Does Liquidity Management Induce Fragility in Treasury Prices? Evidence from Bond Mutual Funds

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Motivation

- Global investors view the U.S. Treasury market as the safe haven

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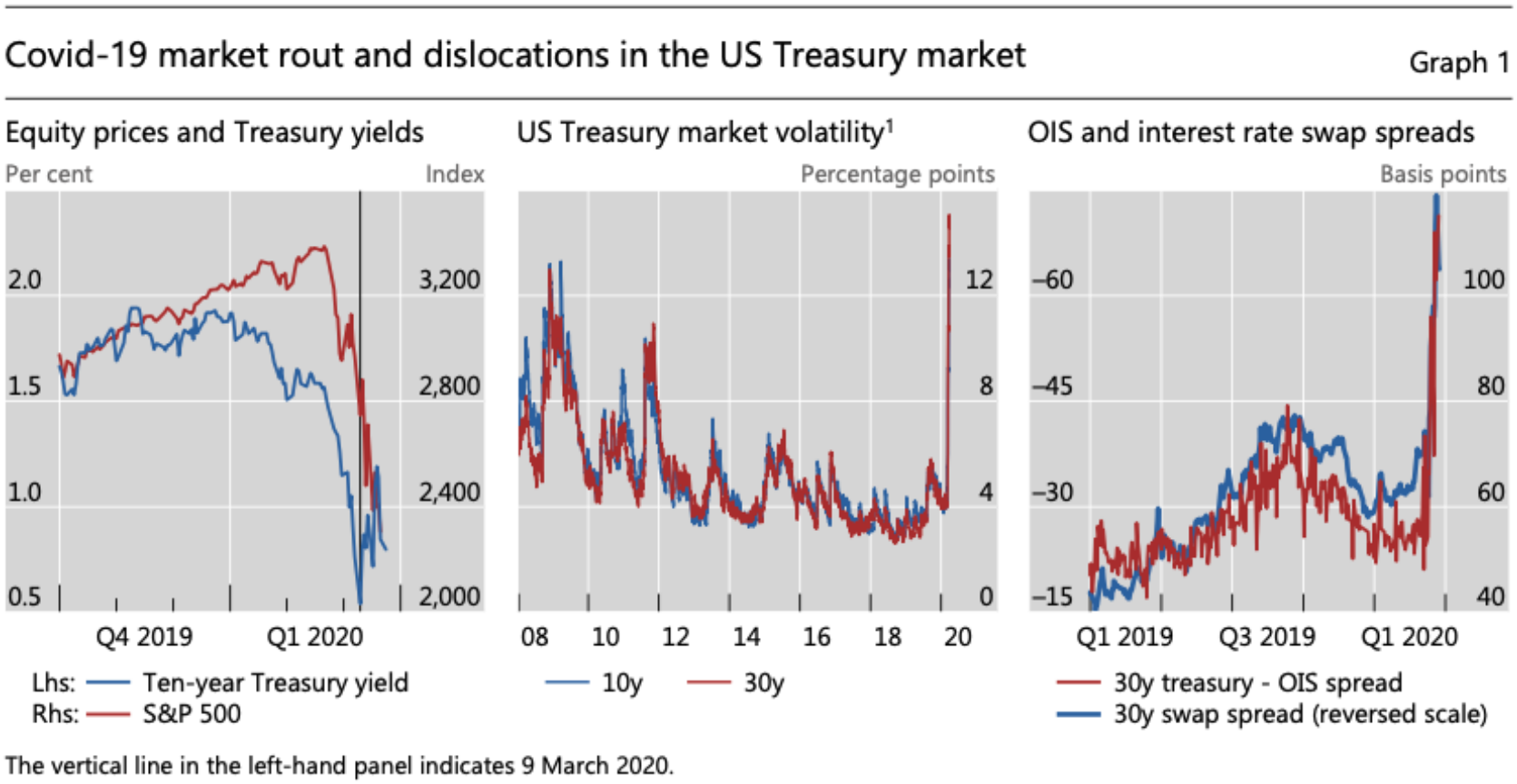
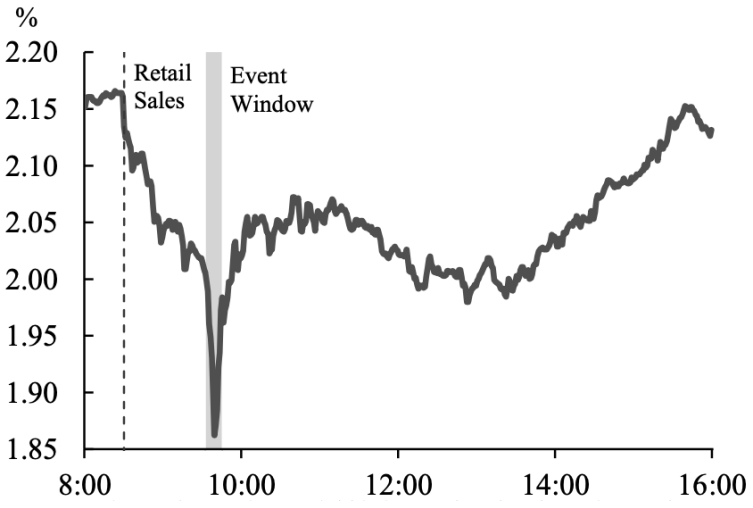


