

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

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IBEFA 2023

# Motivation

- Global investors view the U.S. Treasury market as the safe haven
- until the COVID-19 pandemic

## Covid-19 market rout and dislocations in the US Treasury market

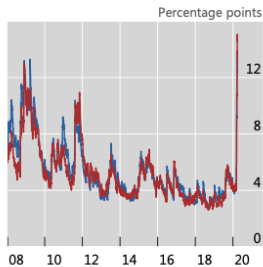
Graph 1

### Equity prices and Treasury yields



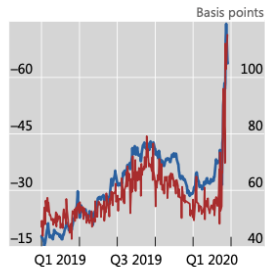
Lhs: — Ten-year Treasury yield  
Rhs: — S&P 500

### US Treasury market volatility<sup>1</sup>



— 10y — 30y

### OIS and interest rate swap spreads



— 30y treasury - OIS spread  
— 30y swap spread (reversed scale)

The vertical line in the left-hand panel indicates 9 March 2020.

*Schrimpf, Shin, and Sushko 2020*

# Motivation

- Increased fragility in the recent Treasury market.

*'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)

- Economic mechanism is not clear yet.

# Our Explanation

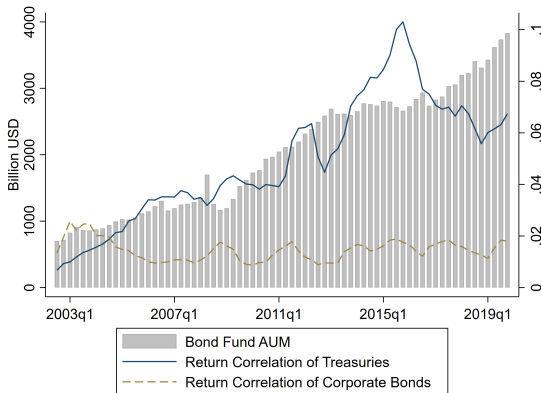
- The rise of open-end mutual funds holding illiquid assets
  - ▶ Perform liquidity transformation
  - ▶ The strategic complementarity among investors generates fragility (e.g., Chen, Goldstein, & Jiang 2010)
- Using Treasuries to manage liquidity
  - ▶ Hold Treasuries or other cash-like assets to buffer flow shocks
  - ▶ Trading-to-flow sensitivity increases for Treasuries, but decrease for corporate bond positions (e.g., Choi et al, 2020; Jiang, Li & Wang 2020)
  - ▶ Particularly so for outflows
  - ▶ Funds spillover the flow shocks to Treasury market
- 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

- Liquidity management can exacerbate flow-induced price pressure on Treasuries and lead to fragility.
  - ▶ Risk-adjusted return: residuals from regressing bond returns onto a factor model
  - ▶ Flow-induced trading generates contemporaneous price pressure
  - ▶ Effect is more pronounced when funds experience outflows
  - ▶ Testable implications:
    - ★ Price comovement (the degree of contagion)
    - ★ Down-market minus up-market price comovement: the asymmetric pattern due to outflows
    - ★ Commonality in illiquidity; Skewness; Volatility
- Weaker for corporate bond prices
- Sample: U.S. open-end bond mutual funds
  - ▶ With their holding data on Treasuries and corporate bonds
  - ▶ Natural experiments: 2003 mutual fund scandal
  - ▶ Implication: COVID-19 pandemic

