**6.180*****	**5.953****
	(4.655)	(3.086)	(3.259)	(3.363)	(4.305)	**(3.106)**	**(2.066)**	**(2.581)**
								0.50
								27,268

During the leverage ratio period illiquidity in constrained IG bonds increases by about **8% of a standard deviation** more at quarter ends when mutual funds experience significant redemptions. This effect is not documented in the pre-leverage ratio period.

Bond Returns and Redemptions from the Bond Mutual Fund Industry

Regulatory Period	Pre-Leverage Ratio		Leverage Ratio	
Bond Type	IG	HY	IG	HY
	(1)	(2)	(3)	(4)
Matched Ret_t	-0.402***	-0.296**	-0.594***	-0.201
	(0.140)	(0.131)	(0.125)	(0.148)
Matched Ret_t $\times$ ln(1 + Bond maturity)	0.322**	0.112*	0.420***	0.274***
	(0.114)	(0.060)	(0.098)	(0.053)
$\mathbb{1}[Constrained_{j,t}]$	0.027	0.130**	0.076**	0.094*
	(0.028)	(0.054)	(0.031)	(0.046)
$\mathbb{1}[Flow \in [0\%, 20\%)]$	0.009	0.731	-0.471	-0.574
	(0.647)	(0.811)	(0.736)	(0.735)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow \in [0\%, 20\%)]$	-0.006	-0.136	**-0.246****	0.069
	(0.111)	(0.086)	**(0.090)**	(0.110)
R-Squared	0.12	0.15	0.27	0.20
Observations	217,269	91,893	301,599	110,534

Note: Regressions **control for flows** and include issuer FE, quarter FE, and bond controls.

Bond Returns and Redemptions from the Bond Mutual Fund Industry

Regulatory Period	Pre-Leverage Ratio		Leverage Ratio	
Bond Type	IG	HY	IG	HY
	(1)	(2)	(3)	(4)
Matched Ret_t	-0.402***	-0.296**	-0.594***	-0.201
	(0.140)	(0.131)	(0.125)	(0.148)
Matched Ret_t $\times$ ln(1 + Bond maturity)	0.322**	0.112*	0.420***	0.274***
	(0.114)	(0.060)	(0.098)	(0.053)
$\mathbb{1}[Constrained_{j,t}]$	0.027	0.130**	0.076**	0.094*
	(0.028)	(0.054)	(0.031)	(0.046)
$\mathbb{1}[Flow \in [0\%, 20\%)]$	0.009	0.731	-0.471	-0.574
	(0.647)	(0.811)	(0.736)	(0.735)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow \in [0\%, 20\%)]$	-0.006	-0.136	**-0.246****	0.069
	(0.111)	(0.086)	**(0.090)**	(0.110)
R-Squared	0.12	0.15	0.27	0.20

When bond mutual funds experience redemptions (fund flows in the bottom quintile), constrained IG bonds lose about **24.6 basis points** more than other IG bonds

Bond Illiquidity and Returns at the Onset of the COVID-19 Pandemic

$$Y_{j,t} = \beta_1 \mathbb{1}[\textit{March } 2020] + \beta_2 \mathbb{1}[\textit{Constrained}_{j,t-1}] + \beta_3 \mathbb{1}[\textit{Constrained}_{j,t-1}] \times \mathbb{1}[\textit{March } 2020] + \eta_j + \varepsilon_{j,t}.$$

Dependent Variable	Monthly Illiquidity$_{j,t}$			Excess Bond Return$_{j,t}$ (%)		
Bond Specification	All	IG	HY	All	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[\textit{March } 2020]$	92.005***	99.072***	68.785***	-6.010***	-6.034***	-5.858***
	(2.183)	(2.573)	(3.621)	(0.079)	(0.091)	(0.152)
$\mathbb{1}[\textit{Constrained}_{j,t-1}]$	-1.949	-6.631	-0.362	1.222***	1.685***	0.274
	(3.835)	(5.025)	(5.100)	(0.145)	(0.160)	(0.288)
$\mathbb{1}[\textit{March } 2020] \times \mathbb{1}[\textit{Constrained}_{j,t-1}]$	3.625	**18.205*** **	-7.532	**-2.144*** **	**-2.954*** **	-0.667*
	(4.959)	**(6.226)**	(7.480)	**(0.201)**	**(0.217)**	(0.397)
R-Squared	0.73	0.73	0.77	0.79	0.78	0.80
Observations	7,806	5,716	2,090	11,032	8,558	2,474

Note: Regressions include bond FE and control for continuous aggregate flows.