Schrimpf, Shin, and Sushko 2020

Motivation

- Increased fragility in the recent Treasury market, e.g., 2013 "taper tantrum" and 2014 "flash rally"

Figure 2.1: 10-Year Treasury Yield on October 15 (Cash)



Joint Staff Report (2015)

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'Spikes in volatility and sudden declines in liquidity have become more frequent in both Treasury and equity markets. There is also evidence that liquidity shifts more rapidly and hence is less predictable in these markets.' Jerome Powell (2016)

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- The rise of open-end mutual funds holding illiquid assets
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- Total AUM of mutual funds investing illiquid assets grew from 1.3 in 2002 to 7.3 trillion USD in 2019
  - The share of marketable Treasury securities held by long-term mutual funds increased from 3% in 2008 to 8% in 2019, more than the amount held by banks and broker-dealers (Nellie Liang 2020)

This Paper: Asset Pricing Implications

- Flow-induced trading can generate excessive common price movement of Treasuries held by bond funds
  - Excess return: residuals from regressing bond returns onto a factor model
  - Excess price comovement as an indicator for market fragility or systemic risk (e.g., King & Wadhwana 1990; Rigobon 2002; Behaert, Harvey, & Ng 2005)

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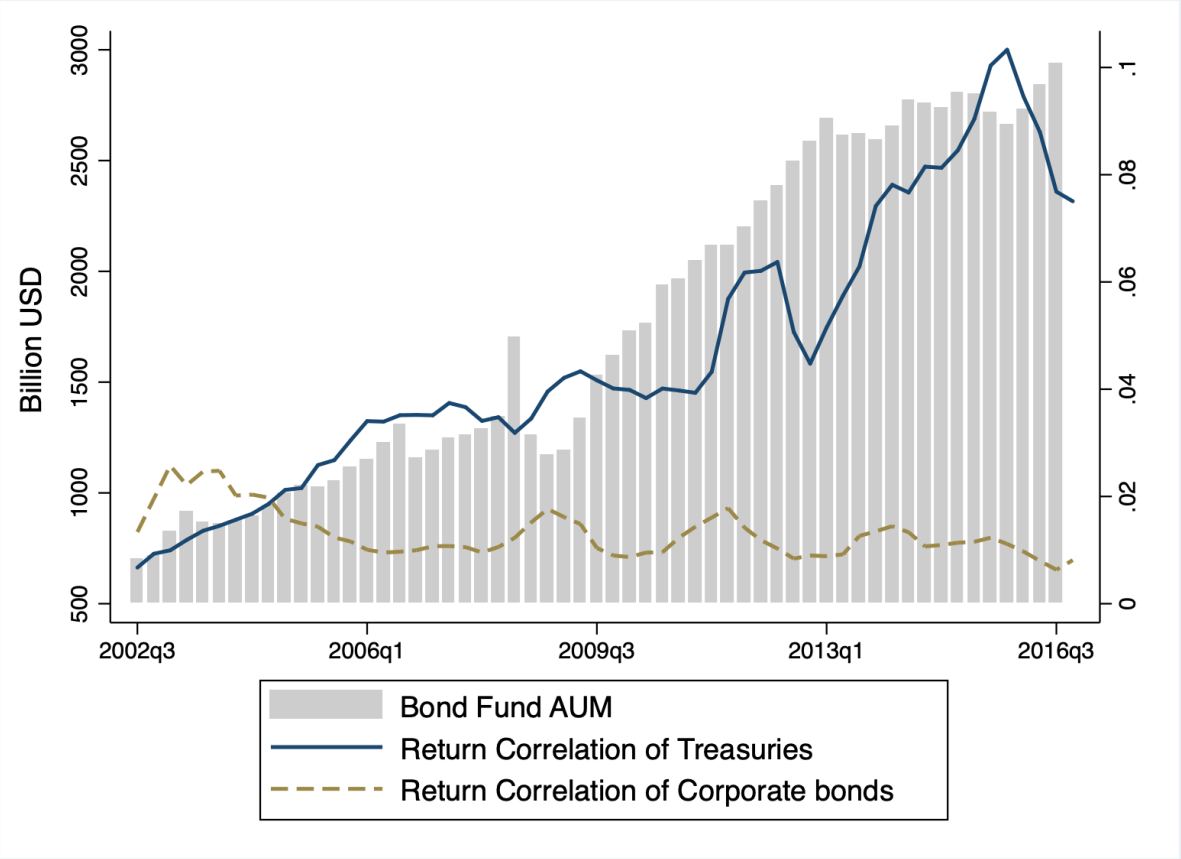
- Weaker for corporate bond prices
- Sample: U.S. open-end bond mutual funds
  - With their holding data on Treasuries and corporate bonds
  - Natural experiments: COVID-19 and 2003 mutual fund scandal