# Trends

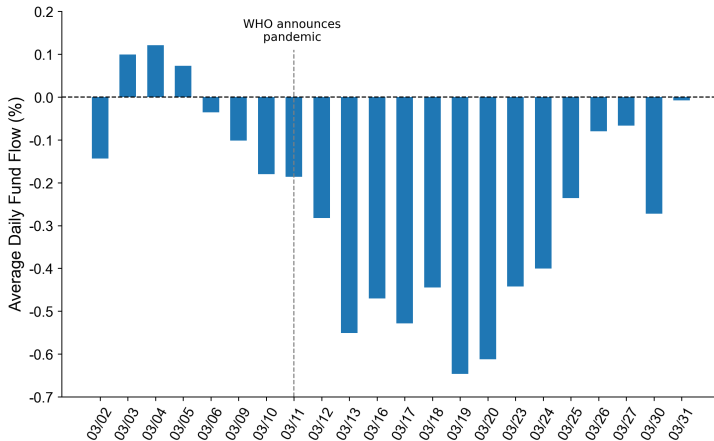
- The average excess return comovement among Treasuries increases from 1% to 7% between 2002 to 2019



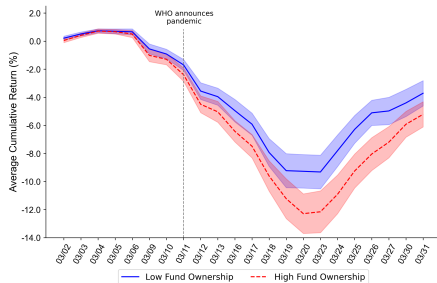
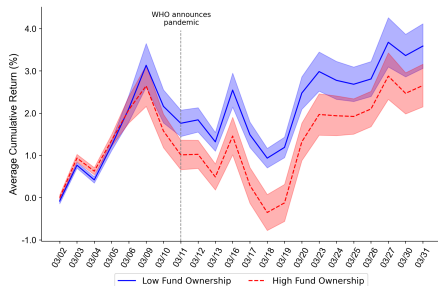
- Echoes the regulators concerns on fragility in Treasuries

# 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



- Bond funds experiencing large outflows incline to liquidate treasuries
- Both long-term and short term evidences suggest that bond funds can contribute to Treasury fragility



# Risk-adjusted 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.
- ▶ Additional factors for robustness: *VIX*, *TERM*, and *DEF*.

# Liquidity Management: Trading-to-Flow Sensitivity

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

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

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

- $\beta_1 > 1$  for Treasuries,  $\beta_1 < 1$  for corporate bonds
- $Out_{f,q}$ : A dummy variable that equals one if  $Flow_{f,q}$  is negative, and zero otherwise

# Result: Liquidity Management

| DepVar:                                 | Net $Buy_{f,q}$     |                     |                     |                     |                     |                     |                     |                     |
|-----------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|                                         | Treasury            |                     |                     |                     | Corporate Bonds     |                     |                     |                     |
|                                         | (1)                 | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 | (7)                 | (8)                 |
| $Fund\ Flow_{f,q}$                      | 1.382***<br>(23.5)  | 1.417***<br>(22.5)  | 1.197***<br>(15.5)  | 1.249***<br>(15.6)  | 0.864***<br>(23.9)  | 0.859***<br>(23.3)  | 0.882***<br>(16.0)  | 0.876***<br>(16.0)  |
| $Fund\ Flow_{f,q} \times Out_{f,q}$     |                     |                     | 0.564***<br>(4.2)   | 0.509***<br>(4.0)   |                     |                     | -0.055<br>(-0.7)    | -0.052<br>(-0.7)    |
| $Fund\ Flow_{f,q-1}$                    | -0.302***<br>(-6.3) | -0.259***<br>(-5.8) | -0.226***<br>(-3.7) | -0.164***<br>(-3.2) | 0.214***<br>(7.2)   | 0.206***<br>(7.0)   | 0.225***<br>(5.4)   | 0.212***<br>(5.1)   |
| $Fund\ Flow_{f,q-1} \times Out_{f,q-1}$ |                     |                     | -0.234*<br>(-2.0)   | -0.313***<br>(-3.1) |                     |                     | -0.044<br>(-0.5)    | -0.025<br>(-0.3)    |
| $Fund\ Return_{f,q}$                    | -0.760***<br>(-3.2) | -0.585*<br>(-2.0)   | -0.789***<br>(-3.3) | -0.608**<br>(-2.1)  | -0.001<br>(-0.0)    | -0.185<br>(-0.8)    | 0.003<br>(0.0)      | -0.183<br>(-0.8)    |
| $Fund\ Return_{f,q-1}$                  | 0.163<br>(0.6)      | 0.326<br>(1.0)      | 0.145<br>(0.5)      | 0.317<br>(1.0)      | -0.552***<br>(-3.3) | -0.693***<br>(-3.9) | -0.547***<br>(-3.2) | -0.689***<br>(-3.8) |
| Fund Fixed Effects                      | No                  | Yes                 | No                  | Yes                 | No                  | Yes                 | No                  | Yes                 |
| Quarter Fixed Effects                   | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| # of Obs                                | 34,008              | 34,008              | 34,008              | 34,008              | 34,008              | 34,008              | 34,008              | 34,008              |
| Adj $R^2$                               | 0.070               | 0.190               | 0.071               | 0.191               | 0.097               | 0.159               | 0.097               | 0.159               |

