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

Mariassunta Giannetti
Stockholm School of Economics, CEPR, and ECGI

Chotibhak (Pab) Jotikasthira
Southern Methodist University

Andreas C. Rapp
Federal Reserve Board of Governors

Martin Waibel
Stockholm School of Economics

NY Fed-ECB Workshop on Nonbank Financial Institutions

June 21, 2024

Leverage Ratio Requirements and Asset Markets

A variety of banking regulations have been introduced following the global financial crisis.

As of 2015, non-US banks and US GSIBs are subject to the **leverage ratio requirement (LR)**, mandating a minimum amount of **capital against all on- and off-balance sheet exposures, irrespective of risk.**

- **Duffie (2018):** *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.*
- The LR **has decreased bank-affiliated dealers' willingness** to accumulate inventories and provide liquidity in investment-grade bonds (Rapp and Waibel, 2023; Breckenfelder and Ivashina, 2021).

How did the LR affect the strategies of unregulated (nonbank) intermediaries?

This Paper: Effects of the LR on Unregulated Bond Mutual Funds

1. Did the **LR** affect the **strategies and performance of bond mutual funds**?
2. Do open-ended mutual funds **provide liquidity differently** since the introduction of the **LR**?
3. Are **adaptations to the LR** introducing new elements of **fragility** in the corporate bond market?

Empirical Identification and Hypotheses

The design of the LR helps to econometrically identify its effects.

- Distinct from other regulations introduced in the aftermath of the global financial crisis.

- Differences used for identification:
  1. Variation across time (before and **after** the implementation of Basel III in 2015)
  2. Variation within a quarter (**quarter end months** vs other months of the quarter)
  3. Variation across bonds (bonds handled by less vs. **more by regulated dealers**).
     - Ideally, arising from exogenous demand shocks and issuer-dealer relationships → propensity scores to address dealers' endogenous selection.

- Testable Hypotheses:
  - Do mutual funds supply more liquidity at quarter ends (rather than in other months) after the introduction of the LR? If so, in which bonds?
  - Our focus: Funds that specialize in **liquidity provision** and trade in **investment-grade (IG) bonds**.

Preview of our Results

- **Fund level:** Following the introduction of the LR requirement in 2015 ...
  - At quarter-ends, **funds with liquidity-supplying strategies (LS funds) provide more liquidity** in IG bonds, especially in **IG bonds that are more affected by the LR (constrained bonds).**
  - No evidence that funds with liquidity-demanding strategies or high-yield bonds have been affected.
  - **IG-focused LS funds outperform** other IG-focused funds and outperformance is **driven by returns in the first month of each quarter.**
  - LS funds **provide less liquidity** when they **experience outflows and poor performance.**

Preview of our Results

- **Fund level:** Following the introduction of the LR requirement in 2015 ...
  - At quarter-ends, **funds with liquidity-supplying strategies (LS funds) provide more liquidity** in IG bonds, especially in **IG bonds that are more affected by the LR (constrained bonds).**
  - No evidence that funds with liquidity-demanding strategies or high-yield bonds have been affected.
  - **IG-focused LS funds outperform** other IG-focused funds and outperformance is **driven by returns in the first month of each quarter.**
  - LS funds **provide less liquidity** when they **experience outflows and poor performance.**

- **Bond level:** In response to the regulatory adaptations ...
  - IG bonds' **liquidity and returns are more exposed to large outflows** from the mutual fund industry.
  - **Constrained bonds** experienced **larger illiquidity and price drops** in March 2020, controlling for flow-induced fire sales.
    - LS funds' **missing liquidity provision** helps explain IG bonds' large price dislocations.

Data

- Mutual fund holdings from Morningstar.
- Mutual fund characteristics 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** to distinguish nonbank and bank-affiliated dealers.
  - US bank-affiliated dealers that are subject to the supplementary leverage ratio as well as European and Japanese dealers are most affected by the leverage ratio.