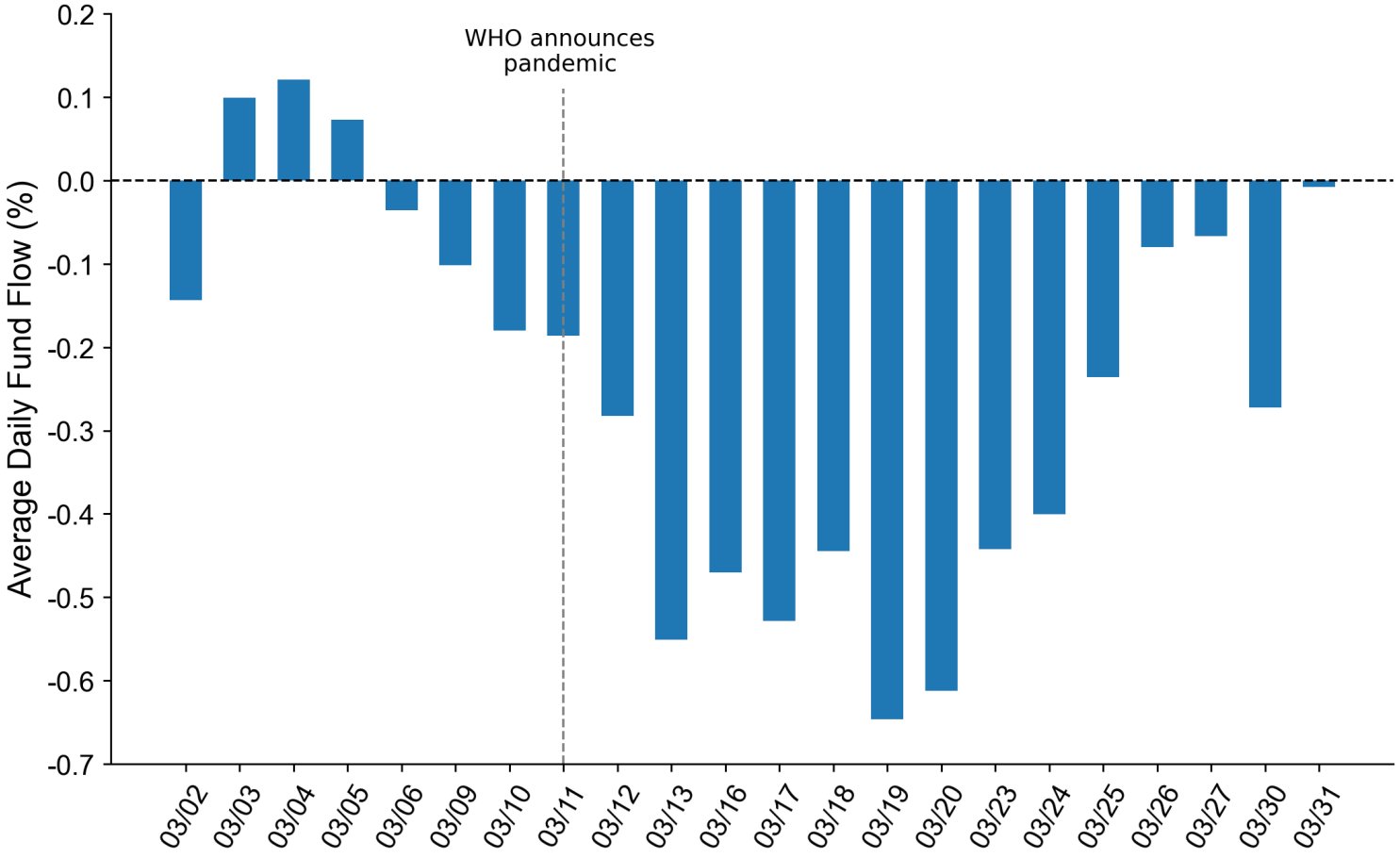
Trends

- The average excess return comovement among Treasuries increases from 1% to 8% between 2002 to 2016