- 1% inflow  $\rightarrow$  a 1.25% (0.88%) increase in Treasury (corporate bond) holdings
- 1% outflow  $\rightarrow$  a 1.76% (0.82%) decrease in Treasury (corporate bond) holdings

# Flow-induced Trading Impact on Treasury Prices

- Following Lou (2012): purchase or sell driven by fund flows

$$FIT_{i,t} = \frac{\sum_i^F Share_{i,f,q-1} * Fund\ Flow_{f,t}}{\sum_i^F Share_{i,f,q-1}}$$

- The asymmetric impact between inflows and outflows:
  - ▶ *FIT\_Positive*: *FIT* computed from funds with positive flows
  - ▶ *FIT\_Negative*: *FIT* computed from funds with negative flows
- Fama-MacBeth (1973) regressions:

$$Return_{i,t} = \alpha + \beta \cdot FIT_{i,t} + \theta \cdot X_{i,t} + \varepsilon_{i,t}$$

- ▶  $X_{i,j,q-1}$ : *On-the-run*, *Coupon*, and *Time-to-maturity*

# Flow-induced Trading Impact on Treasury Prices

$$Return_{i,t} = \alpha + \beta \cdot FIT_{i,t} + \theta \cdot X_{i,t} + \varepsilon_{i,t}$$

| DepVar:                 | Risk-adjusted Return |                   | Excess Return      |                    |
|-------------------------|----------------------|-------------------|--------------------|--------------------|
|                         | (1)                  | (2)               | (3)                | (4)                |
| <i>FIT</i>              | 4.801***<br>(3.9)    |                   | 2.833***<br>(3.0)  |                    |
| <i>FIT_Pos</i>          |                      | 3.618**<br>(2.3)  |                    | 0.955<br>(0.8)     |
| <i>FIT_Neg</i>          |                      | 7.755***<br>(3.0) |                    | 6.544***<br>(3.5)  |
| <i>On-the-run</i>       |                      |                   | 3.717<br>(1.5)     | 3.904<br>(1.6)     |
| <i>Coupon Rate</i>      |                      |                   | 21.307***<br>(9.1) | 20.987***<br>(9.0) |
| <i>Time-to-maturity</i> |                      |                   | 12.247<br>(1.6)    | 12.410*<br>(1.7)   |
| # of Obs                | 57,521               | 57,521            | 57,521             | 57,521             |

- A one SD increase in *FIT* is associated with a 4.8 bp increase in the risk-adjusted return in the contemporaneous month.
- The price impact is about two times stronger for outflows than for inflows.