Bond Illiquidity and Returns at the Onset of the COVID-19 Pandemic

$$Y_{j,t} = \beta_1 \mathbb{1}[\textit{March } 2020] + \beta_2 \mathbb{1}[\textit{Constrained}_{j,t-1}] + \beta_3 \mathbb{1}[\textit{Constrained}_{j,t-1}] \times \mathbb{1}[\textit{March } 2020] + \eta_j + \varepsilon_{j,t}.$$

Dependent Variable	**Monthly Illiquidity$_{j,t}$**			Excess Bond Return$_{j,t}$ (%)		
Bond Specification	All	IG	HY	All	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[\textit{March } 2020]$	92.005***	99.072***	68.785***	-6.010***	-6.034***	-5.858***
	(2.183)	(2.573)	(3.621)	(0.079)	(0.091)	(0.152)
$\mathbb{1}[\textit{Constrained}_{j,t-1}]$	-1.949	-6.631	-0.362	1.222***	1.685***	0.274
	(3.835)	(5.025)	(5.100)	(0.145)	(0.160)	(0.288)
$\mathbb{1}[\textit{March } 2020] \times \mathbb{1}[\textit{Constrained}_{j,t-1}]$	3.625	**18.205*** **	-7.532	**-2.144*** **	**-2.954*** **	-0.667*
	(4.959)	**(6.226)**	(7.480)	**(0.201)**	**(0.217)**	(0.397)

In March 2020, Illiquidity **increased by nearly 20% more** for bonds intermediated by dealers subject to the leverage ratio constraints.

Bond Illiquidity and Returns at the Onset of the COVID-19 Pandemic

$$Y_{j,t} = \beta_1 \mathbb{1}[\textit{March } 2020] + \beta_2 \mathbb{1}[\textit{Constrained}_{j,t-1}] + \beta_3 \mathbb{1}[\textit{Constrained}_{j,t-1}] \times \mathbb{1}[\textit{March } 2020] + \eta_j + \varepsilon_{j,t}.$$

Dependent Variable	Monthly Illiquidity$_{j,t}$			**Excess Bond Return$_{j,t}$ (%)**		
Bond Specification	All	IG	HY	All	IG	HY
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[\textit{March } 2020]$	92.005***	99.072***	68.785***	-6.010***	-6.034***	-5.858***
	(2.183)	(2.573)	(3.621)	(0.079)	(0.091)	(0.152)
$\mathbb{1}[\textit{Constrained}_{j,t-1}]$	-1.949	-6.631	-0.362	1.222***	1.685***	0.274
	(3.835)	(5.025)	(5.100)	(0.145)	(0.160)	(0.288)
$\mathbb{1}[\textit{March } 2020] \times \mathbb{1}[\textit{Constrained}_{j,t-1}]$	3.625	**18.205*** **	-7.532	**-2.144*** **	**-2.954*** **	-0.667*
	(4.959)	**(6.226)**	(7.480)	**(0.201)**	**(0.217)**	(0.397)

While in March 2020, all corporate bonds experienced negative returns, returns of constrained IG bonds were **about 50% lower** than those of other IG bonds

Conclusions

- We provide the first evidence that the Basel III **leverage ratio** has spillover effects on **unregulated** financial institutions.
  - Mutual funds provide liquidity in the corporate bond market when the leverage ratio constraints on bank-affiliated dealers are most binding, and their performance has benefited from the regulation.
  - Mutual funds' liquidity provision depends on flows and drastically decreases when the bond mutual fund industry experiences significant redemptions.
- Bond **liquidity and returns** have become more dependent on the **funding conditions of bond mutual funds.**
  - Liquidity of corporate bonds that are intermediated by bank-affiliated dealers ("constrained bonds") significantly deteriorates at quarter ends if the bond mutual fund industry experiences significant redemptions.
  - Constrained bonds also have to pay a premium, as their valuations significantly deteriorate when the bond mutual fund industry experiences large outflows.