Mutual Fund Fragility, Dealer Liquidity Provisions and the Pricing of Municipal Bonds

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Disclaimer: The views expressed herein are those of the authors and do not necessarily reflect those of the Federal Reserve Board or its staff.

Motivation

- Fixed-income mutual funds engage in substantial liquidity transformation:
    - Offering daily claims to investors while holding illiquid assets.

- Such liquidity transformation could generate a first-mover advantage among investors in the face of a negative shock:
    - Leading to amplified redemption.
    - **[Chen, Goldstein, and Jiang (2010), Goldstein, Jiang, and Ng (2017), Zeng (2017), Falato, Goldstein, and Hortascu (2020)]**

- Massive redemptions could affect the underlying asset markets.
    - Fund outflows lead to fire sales and affect prices and volatility in the corporate bond markets.
    - **[Jiang, Li and Wang (2017), Choi, Hoseinzade, Shin, and Tehranian (2020), Falato, Hortascu, Li, and Shin (2020), Ma, Xiao, and Zeng (2020), Jiang, Li, Sun and Wang (2020)]**

Motivation

- Little research on understanding the role played by dealers in transmitting the fragility risks posed by mutual funds.
  - The impact of mutual fund liquidity demand on market stablity relies on dealers' liquidity provisions.

- We use the Covid-19 crisis to analyze the fragility risks that mutual funds introduce to the municipal bond market.
  - A key feature: the role of muni dealers in transmitting mutual fund fragility risks.
    - How does trading in munis relate to mutual fund ownership in crisis?
    - How do dealers behave when facing large selling pressures?
    - How do dealers' behaviors change for bonds with larger potential mutual fund fire sales post crisis?
    - What are the potential impact of mutual fund fragility risks on liquidity and pricing of munis?

Why do we use muni market to study mutual fund fragility risks?

- Mutual funds are the largest institutional investors of munis.
  - Hold about 20% of municipal bonds (outstanding amount).

- A huge market ($4 trillion dollars) that is
  - Illiquid, segregated, and reliant on dealer intermediation.

- Very few means to hedge price movements.

- Holding concentrations of munis by mutual funds are higher than that of corporate bonds.

What's our key identification strategy?

- How do we disentangle the effects of mutual fund fragility risks from the general pandemic effects?
    - Only about 30% of municipal bonds are held at all by mutual funds.
    - This dichotomization gives us a control group capturing the general pandemic effects.

- Are bonds held by mutual funds comparable to those that are not?
    - Control for time-varying effects of various bond characteristics.
    - In strictest specification, include issuer×date fixed effects.

The run on muni mutual funds during the Covid-19 crisis

- Early–mid Mar: muni market under severe stress (yield spreads ↑ 6%); mutual funds saw large outflows (16% of AUMs).

- Late Mar–Early Apr: Fed interventions (MLF, PDCF, MMLF, CPFF)

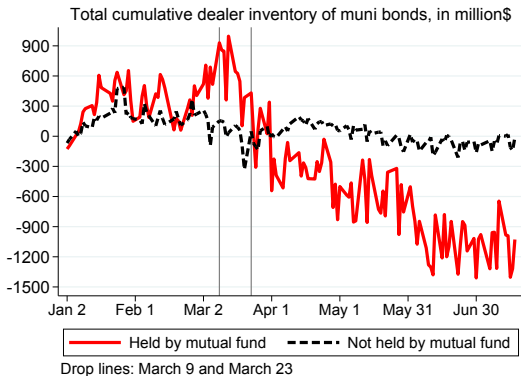Daily Flows to Municipal Bond Mutual Funds, in billion $

Drop lines: March 9 and March 23
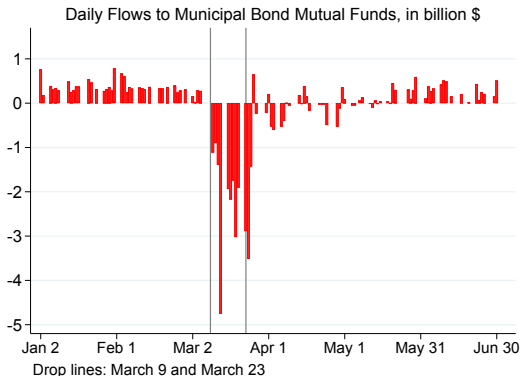
Preview of main results [1/3]

- Mutual fund redemptions destabilize the muni market during the Covid-19 crisis.