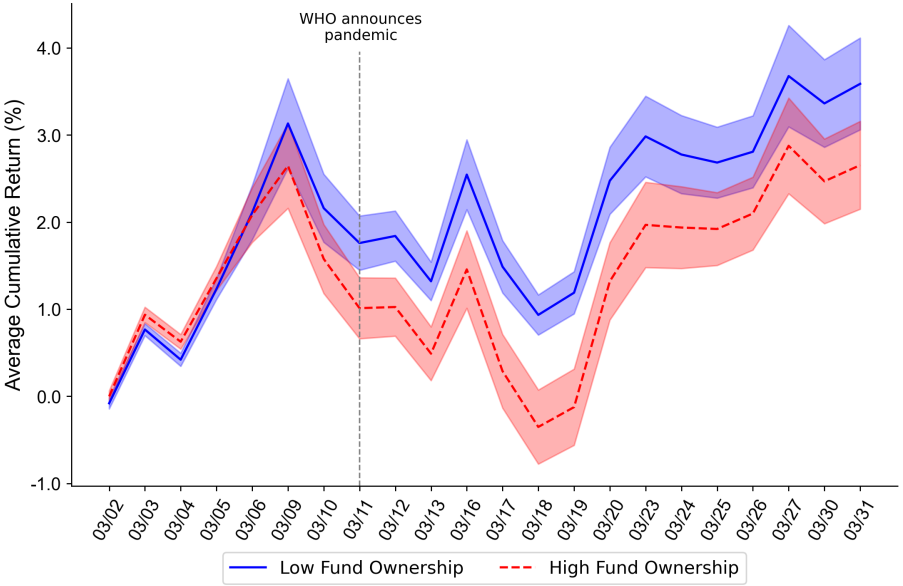


What Happened in March, 2020: Fund Flow

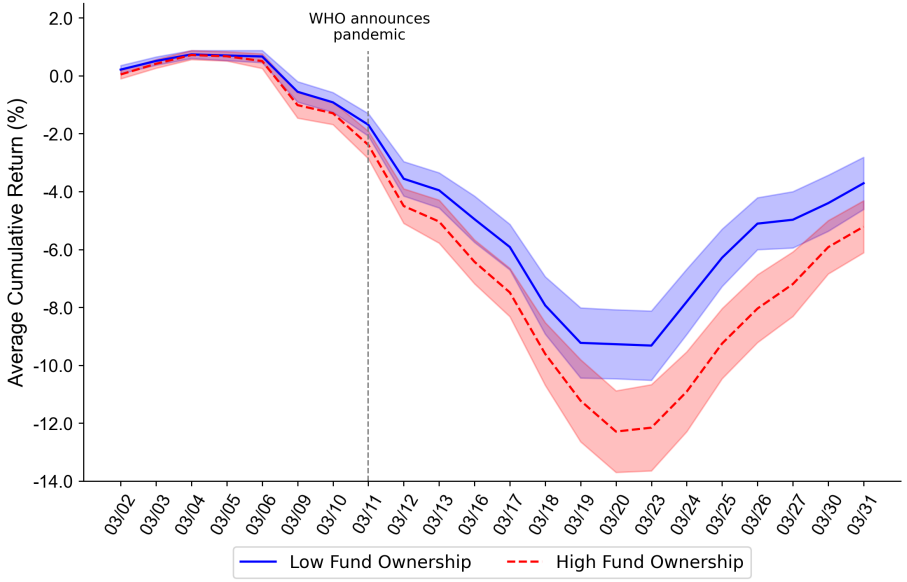
- Totally 5% AUM flow out of bond funds between 03/11 to 03/31



What Happened in March, 2020: Bond Prices



Treasuries



Corporate bonds

Literature

- Liquidity management
  - Chen et al 2010; Chernenko & Sunderam 2016; Jiang et al 2020; Choi et al 2020; Falato, Goldstein & Hortacsu 2020;
  - Jotikasthira, Lundblad & Ramadorai 2012; Aragon et al 2017; Ma, Xiao & Zeng 2020
- Fixed-income markets during the COVID-19 pandemic, among others
  - Treasuries: Duffie 2020; Fleming & Ruela 2020; He, Nagel & Song 2020; Schrimpf et al 2020
  - Corporate bonds: Haddad, Muir & Tyler 2020; Liang 2020; O'Hara & Zhou 2020; Jiang, Li, Sun, & Wang 2020
- The effect of institutional trading on asset prices and financial fragility
  - Edmans, Goldstein & Jiang 2012; Lou 2012
  - Greenwood & Thesmar 2011; Anton & Polk 2014; Huang, Song & Xiang 2020

Data

- Data sources:
  - CRSP: Mutual fund files, U.S Treasuries files
  - Bond information: TRACE, Mergent-FISD
  - Fund holding: Morningstar
- Sample construction:
  - U.S. actively managed open-end mutual funds mainly invest in fixed-income assets
    - ★ Morningstar global broad category="Fixed Income"
  - Corporate bonds
    - ★ Drop callables, puttables, convertibles, asset-backed securities, and corporate bonds with warrants or with unusual/zero coupons
  - Time-to-maturity no less than 6 months
- Sample period: 2002–2016, 2020Q1
  - 927 treasuries, 2,224 corporate bonds
  - 2099 bond funds

Excess Bond Return

- Daily bond return

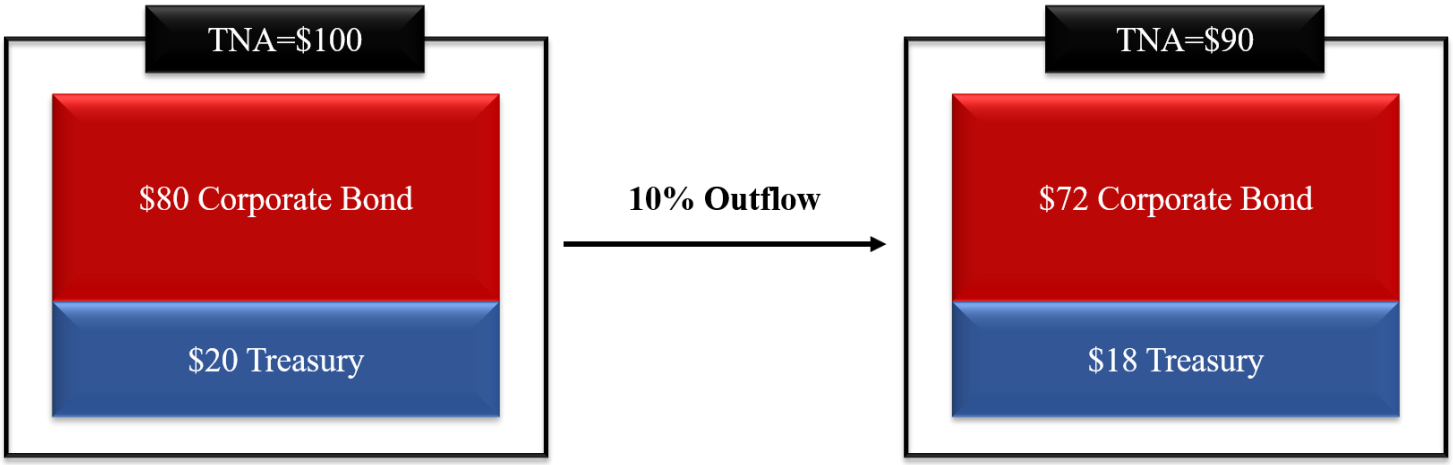
$$Bond\ Ret_{i,t} = \frac{P_{i,t} + AI_{i,t} + C_{i,t}}{P_{i,t-1} + AI_{i,t-1}} - 1.$$