- 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): Identifying Funds' Liquidity Provision to Dealers

- Bond mutual funds' strategies change little over time.
- Rationale: Funds specializing in liquidity provision take advantage of bank-affiliated dealers' regulatory constraints.
- Definition of a liquidity-supplying fund (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): Bonds most affected ("constrained") by the LR

- Scarcity of counterparties for bonds in which regulated dealers have accumulated large inventories.
  - **(i)** Natural dealers of these bonds are constrained by the LR, and **(ii)** the market is selling.

- Rationale: Dealers reduce inventories by unloading their largest bond positions near quarter-end.

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

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

- A bond is constrained if it is in the top quintile of Constr. Dealers' Inventory Holdings$_{j,m}$.
- Inventory build-up may be endogenous $\rightarrow$ results are robust if we use propensity score matching.

Mutual Fund Trading: Liquidity Provision by Regulatory Period

$$\textit{Fund Position Change}_{i,j,t} = \beta_0 + \beta_1 \mathbb{1}[QE] + \beta_2 \mathbb{1}[QE] \times \mathbb{1}[\textit{LR Period}] + \theta_1' \mathbf{M_{j,t}} + \theta_2' \mathbf{M_{i,t}} + \eta_j \times \lambda_y + \varepsilon_{i,j,t}$$

Fund Type	**LS Fund**		
Bond Type	**Investment-Grade**		
Regulatory Period	Leverage Ratio	Pre-Leverage Ratio	All
	(1)	(2)	(3)
$\mathbb{1}[QE]$	**0.056****	-0.042	-0.107
	(0.026)	(0.081)	(0.072)
$\mathbb{1}[QE] \times \mathbb{1}[\textit{LR Period}]$			**0.190****
			(0.079)
Observations	1,411,265	491,668	1,902,933
R-squared	0.102	0.147	0.127

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

Mutual Fund Trading: Liquidity Provision by Regulatory Period

$$\textit{Fund Position Change}_{i,j,t} = \beta_0 + \beta_1 \mathbb{1}[QE] + \beta_2 \mathbb{1}[QE] \times \mathbb{1}[LR\ Period] + \theta_1' \mathbf{M_{j,t}} + \theta_2' \mathbf{M_{i,t}} + \eta_j \times \lambda_y + \varepsilon_{i,j,t}$$

Fund Type	**LS Fund**		
Bond Type	**Investment-Grade**		
Regulatory Period	Leverage Ratio	Pre-Leverage Ratio	All
	(1)	(2)	(3)
$\mathbb{1}[QE]$	**0.056****	-0.042	-0.107
	(0.026)	(0.081)	(0.072)
$\mathbb{1}[QE] \times \mathbb{1}[LR\ Period]$			**0.190****
			(0.079)
Observations	1,411,265	491,668	1,902,933
R-squared	0.102	0.147	0.127

Increased quarter-end purchases equivalent to about
60% of the average change in a LS fund's position size

Mutual Fund Trading: Liquidity Provision in Constrained vs. Unconstrained Bonds

Regulatory Period	Leverage Ratio Period					
Bond Type	Investment-Grade			High-Yield		
Fund Type	LS	Non-LS	All	LS	Non-LS	All
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[QE]$	0.039	0.040	0.031	0.128	0.024	0.027
	(0.024)	(0.025)	(0.025)	(0.082)	(0.036)	(0.036)
$\mathbb{1}[Constr.\ Bond]$	0.035*	0.048*	0.032	0.125**	0.060	0.051
	(0.019)	(0.027)	(0.029)	(0.050)	(0.039)	(0.039)
$\mathbb{1}[QE] \times \mathbb{1}[Constr.\ Bond]$	**0.081****	-0.010	-0.003	0.102	0.042	0.047
	(0.035)	(0.044)	(0.042)	(0.062)	(0.044)	(0.043)
$\mathbb{1}[LS\ Fund]$			0.040*			0.102**
			(0.022)			(0.045)
$\mathbb{1}[LS\ Fund] \times \mathbb{1}[QE]$			0.029			0.093
			(0.024)			(0.089)
$\mathbb{1}[Constr.\ Bond] \times \mathbb{1}[LS\ Fund]$			0.026			0.102**
			(0.061)			(0.036)
$\mathbb{1}[Constr.\ Bond] \times \mathbb{1}[LS\ Fund] \times \mathbb{1}[QE]$			**0.079****			0.040
			(0.032)			(0.051)
Observations	1,369,784	1,831,521	3,202,648	422,390	1,445,708	1,868,861
R-squared	0.096	0.086	0.077	0.120	0.100	0.098