# Common Ownership and Return Comovement

- Common ownership (Anton and Polk, 2014) for each Treasury pair,  $i$  and  $j$ , at quarter  $q$ , (standardized)

$$\text{Common Ownership}_{i,j,q} = \frac{\sum_{f=1}^F (\text{Shares}_{i,f,q} \times P_{i,q} + \text{Shares}_{j,f,q} \times P_{j,q})}{\text{SharesOutstanding}_{i,q} \times P_{i,q} + \text{SharesOutstanding}_{j,q} \times P_{j,q}}$$

- Fama-MacBeth (1973) regressions

$$\begin{aligned}\text{Corr}_{i,j,q} &= \alpha + \beta \cdot \text{Common Ownership}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q} \\ \text{Down-minus-up}_{i,j,q} &= \alpha + \beta \cdot \text{Common Ownership}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}\end{aligned}$$

- ▶ *Corr*: The pairwise return correlation of daily risk-adjusted returns
- ▶ *Down-minus-up*: The difference in the pairwise return correlation between downside and upside markets
  - ★ Upside (downside) markets: daily aggregate Treasury market return above (below) quarter median
  - ★ Advantages: (1) "crash contagion" (2) mitigate endogeneity

# Result: Common Ownership and Return Comovement

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

| Panel A: Treasury                  |                    |                      | Panel B: Corporate Bonds           |                   |                      |
|------------------------------------|--------------------|----------------------|------------------------------------|-------------------|----------------------|
| DepVar:                            | Corr               |                      | DepVar:                            | Corr              |                      |
|                                    | (1)                | (2)                  |                                    | (3)               | (4)                  |
| <i>Common Ownership</i>            | 0.103***<br>(36.8) | 0.079***<br>(19.8)   | <i>Common Ownership</i>            | 0.007***<br>(9.9) | 0.005***<br>(9.1)    |
| <i>On-the-run Difference</i>       |                    | 0.016***<br>(4.3)    | <i>Liquidity Difference</i>        |                   | -0.004***<br>(-13.4) |
| <i>Coupon Rate Difference</i>      |                    | -0.056***<br>(-20.7) | <i>Coupon Rate Difference</i>      |                   | -0.002***<br>(-4.3)  |
| <i>Time-to-maturity Difference</i> |                    | -0.176***<br>(-21.6) | <i>Rating Difference</i>           |                   | -0.003***<br>(-7.5)  |
|                                    |                    |                      | <i>Time-to-maturity Difference</i> |                   | -0.003***<br>(-7.3)  |
| # of Obs                           | 2,185,735          | 2,185,735            | # of Obs                           | 11,528,871        | 11,528,871           |

- A one SD increase in *Common Ownership* is associated with a 7.9% 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 = 1.4%)

# Result: Upside vs. Downside Markets

$$Down-minus-up_{i,j,q} = \alpha + \beta \cdot Common\ Ownership_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}$$

| Panel A: Treasury                  |                   |                     | Panel B: Corporate Bonds           |                 |                   |
|------------------------------------|-------------------|---------------------|------------------------------------|-----------------|-------------------|
| DepVar:                            | Down-minus-up     |                     | DepVar:                            | Down-minus-up   |                   |
|                                    | (1)               | (2)                 |                                    | (3)             | (4)               |
| <i>Common Ownership</i>            | 0.011***<br>(5.3) | 0.008***<br>(2.9)   | <i>Common Ownership</i>            | 0.0005<br>(1.3) | 0.0004<br>(1.3)   |
| <i>On-the-run Difference</i>       |                   | -0.012***<br>(-5.2) | <i>Liquidity Difference</i>        |                 | -0.0000<br>(-0.1) |
| <i>Coupon Rate Difference</i>      |                   | 0.008<br>(1.5)      | <i>Coupon Rate Difference</i>      |                 | 0.0000<br>(0.0)   |
| <i>Time-to-maturity Difference</i> |                   | -0.065***<br>(-7.5) | <i>Rating Difference</i>           |                 | -0.0004<br>(-1.1) |
|                                    |                   |                     | <i>Time-to-maturity Difference</i> |                 | 0.0006<br>(1.2)   |
| # of Obs                           | 2,185,735         | 2,185,735           | # of Obs                           | 11,528,871      | 11,528,871        |