- Adjusted bond return

$$Bond\ Ret - RF_{it} = \alpha_{it} + \sum_{s=0}^{2} \beta_{it-s} TRY_{t-s} + \sum_{s=0}^{2} \gamma_{it-s} IG_{t-s} + \sum_{s=0}^{2} \theta_{it-s} HY_{t-s} + \varepsilon_{it}$$

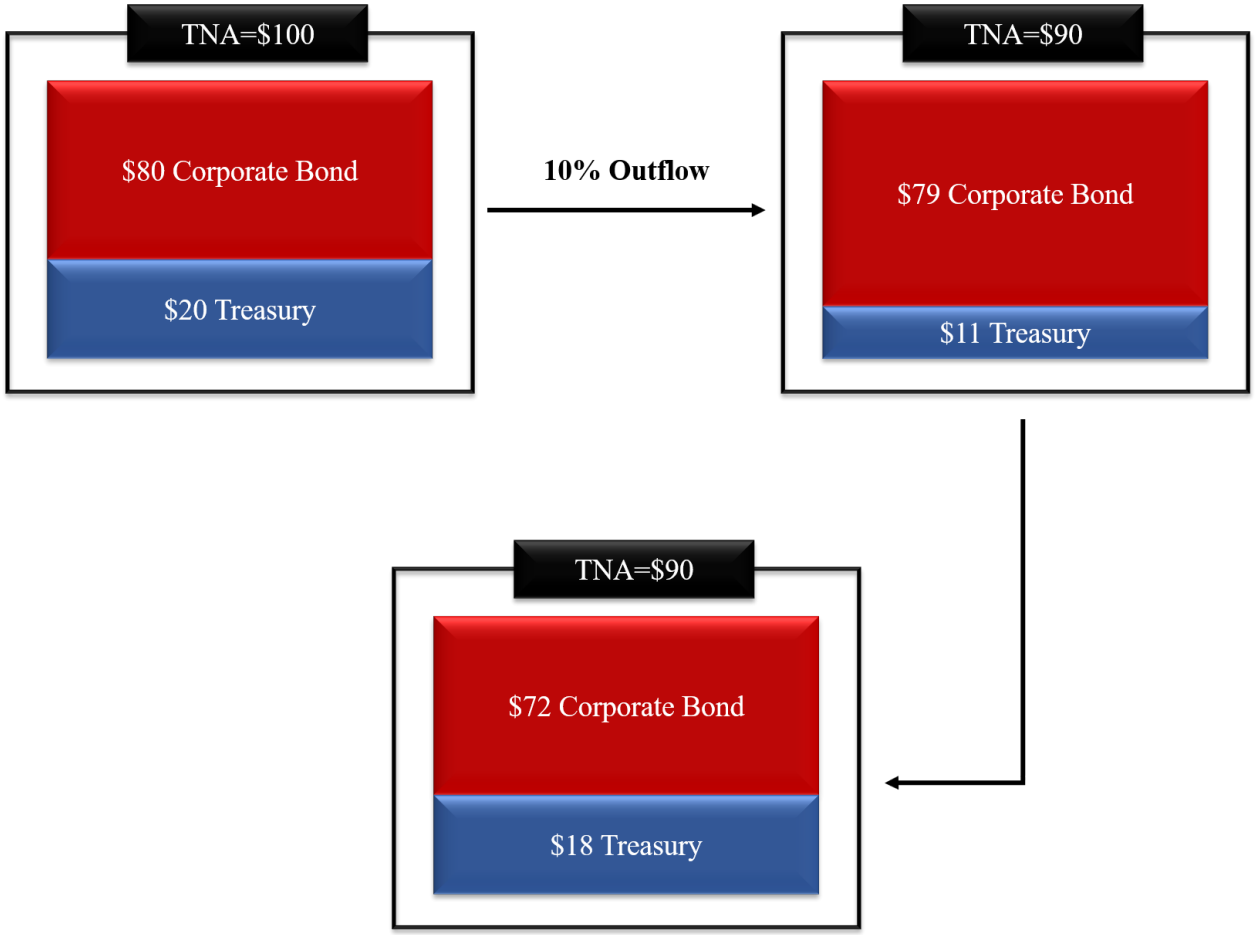
  - TRY: average daily returns of treasury securities
  - IG: Barclays corporate bond market index LUACTRUU (investment-grade)
  - HY: Barclays corporate bond market index LF98TRUU (junk bond)
  - We include two lags for each factor to take into account of non-synchronized trading.

An Example without Liquidity Management



- The trading-to-flow sensitivity is one on both Treasuries and corporate bonds.

An Example with Liquidity Management



- The trading-to-flow sensitivity is larger than one on Treasuries but is smaller than one on corporate bonds.