Trading volume of muni bonds, in billlion $

Drop lines: March 9 and March 23
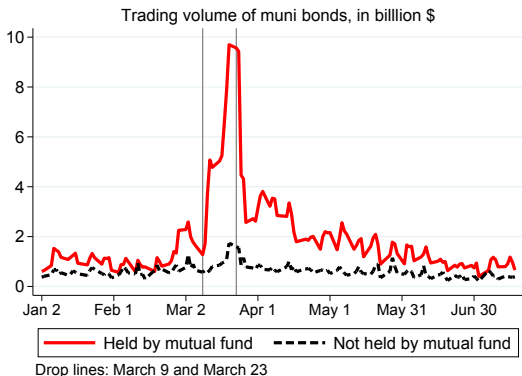
## Preview of main results [2/3]

- Muni dealers play a key role in transmitting fire sale risks of mutual funds.
  - Dealers stop taking (and start selling!) bonds held by mutual funds at the height of the crisis, and continue to do so *after* the crisis.

Total cumulative dealer inventory of muni bonds, in million$

Held by mutual fund   ----- Not held by mutual fund

Drop lines: March 9 and March 23

Preview of main results [3/3]

- Mutual fund fragility risks introduce what appears to be a "**fire sale premium**" incorporated in muni pricing in the post-crisis period.
  - A 30-basis-point wedge persists between the yield spreads of bonds held by mutual funds and those that are not.

Tax-adjusted yield spreads of muni bonds, in percent

Held by mutual fund   Not held by mutual fund
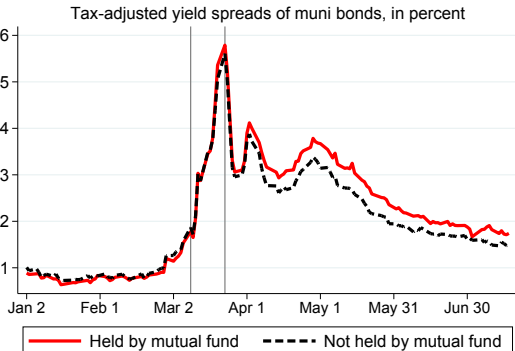
Drop lines: March 9 and March 23

Data

- Full sample period: end of 2019 to July 17, 2020

- Data for municipal bonds
    - Municipal Securities Rulemaking Board (MSRB): transaction-level data on secondary market trading
    - Mergent Municipal Bond Securities Database: bond characteristics information.
      [Exclude if issued within three months, maturing within one year, with insurance, with floating coupon rates, or not exempt from federal tax]

- Data for municipal mutual funds
    - Thomson Reuters eMAXX: security-level holding information (quarterly) for 893 funds
    - Morningstar: assets under management (AUMs) and investor flow (daily) for 428 funds

Mutual fund ownership and bond trading activities [1/2]

- Does mutual fund ownership (rather than other factors) drive the surge in muni trading during the crisis?

  - Sample period: Feb 24 to Mar 20, 2020

  - $\log(TradingVolume_{i,t}) = \beta_1 \times HeldbyMF_i + \beta_2 \times Crisis_t + \beta_3 \times Crisis_t \times HeldbyMF_i + \gamma \times X_{i,t} + \mu_{type} + \mu_{sector} + \mu_{state} + \epsilon_{i,t}$

- Variable definition:

  - *TradingVolume*: Total par amount traded between customers and dealers in bond i on day t.
  - *HeldbyMF*: a dummy equal to one if the bond is held by mutual funds as of the end of 2019.
  - *Crisis*: a dummy equal to one for the period Mar 9–20.
  - *X*: bond characteristics (rating, coupon, age, time to maturity, and amount outstanding).
  - Fixed effects μ: bond type (3), sector (8), state (50).

Mutual fund ownership and bond trading activities [2/2]

- Compared to other bonds, those held by mutual funds experience an additional 29% increase in trading activities during the crisis period.

- Robust to the inclusion of **issuer×date fixed effects**.

	Dependent variable: log(Trading volume)				
	(1)	(2)	(3)	(4)	(5)
Held by MF×Crisis	0.293***				
	(7.10)				
MF share×Crisis		0.924***	0.926***	0.907***	0.810***
		(8.02)	(8.03)	(8.23)	(7.71)
Crisis	-0.066***	-0.058***			
	(-3.03)	(-2.96)			
Bond controls	Yes	Yes	Yes	Yes	Yes
Rating FE	Yes	Yes	Yes		
Type FE	Yes	Yes	Yes		
Sector FE	Yes	Yes	Yes		
State FE	Yes	Yes	Yes		
Date FE			Yes	Yes	
Issuer FE				Yes	
Bond controls×Crisis					Yes
Issuer×Date FE					Yes
Adj. R^2	0.062	0.078	0.078	0.117	0.101
N of obs.	197016	197016	197016	195372	157038

(Lack of) dealer liquidity provision during the crisis [1/2]