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

Mutual Fund Trading: Liquidity Provision in Constrained vs. Unconstrained Bonds

Regulatory Period	Leverage Ratio Period					
Bond Type	Investment-Grade			High-Yield		
Fund Type	LS	Non-LS	All	LS	Non-LS	All
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}[QE]$	0.039	0.040	0.031	0.128	0.024	0.027
	(0.024)	(0.025)	(0.025)	(0.082)	(0.036)	(0.036)
$\mathbb{1}[Constr.\ Bond]$	0.035*	0.048*	0.032	0.125**	0.060	0.051
	(0.019)	(0.027)	(0.029)	(0.050)	(0.039)	(0.039)
$\mathbb{1}[QE] \times \mathbb{1}[Constr.\ Bond]$	**0.081****	-0.010	-0.003	0.102	0.042	0.047
	(0.035)	(0.044)	(0.042)	(0.062)	(0.044)	(0.043)
$\mathbb{1}[LS\ Fund]$			0.040*			0.102**
			(0.022)			(0.045)
$\mathbb{1}[Constr.\ Bond] \times \mathbb{1}[LS\ Fund]$			0.026			0.102**
			(0.061)			(0.036)
$\mathbb{1}[Constr.\ Bond] \times \mathbb{1}[LS\ Fund] \times \mathbb{1}[QE]$			**0.079****			0.040
			(0.032)			(0.051)
Observations	1,369,784	1,831,521	3,202,648	422,390	1,445,708	1,868,861
R-squared	0.096	0.086	0.077	0.120	0.100	0.098

Increase in quarter-end purchases of constrained IG bonds equivalent to **25% of the average change** in a LS fund's position size

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

Mutual Fund Performance: LS Funds' Alpha by Regulatory Period

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

Fund specialization	IG-Focused Funds		HY-Focused Funds	
	(1)	(2)	(3)	(4)
$\mathbb{1}[\textit{LS Fund}]$	-0.005	-0.007	0.028	0.038*
	(0.009)	(0.010)	(0.019)	(0.019)
$\mathbb{1}[\textit{LS Fund}] \times \mathbb{1}[\textit{LR Period}]$	**0.023****	**0.026****	-0.021	-0.029
	(0.011)	**(0.012)**	(0.020)	(0.020)
R-Squared	0.44	0.45	0.41	0.41
Observations	41,297	39,252	25,031	23,767

Note: Regressions include fund-category x period FE, and fund controls
Columns 2 and 4 exclude the Taper Tantrum Period

Mutual Fund Performance: LS Funds' Alpha by Regulatory Period

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

Fund specialization	IG-Focused Funds		HY-Focused Funds	
	(1)	(2)	(3)	(4)
$\mathbb{1}[\textit{LS Fund}]$	-0.005	-0.007	0.028	0.038*
	(0.009)	(0.010)	(0.019)	(0.019)
$\mathbb{1}[\textit{LS Fund}] \times \mathbb{1}[\textit{LR Period}]$	**0.023****	**0.026****	-0.021	-0.029
	(0.011)	**(0.012)**	(0.020)	(0.020)
R-Squared	0.44	0.45	0.41	0.41
Observations	41,297	39,252	25,031	23,767

After the introduction of the leverage ratio, outperformance of investment grade LS funds, relative to non-LS funds, amounts to **0.27% per annum**