Liquidity Management: Trading-to-Flow Sensitivity

$$NetBuy_{f,q} = \frac{\sum_i^N Share_{i,f,q} P_{i,q-1} - \sum_i^N Share_{i,f,q-1} P_{i,q-1}}{\sum_i^N Share_{i,f,q-1} P_{i,q-1}}$$

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$$Fund\ Flow_{f,q} = \frac{TNA_{f,q} - TNA_{f,q-1}(1 + Fund\ Return_{f,q})}{TNA_{f,q-1}}$$

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$$\begin{aligned} NetBuy_{f,q} = \alpha + \beta_1 \cdot Fund\ Flow_{f,q} + \beta_2 \cdot Fund\ Flow_{f,q-1} + \\ \gamma_1 \cdot Fund\ Return_{f,q} + \gamma_2 \cdot Fund\ Return_{f,q-1} + \phi_f + \delta_q + \varepsilon_{f,q} \end{aligned}$$

- $\beta_1 > 1$ for Treasuries, $\beta_1 < 1$ for corporate bonds
- $Out_{f,q}$: A dummy variable that equals one if $Flow_{f,q}$ is lower than the median of fund flow in quarter q, and zero otherwise

Result: Liquidity Management

DepVar:	$Net\ Buy_{f,q}$							
	Treasuries				Corporate Bonds			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Fund\ Flow_{f,q}$	1.134***	1.130***	1.046***	1.053***	0.773***	0.754***	0.822***	0.813***
	(20.0)	(19.7)	(15.2)	(15.2)	(20.8)	(19.8)	(13.8)	(13.0)
$Fund\ Flow_{f,q} \times Out_{f,q}$			0.274**	0.231*			-0.163*	-0.190*
			(2.3)	(1.9)			(-1.8)	(-1.9)
$Fund\ Flow_{f,q-1}$	-0.169***	-0.160***	-0.134**	-0.104*	0.196***	0.182***	0.208***	0.196***
	(-3.5)	(-3.5)	(-2.1)	(-2.0)	(7.7)	(7.4)	(5.7)	(5.7)
$Fund\ Flow_{f,q-1} \times Out_{f,q-1}$			-0.103	-0.179			-0.052	-0.056
			(-0.7)	(-1.5)			(-0.7)	(-0.8)
$Fund\ Return_{f,q}$	-0.697***	-0.630**	-0.704***	-0.630**	0.030	-0.133	0.040	-0.127
	(-3.3)	(-2.4)	(-3.4)	(-2.4)	(0.1)	(-0.6)	(0.1)	(-0.5)
$Fund\ Return_{f,q-1}$	0.107	0.234	0.093	0.227	-0.470**	-0.646***	-0.458**	-0.636***
	(0.5)	(0.8)	(0.4)	(0.8)	(-2.6)	(-3.1)	(-2.5)	(-3.0)
Fund Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Obs	26,638	26,560	26,638	26,560	26,638	26,560	26,638	26,560
Adj R^2	0.067	0.162	0.067	0.162	0.092	0.110	0.092	0.111

- 1% inflow $\rightarrow$ a 1.05% (0.82%) increase in Treasury (corporate bond) holdings
- 1% outflow $\rightarrow$ a 1.28% (0.62%) decrease in Treasury (corporate bond) holdings

Main Hypothesis

- Treasuries commonly held by bond funds ("common ownership") should exhibit a strong excess return comovement.
  - Treasuries are widely traded by bond funds as a liquidity buffer
  - Treasury prices should have systematic exposure to fund flows
- Such effect should be stronger during downside markets
  - Bond funds face more redemption during downside markets
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- Similar in Anton and Polk (2014), for each Treasury pair, i and j, at quarter q,

$$Common\ Ownership_{i,j,q} = \frac{\sum_{f=1}^{F}(Shares_{i,f,q} \times P_{i,q} + Shares_{j,f,q} \times P_{j,q})}{SharesOutstanding_{i,q} \times P_{i,q} + SharesOutstanding_{j,q} \times P_{j,q}}$$

Common Ownership and Return Comovement

- Fama-MacBeth (1973) regressions

$$
\begin{aligned}
Corr_{i,j,q} &= \alpha + \beta \cdot Common\ Ownership^{*}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q} \\
Down\text{-}minus\text{-}up_{i,j,q} &= \alpha + \beta \cdot Common\ Ownership^{*}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}
\end{aligned}
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  - *Corr*: The pairwise return correlation of daily excess returns for two securities in a quarter
  - *Down-minus-up*: The difference in the pairwise return correlation between downside and upside markets for each pair of securities
    - Upside (downside) markets: daily aggregate Treasury market return above (below) quarter median

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- $X_{i,j,q-1}$
  - Treasuries: *Coupon_Difference*, *Time-to-maturity_Difference*, *On-the-run Difference*
  - Corporate bonds: *Coupon_Difference*, *Time-to-maturity_Difference*, *Liquidity_Diff*, *Rating_Difference*

Result: Common Ownership and Return Comovement

$$Corr_{i,j,q} = \alpha + \beta \cdot Common\ Ownership^{*}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}$$