- How did dealers respond to mutual fund sell-offs?
    - Sample period: Feb 24 to Mar 20, 2020
    - $\log(DealerNetPurchase_{i,t}) = \beta_1 \times HeldbyMF_i + \beta_2 \times Crisis_t + \beta_3 \times Crisis_t \times HeldbyMF_i + \gamma \times X_{i,t} + \mu_{type} + \mu_{sector} + \mu_{state} + \epsilon_{i,t}$

- Variable definition:
    - *DealerNetPurchase*: dealers' aggregate purchase minus their aggregate sales in bond i on day t.
    - *HeldbyMF*: a dummy equal to one if the bond is held by mutual funds as of the end of 2019.
    - *Crisis*: a dummy equal to one for the period Mar 9–20
    - X: bond characteristics (rating, coupon, age, time to maturity, and amount outstanding).
   - Fixed effects μ: bond type (3), sector (8), state (50).

(Lack of) dealer liquidity provision during the crisis [2/2]

- Dealers sell more bonds with mutual fund holders during the crisis.

	Dependent variable: Dealer net purchase				
	(1)	(2)	(3)	(4)	(5)
Held by MF×Crisis	-0.019***				
	(-3.73)				
MF share×Crisis		-0.062***	-0.062***	-0.058***	-0.038**
		(-3.46)	(-3.39)	(-3.09)	(-2.64)
Crisis	-0.009	-0.010			
	(-1.46)	(-1.64)			
Bond controls	Yes	Yes	Yes	Yes	Yes
Rating FE	Yes	Yes	Yes		
Type FE	Yes	Yes	Yes		
Sector FE	Yes	Yes	Yes		
State FE	Yes	Yes	Yes		
Date FE			Yes	Yes	
Issuer FE				Yes	
Bond controls×Crisis					Yes
Issuer×Date FE					Yes
Adj. R^2	0.003	0.003	0.006	-0.029	-0.031
N of obs.	197016	197016	197016	195372	157038

Muni fund AUMs around the crisis

- Shortly after the Fed's interventions, redemptions from muni funds subsided.
  - Fund flows largely normalize in April, and in May muni funds start to attract consecutive inflows.

Assets in Municipal Bond Mutual Funds, in billion $
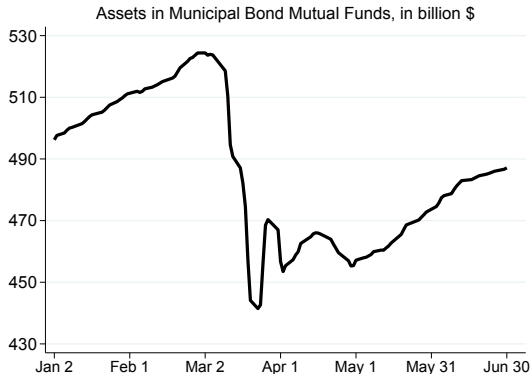
Post-crisis dealer liquidity provision [1/2]

- In the post-crisis era, do dealers reduce their inventories in bonds bearing potential mutual fund fragility risks?

  - *Cumu Inventory*$_{i,t}$ =
    $\alpha + \beta_1 PostCrisis_t + \beta_2 Held\ by\ MF_{i,t} + \beta_3 PostCrisis_t \times Held\ by\ MF_{i,t} + \gamma X_{i,t} + \mu_{rating} + \mu_{type} + \mu_{sector} + \mu_{state} + \epsilon_{i,t}$

- Sample period: Jan 3 to Jul 17 (**excluding Mar and Apr**)

- Independent variables:
  - *PostCrisis*: a dummy equal to one for the period May 1–Jul 17
  - Variable of interest: the interaction term of *Held by MF* and *PostCrisis*.

Post-crisis dealer liquidity provision [2/2]

- Dealers reduce their inventories more in bonds bearing higher mutual fund fragility risks.

	(1)	(2)	(3)	(4)	(5)
Dependent variable: Cumulative dealer inventory					
Held by MF×Post-crisis	-0.267***				
	(-6.87)				
MF share×Post-crisis		-0.858***	-0.859***	-0.846***	-0.552***
		(-5.60)	(-5.61)	(-5.30)	(-3.51)
Post-crisis	-0.053***	-0.066***			
	(-6.84)	(-4.46)			
Bond controls	Yes	Yes	Yes	Yes	Yes
Rating FE	Yes	Yes	Yes		
Type FE	Yes	Yes	Yes		
Sector FE	Yes	Yes	Yes		
State FE	Yes	Yes	Yes		
Date FE			Yes	Yes	
Issuer FE				Yes	
Bond controls×Post-Crisis					Yes
Issuer×Date FE					Yes
Adj. R^2	0.009	0.010	0.010	0.102	-0.022
N of obs.	702372	702372	702372	701189	531024

Changes in market liquidity conditions

- Post-crisis liquidity deteriorates more in bonds held by mutual funds.
- Such deterioration is more severe among more frequently traded bonds.