- A one standard deviation increase in *Common Ownership* is associated with a 0.8% increase *Down-minus-up* (sample mean = 0.3%)
- Bond funds use Treasury securities instead of corporate bonds as flow buffer in liquidity management



# Natural Experiment: 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
  - ▶ Treasuries owned by scandal funds experienced a significant reduction in ownership during the scandal period, which is exogenous
- Following Koch, Ruenzi, and Starks (2016), a difference-in-differences regression:

$$\begin{aligned} Down-minus-up_{i,j,q} = & \alpha + \beta \cdot Treat_{i,j} \times Event_q + \theta_1 \cdot Treat_{i,j} \\ & + \theta_2 \cdot X_{i,j,q-1} + year-quarter\ dummies + \varepsilon_{i,j,q}, \end{aligned} \quad (1)$$

# Natural Experiment: 2003 Mutual Fund Scandal

| DepVar:                            | Down-minus-up     |                     |                      |                      |
|------------------------------------|-------------------|---------------------|----------------------|----------------------|
|                                    | (1)               | (2)                 | (3)                  | (4)                  |
| <i>Treat</i> $\times$ <i>Event</i> | -0.005*<br>(-1.8) | -0.005*<br>(-1.8)   | -0.005**<br>(-2.0)   | -0.007***<br>(-2.6)  |
| <i>Treat</i>                       | 0.005**<br>(2.3)  | 0.005**<br>(2.4)    | 0.003<br>(1.5)       | -0.002<br>(-0.8)     |
| <i>On-the-run Difference</i>       |                   | -0.012***<br>(-3.7) | -0.012***<br>(-3.6)  | -0.006<br>(-0.8)     |
| <i>Coupon Rate Difference</i>      |                   |                     | -0.007***<br>(-11.4) | -0.007***<br>(-11.9) |
| <i>Time-to-maturity Difference</i> |                   |                     |                      | -0.051***<br>(-89.6) |
| # of Obs                           | 128,818           | 128,818             | 128,818              | 128,818              |

# Treasury market turmoil during COVID-19

$$\text{Corr}_{i,j,m} = \alpha + \beta \cdot \text{Treat}_{i,j} \times \text{After}_m + \theta_1 \cdot \text{Treat}_{i,j} + \theta_2 \cdot \text{After}_m + \theta_3 \cdot X_{i,j} + \varepsilon_{i,j,m}$$

- $\text{Treat}_{i,j} = 1$  if the security pair  $i$  and  $j$  has common ownership (at the end of 2019) above the median, and zero otherwise.
- $\text{After}_m = 1$  if  $\text{Corr}_{i,j,m}$  is computed on and after March 11, 2020, zero otherwise.

| DepVar:                            | Corr               |                    |                     |                     |
|------------------------------------|--------------------|--------------------|---------------------|---------------------|
|                                    | Treasury           |                    | Corporate Bonds     |                     |
|                                    | (1)                | (2)                | (3)                 | (4)                 |
| $\text{Treat} \times \text{After}$ | 0.042***<br>(7.2)  | 0.042***<br>(10.7) | 0.009***<br>(2.6)   | 0.009***<br>(2.6)   |
| $\text{Treat}$                     | 0.210***<br>(47.6) | 0.134***<br>(48.0) | 0.017***<br>(8.8)   | 0.010***<br>(4.7)   |
| $\text{After}$                     | 0.015***<br>(4.0)  | 0.015***<br>(5.7)  | -0.009***<br>(-3.5) | -0.009***<br>(-3.5) |
| Controls                           | No                 | Yes                | No                  | Yes                 |
| # of Obs                           | 97,006             | 97,006             | 126,186             | 126,186             |
| Adj $R^2$                          | 0.063              | 0.567              | 0.001               | 0.003               |