Panel A: Treasury			Panel B: Corporate Bonds		
	Corr			Corr	
	(1)	(2)		(3)	(4)
*Common Ownership**	0.090***	0.064***	*Common Ownership**	0.007***	0.005***
	(25.6)	(13.2)		(12.2)	(10.0)
On-the-run Difference		0.079***	*Liquidity Difference*		-0.021***
		(10.7)			(-11.1)
Coupon Rate Difference		-0.022***	*Coupon Rate Difference*		-0.001***
		(-13.5)			(-2.9)
Time-to-maturity Difference		-0.166***	*Rating Difference*		-0.001***
		(-19.9)			(-5.4)
			Time-to-maturity Difference		-0.003***
					(-9.7)
# of Obs	1,533,640	1,533,640	# of Obs	9,072,186	9,072,186

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- A one SD increase in *Common Ownership** is associated with a 6.4% increase in the return correlation between two Treasuries (sample mean = 6.2%)
- A one SD increase in *Common Ownership** is associated with a 0.5% increase in the return correlation between two corporate bonds (sample mean = 1.3%)

Result: Upside vs. Downside Markets

$$\textit{Down-minus-up}_{i,j,q} = \alpha + \beta \cdot \textit{Common Ownership}^{*}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}$$

Panel A: Treasury			Panel B: Corporate Bonds		
	Down-minus-up			*Down-minus-up*	
	(1)	(2)		(3)	(4)
*Common Ownership**	0.016***	0.011***	*Common Ownership**	0.0003	0.0003
	(6.3)	(3.7)		(0.7)	(0.8)
On-the-run Difference		-0.013***	*Liquidity Difference*		0.0011
		(-3.8)			(0.5)
Coupon Rate Difference		0.005*	*Coupon Rate Difference*		-0.0001
		(1.7)			(-0.5)
Time-to-maturity Difference		-0.061***	*Rating Difference*		-0.0001
		(-6.1)			(-0.5)
			Time-to-maturity Difference		0.0004
					(0.9)
# of Obs	1,533,640	1,533,640	# of Obs	9,072,186	9,072,186

- A one standard deviation increase in *Common Ownership** is associated with a 1.1% increase *Down-minus-up* (sample mean = 0.3%)

Endogeneity Concerns

- Fund ownership may be driven by some unobservable bond characteristics that can induce return comovement
  - Although this is less of a concern for results using *Down-minus-up*

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- Fund ownership may be driven by some unobservable bond characteristics that can induce return comovement
  - Although this is less of a concern for results using *Down-minus-up*
- Exploit two quasi natural experiments, in which bond funds experience plausibly exogenous shock to fund flow

Natural Experiment I: COVID-19

- We conduct a difference-in-difference analysis in the first quarter of 2020, around the WHO's COVID-19 pandemic announcement (March 11, 2020) .

$$Corr_{i,j,m} = \alpha + \beta \cdot Treat_{i,j} \times After_m + \theta_1 \cdot Treat_{i,j} + \theta_2 \cdot After_m + \theta_3 \cdot X_{i,j,2019} + \varepsilon_{i,j,m}$$

  - Common ownership is calculated from fund holding at the end of 2019
  - $Treat_{i,j} = 1$ if the security pair i and j has common ownership above the median, and zero otherwise.
  - $After_m = 1$ if $Corr_{i,j,m}$ is computed on and after March 11, 2020, and zero otherwise.
  - $X_{i,j,2019}$: the same set of control variables as before at the end of 2019

Natural Experiment I: COVID-19

Panel A: Summary Statistics for *Corr*								
	Mean	sd	p10	p25	p50	p75	p90	*N*
Treasuries								
Before March 11	0.142	0.497	-0.575	-0.278	0.176	0.530	0.826	48503
After March 11	0.178	0.438	-0.427	-0.151	0.200	0.517	0.765	48503
Corporate Bonds								
Before March 11	0.030	0.244	-0.276	-0.125	0.024	0.182	0.348	63093
After March 11	0.026	0.373	-0.475	-0.250	0.028	0.306	0.527	63093

- The average *Corr* of Treasury pairs increased after the WHO's announcement
- The average *Corr* of coporate bond pairs remained almost unchanged

Natural Experiment I: COVID-19

Panel B: Diff-in-diff regressions				
DepVar:	Corr			
	Treasuries		Corporate Bonds	
	(1)	(2)	(3)	(4)
Treat × *After*	0.042***	0.042***	0.009***	0.009***
	(7.2)	(9.4)	(2.6)	(2.6)
Treat	0.210***	0.117***	0.017***	0.009***
	(47.6)	(35.5)	(8.8)	(4.2)
After	0.015***	0.015***	-0.009***	-0.009***
	(4.0)	(5.1)	(-3.5)	(-3.5)
Controls	No	Yes	No	Yes
# of Obs	97,006	97,006	126,186	126,186
Adj R^2	0.063	0.450	0.001	0.002

Natural Experiment II: 2003 Mutual Fund Scandal

- Regulatory inquiry in September 2003 resulted in litigation in which 25 mutual fund families were implicated in illegal trading practices
- The natural experiment
  - The scandal had a negative impact on affected funds' flows from 2003Q4 to 2006Q4 (McCabe, 2009; Anton and Polk, 2014; Koch, Ruenzi, and Starks, 2016)
  - It was unlikely to be related to the characteristics of bonds the funds hold