Dependent variable: Size-matched bid-ask spread						
	(1)	(2)	(3)	(4)	**Freq>10** (5)	**Freq>20** (6)
Held by MF×Post-crisis	0.028*** (3.32)					
MF share×Post-crisis		0.051* (1.97)	0.046* (1.87)	0.062* (1.87)	0.181*** (3.15)	0.260** (2.62)
Post-crisis		0.118*** (9.22)	0.125*** (10.07)			
Bond controls	Yes	Yes	Yes	Yes	Yes	Yes
Rating FE	Yes	Yes				
Type FE	Yes	Yes				
Sector FE	Yes	Yes				
State FE	Yes	Yes				
Date FE			Yes			
Issuer FE			Yes			
Bond controls×Post-Crisis				Yes	Yes	Yes
Issuer×Date FE				Yes	Yes	Yes
Adj. R^2	0.271	0.273	0.327	0.338	0.358	0.381
N of obs.	122408	122408	119818	62202	24534	9837

The aftermath: pricing implications of mutual fund fragility risks

- In the post-crisis period, all muni bonds have higher yields, but yield spreads for bonds held by mutual funds increase by **additional 34 bps**.

	Dependent variable: bond yield spreads (tax-adjusted)				
	(1)	(2)	(3)	(4)	(5)
Held by MF×Post-crisis	0.337***				
	(18.97)				
MF share×Post-crisis		1.166***	1.149***	1.153***	0.401***
		(23.68)	(23.90)	(25.98)	(16.36)
Post-crisis	1.132***	1.138***			
	(15.00)	(14.73)			
Bond controls	Yes	Yes	Yes	Yes	Yes
Rating FE	Yes	Yes	Yes		
Type FE	Yes	Yes	Yes		
Sector FE	Yes	Yes	Yes		
State FE	Yes	Yes	Yes		
Date FE			Yes	Yes	
Issuer FE				Yes	
Bond controls×Post-Crisis					Yes
Issuer×Date FE					Yes
Adj. R^2	0.538	0.542	0.624	0.682	0.743
N of obs.	702372	702372	702372	701189	531024

What is the mechanism of post-crisis pricing effects? [1/2]

- If the pricing effects are indeed driven by the fear for potential mutual fund runs:
    - We should expect such **pricing effects to be stronger for bonds held by mutual funds more susceptible to runs**.

- What determines mutual funds' potential run risks?
    - Exposure to sectors hard hit by the pandemic
    - Average maturity of a fund's portfolio
    - Average illiquidity levels of a fund's portfolio

- We link these latent fragility sources to the pricing of individual bonds.
    1. For each fund, calculate fund-level run risks based on holdings
    2. For each bond, calculate the average run risks for its holding funds (weighted by holding amount)
    3. Sort bonds into 2 subsamples based on their run risk measures

What is the mechanism of post-crisis pricing effects? [2/2]

- Focus on bonds held by mutual funds.

- Underlying mutual fund fragility drives individual bond pricing, especially when the bond is held by more run-susceptible funds.

Dependent variable: bond yield spreads (tax-adjusted)						
	MF holders' Covid exposure		MF holders' portfolio maturity		MF holders' portfolio liquidity	
	Large (1)	**Small** (2)	**Long** (3)	**Short** (4)	**Low** (5)	**High** (6)
MFshare×PostCrisis	0.51*** (8.99)	0.17*** (4.57)	0.57*** (9.77)	0.22*** (7.44)	0.53*** (9.22)	0.13*** (4.01)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Controls×PostCrisis	Yes	Yes	Yes	Yes	Yes	Yes
Issuer×Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.761	0.790	0.756	0.830	0.752	0.801
N of obs.	114036	117572	109992	120152	112412	119641
p-value of the diff.	0.000		0.000		0.000	

Note: Sectors with (more) Covid exposure: transportation, health & nursing care, leisure

Conclusions

- Investor redemptions from mutual funds greatly destabilize the muni market during the Covid-19 crisis.

  - A bond experiences more intensive trading and price depression when its holding funds have suffered larger redemptions.

- Muni dealers play a key role in transmitting fire sale risks of mutual funds.

  - Dealers pull back from bonds held by mutual funds during the crisis, and continue to do so *after* the crisis.

- The fragility risks posed by mutual funds seem to have lasting effects on the muni market.

  - A wedge persists between the yield spreads of bonds held by mutual funds and those that are not.
  - The pricing effects are stronger when a bond's holding funds are more susceptible to potential investor runs.