Mutual Fund Performance: Realization of Fund Alpha within a Quarter

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

Month of Quarter	Month 1		Months 2 & 3	
Fund specialization	IG-Focused	HY-Focused	IG-Focused	HY-Focused
	(1)	(2)	(3)	(4)
$\mathbb{1}[\textit{LS Fund}]$	0.008	0.031	-0.012	0.027
	(0.012)	(0.023)	(0.010)	(0.022)
$\mathbb{1}[\textit{LS Fund}] \times \mathbb{1}[\textit{LR Period}]$	**0.038****	-0.008	0.017	-0.026
	(0.016)	(0.028)	(0.012)	(0.024)
R-Squared	0.45	0.34	0.46	0.42
Observations	13,329	8,291	28,365	16,826

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

Mutual Fund Trading: Net Liquidity Supply over Mean Dealer Inventories in IG Bonds

Panel A: Bonds Traded by Liquidity-Supplying Funds

	Pre-Leverage Ratio		Leverage Ratio	
Bond	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

	Pre-Leverage Ratio		Leverage Ratio	
Bond	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)

$$Y_{j,t} = \beta_1 \mathbb{1}[Constrained_{j,t}] + \beta_2 \mathbb{1}[Flow_t \in [0\%, 20\%]] + [...]$$
$$+ \beta_3 \mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow_t \in [0\%, 20\%]] \times \mathbb{1}[LR\ Period] + \gamma' \mathbf{M_{j,t}} + \eta_s \times \lambda_q + \varepsilon_{j,t}.$$

Dependent Variable	**Average Illiquidity**		**Excess Bond Return**	
Bond Type	IG	HY	IG	HY
	(1)	(2)	(3)	(4)
$\mathbb{1}[Constrained_{j,t}]$	-8.178***	-5.943***	0.028*	0.144***
	(0.415)	(0.525)	(0.015)	(0.029)
$\mathbb{1}[Flow \in [0\%, 20\%)]$	5.075***	0.977	-0.076*	0.999***
	(0.628)	(0.811)	(0.040)	(0.076)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow \in [0\%, 20\%)]$	-2.186**	-1.200	0.029	-0.072
	(0.947)	(1.138)	(0.042)	(0.071)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[LR\ Period]$	1.643***	1.181*	0.031*	-0.054
	(0.510)	(0.639)	(0.018)	(0.040)
$\mathbb{1}[Flow \in [0\%, 20\%)] \times \mathbb{1}[LR\ Period]$	-4.676***	-0.459	-0.282***	-1.626***
	(0.674)	(0.920)	(0.050)	(0.101)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow \in [0\%, 20\%)] \times \mathbb{1}[LR\ Period]$	**4.479*** **	0.429	**-0.247*** **	0.034
	(1.139)	(1.361)	**(0.052)**	(0.098)
R-Squared	0.56	0.65	0.33	0.40
Observations	381,789	160,471	502,101	190,227

Note: Regressions **control for flow-induced fire sales and aggregate flows** and include issuer-times-quarter FE, and bond controls.

$$Y_{j,t} = \beta_1 \mathbb{1}[Constrained_{j,t}] + \beta_2 \mathbb{1}[Flow_t \in [0\%, 20\%]] + [...]$$
$$+ \beta_3 \mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow_t \in [0\%, 20\%]] \times \mathbb{1}[LR\ Period] + \gamma' \mathbf{M_{j,t}} + \eta_s \times \lambda_q + \varepsilon_{j,t}.$$

Dependent Variable	Average Illiquidity		Excess Bond Return	
Bond Type	IG	HY	IG	HY
	(1)	(2)	(3)	(4)
$\mathbb{1}[Constrained_{j,t}]$	-8.178***	-5.943***	0.028*	0.144***
	(0.415)	(0.525)	(0.015)	(0.029)
$\mathbb{1}[Flow \in [0\%, 20\%)]$	5.075***	0.977	-0.076*	0.999***
	(0.628)	(0.811)	(0.040)	(0.076)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow \in [0\%, 20\%)]$	-2.186**	-1.200	0.029	-0.072
	(0.947)	(1.138)	(0.042)	(0.071)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[LR\ Period]$	1.643***	1.181*	0.031*	-0.054
	(0.510)	(0.639)	(0.018)	(0.040)
$\mathbb{1}[Flow \in [0\%, 20\%)] \times \mathbb{1}[LR\ Period]$	-4.676***	-0.459	-0.282***	-1.626***
	(0.674)	(0.920)	(0.050)	(0.101)
$\mathbb{1}[Constrained_{j,t}] \times \mathbb{1}[Flow \in [0\%, 20\%)] \times \mathbb{1}[LR\ Period]$	**4.479*** **	0.429	**-0.247*** **	0.034
	(1.139)	(1.361)	**(0.052)**	(0.098)
R-Squared	0.56	0.65	0.33	0.40
Observations	381,789	160,471	502,101	190,227