Natural Experiment II: 2003 Mutual Fund Scandal

- Following Anton and Polk (2014), a 2-stage IV regression
- January 2004 to December 2006
- IV: the ratio of common ownership from the scandal funds at 2003/09

$$RATIO_{i,j} = \frac{\sum_{s=1}^{S}(Shares_{i,s} \times P_i + Shares_{j,s} \times P_j)}{\sum_{f=1}^{F}(Shares_{i,f} \times P_i + Shares_{j,f} \times P_j)}$$

$$\begin{aligned} Common\ Ownership^*_{i,j,q} = \alpha + \beta \cdot RATIO_{i,j} + \gamma \cdot Common\ Ownership200309^* \\ + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q} \end{aligned}$$

$$\begin{aligned} Down\text{-}minus\text{-}up_{i,j,q} = \alpha + \beta \cdot Common\ \widehat{Ownership}^*_{i,j,q-1} \\ + \gamma \cdot Common\ Ownership200309^* + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q} \end{aligned}$$

Natural Experiment II: 2003 Mutual Fund Scandal

Panel B: Second Stage Regression				
DepVar:	Down-minus-up			
	Treasuries		Corporate Bonds	
	(1)	(2)	(3)	(4)
Common $\widehat{\textit{Ownership}}*$	0.031***	0.110***	-0.000	-0.003
	(14.9)	(4.2)	(-0.3)	(-0.5)
*Common Ownership200309**		-0.052***		0.002
		(-4.2)		(0.5)
On-the-run Difference		0.004		
		(0.4)		
Liquidity Difference				0.002
				(0.7)
Coupon Rate Difference		0.009***		0.000**
		(4.5)		(2.2)
Rating Difference				0.000*
				(1.9)
Time-to-maturity Difference		-0.048***		0.001*
		(-17.8)		(1.8)
# of Obs	51,560	51,560	908,179	908,179
Adj R^2	0.006	0.049	0.001	0.001

Additional Tests I: Outflow of Common Holders

$$Corr_{i,j,q} = \alpha + \beta_1 \cdot Common\ Ownership^*_{i,j,q-1} + \beta_3 \cdot Ratio\ of\ Outflow_{i,j,q}$$
$$\beta_2 \cdot Common\ Ownership^*_{i,j,q-1} \times Ratio\ of\ Outflow_{i,j,q} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}$$

- *Ratio of Outflow*$_{i,j,q}$ is the fraction of the pair's common funds with fund flows lower than the quarter median
- $\beta_2 > 0$ for Treasury pairs

DepVar:	Corr			
	Treasuries		Corporate Bonds	
	(1)	(2)	(3)	(4)
Common Ownership*	0.061***	0.061***	0.003***	0.003***
	(8.0)	(8.3)	(3.3)	(3.5)
Common Ownership* $\times$ *Ratio of Outflow*	0.034***	0.033**	0.001	0.001
	(2.7)	(2.6)	(0.9)	(0.6)
Ratio of Outflow	-0.014**	0.009	0.000	0.003*
	(-2.1)	(1.0)	(0.6)	(1.9)
Control	Yes	Yes	Yes	Yes
Control $\times$ *Ratio of Outflow*	No	Yes	No	Yes
# of Obs	1,285,706	1,285,706	4,033,587	4,033,587

Additional Tests II: Liquidity Commonality

- Measuring liquidity commonality: *Common Dry-ups*
  - Liquidity dry-up: the day with the highest bid-ask spread in the current and the previous four quarters
  - *Common Dry-ups*$_{i,j,t} = 1$ if the two Treasuries have liquidity dry-ups within the same calendar week or within 7 trading days in quarter t

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DepVar: *Common Dry-ups*	within calendar week		within 7 days	
	(1)	(2)	(3)	(4)
Common Ownership*	0.001**	0.001**	0.002**	0.002**
	(2.3)	(2.3)	(2.4)	(2.4)
On-the-run Difference		-0.002		-0.002
		(-0.9)		(-0.7)
Coupon Rate Difference		0.000		-0.000**
		(0.2)		(-2.1)
Time-to-maturity Difference		-0.000**		-0.001*
		(-2.4)		(-1.9)
# of Obs	1,533,640	1,533,640	1,533,640	1,533,640

- This magnitude is economically sizeable, given the mean of *Common Dry-ups* of 0.007

Additional Tests III: Individual Treasuries

- Measures of fragility for individual Treasuries:
  - Skewness of excess returns
  - Volatility of excess returns
  - Liquidity range: the difference between the maximum and minimum daily bid-ask spread within the quarter
- Run the Fama-MacBeth regressions on bond fund ownership

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DepVar:	Skewness		Volatility		Liquidity Range	
	(1)	(2)	(3)	(4)	(5)	(6)
Ownership*	-0.582***	-0.280***	0.019***	0.006***	0.007***	0.004*
	(-9.6)	(-7.0)	(5.4)	(3.9)	(3.1)	(1.8)
On-the-run		-0.740***		-0.037***		-0.023***
		(-9.8)		(-6.9)		(-2.7)
Coupon Rate		0.050*		0.005***		-0.001*
		(1.8)		(3.1)		(-2.0)
Time-to-maturity		-0.928***		0.054***		0.011**
		(-20.3)		(6.5)		(2.6)
# Obs	12,576	12,576	12,576	12,576	12,450	12,450

Conclusion

- Liquidity management contribute to the increasing fragility in the Treasury market
- Our findings call for regulatory actions to stabilize the most liquid asset market
  - e.g., Liang (2020) advocates to match the liquidity of bond funds' assets to the liquidity that funds offer
  - Swing pricing, e.g., Jin, Kacperczyk, Kahraman, & Suntheim (2019)