Note: Regressions **control for flow-induced fire sales and aggregate flows** and include issuer-times-quarter FE, and bond controls.

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

$$Y_{j,t} = \beta_1 \mathbb{1}[\textit{March } 2020] + \beta_2 \mathbb{1}[\textit{Constrained}_{j,t-1}] + \beta_3 \mathbb{1}[\textit{Constrained}_{j,t-1}] \times \mathbb{1}[\textit{March } 2020] + \eta_s + \gamma' \mathbf{M_{j,t}} + \varepsilon_{j,t}.$$

Dependent Variable	**Average Illiquidity**		**Excess Bond Return**	
Bond Type	IG	HY	IG	HY
	(1)	(2)	(3)	(4)
$\mathbb{1}[\textit{March } 2020]$	108.407***	83.028***	-0.840***	-3.585***
	(3.382)	(5.197)	(0.179)	(0.412)
$\mathbb{1}[\textit{Constrained}_{j,t-1}]$	-10.605***	0.166	0.406***	0.065
	(2.645)	(4.146)	(0.079)	(0.198)
$\mathbb{1}[\textit{March } 2020] \times \mathbb{1}[\textit{Constrained}_{j,t-1}]$	**14.128*** **	-8.862	**-1.124*** **	-0.422
	(5.179)	(6.259)	**(0.146)**	(0.293)
R-Squared	0.51	0.63	0.74	0.76
Observations	6,288	2,280	8,918	2,660

Note: Regressions include bond issuer FE, and bond controls, including flow-induced fire sales

In March 2020, illiquidity **increased by nearly 15% more** for bonds intermediated by dealers subject to the leverage ratio constraints.

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

$$Y_{j,t} = \beta_1 \mathbb{1}[\textit{March 2020}] + \beta_2 \mathbb{1}[\textit{Constrained}_{j,t-1}] + \beta_3 \mathbb{1}[\textit{Constrained}_{j,t-1}] \times \mathbb{1}[\textit{March 2020}] + \eta_s + \gamma' \mathbf{M_{j,t}} + \varepsilon_{j,t}.$$

Dependent Variable	**Average Illiquidity**		**Excess Bond Return**	
Bond Type	IG	HY	IG	HY
	(1)	(2)	(3)	(4)
$\mathbb{1}[\textit{March 2020}]$	108.407***	83.028***	-0.840***	-3.585***
	(3.382)	(5.197)	(0.179)	(0.412)
$\mathbb{1}[\textit{Constrained}_{j,t-1}]$	-10.605***	0.166	0.406***	0.065
	(2.645)	(4.146)	(0.079)	(0.198)
$\mathbb{1}[\textit{March 2020}] \times \mathbb{1}[\textit{Constrained}_{j,t-1}]$	**14.128*** **	-8.862	**-1.124*** **	-0.422
	(5.179)	(6.259)	**(0.146)**	(0.293)
R-Squared	0.51	0.63	0.74	0.76
Observations	6,288	2,280	8,918	2,660

Note: Regressions include bond issuer FE, and bond controls, including flow-induced fire sales

While in March 2020 all corporate bonds experienced negative returns, returns of constrained IG bonds decreased **more than twice as much** as 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 primarily intermediated by bank dealers significantly deteriorates during the LR period when the bond mutual fund industry experiences redemptions.