# Liquidity Commonality among Treasuries

- Recent studies document a deterioration in the liquidity conditions in the Treasury market
  - ▶ Schrimpf, Shin, and Sushko (2020), Fleming and Ruela (2020)
  - ▶ Liquidity dry-up in Treasuries during the COVID-19 crisis
  - ▶ Another indicator for market fragility
- We use the sample spanning a long period (from 2002 to 2019) and conduct cross-sectional tests to study whether fund common ownership can generate liquidity commonality in Treasuries.
  - ▶ Liquidity dry-up event: days with bid-ask spreads exceeding the top quartile of bid-ask spreads in the previous four quarters.
  - ▶ *Common Dry-ups*: A dummy variable that equals one if these two Treasuries have experienced liquidity dry-ups in the same day.
  - ▶ For individual bonds, decreasing skewness: larger price crash likelihood

# Liquidity Commonality among Treasuries

$$\text{Common Dry-ups}_{i,j,q} = \alpha + \beta \cdot \text{Common Ownership}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}$$

| Panel A: Full Sample         |                     |                     |                     |                      |
|------------------------------|---------------------|---------------------|---------------------|----------------------|
| DepVar:                      | Common Dry-ups      |                     | Skewness            |                      |
|                              | (1)                 | (2)                 | (3)                 | (4)                  |
| <i>Common Ownership</i>      | 0.025***<br>(3.6)   | 0.027***<br>(3.6)   |                     |                      |
| <i>Ownership</i>             |                     |                     | -0.587***<br>(-9.9) | -0.441***<br>(-10.9) |
| Controls                     | No                  | Yes                 | No                  | Yes                  |
| # of Obs                     | 2,185,735           | 2,185,735           | 16,477              | 16,477               |
| Panel B: Mutual Fund Scandal |                     |                     |                     |                      |
| DepVar:                      | Common Dry-ups      |                     | Skewness            |                      |
|                              | (1)                 | (2)                 | (3)                 | (4)                  |
| <i>Treat × Event</i>         | -0.002***<br>(-3.3) | -0.002***<br>(-3.2) | 0.238**<br>(2.0)    | 0.269**<br>(2.2)     |
| <i>Treat</i>                 | 0.002***<br>(4.1)   | 0.002***<br>(3.3)   | -0.184**<br>(-2.0)  | -0.260***<br>(-2.7)  |
| Controls                     | No                  | Yes                 | No                  | Yes                  |
| # Obs                        | 128,818             | 128,818             | 3,082               | 3,082                |

# Conclusion

- Liquidity management contribute to the increasing fragility in the Treasury market
  - ▶ Non-fundamental-driven flow-induced trading generates contemporaneous price impacts and subsequent reversal.
  - ▶ Excess return comovement, especially during downside markets.
  - ▶ Liquidity commonalities
  - ▶ Skewness
- 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)

## Appendix

# Outflow Funds versus Inflow Funds

| DepVar:                                                  | Corr               |                    |                   |                   |
|----------------------------------------------------------|--------------------|--------------------|-------------------|-------------------|
|                                                          | Treasury           |                    | Corporate Bonds   |                   |
|                                                          | (1)                | (2)                | (3)               | (4)               |
| <i>Common Ownership</i>                                  | 0.075***<br>(10.5) | 0.075***<br>(10.6) | 0.004***<br>(4.5) | 0.004***<br>(4.6) |
| <i>Common Ownership</i> $\times$ <i>Ratio of Outflow</i> | 0.039**<br>(2.3)   | 0.038**<br>(2.3)   | -0.000<br>(-0.2)  | -0.000<br>(-0.0)  |
| <i>Ratio of Outflow</i>                                  | 0.015<br>(1.3)     | 0.015<br>(1.3)     | -0.002*<br>(-1.7) | -0.002*<br>(-1.8) |
| Control                                                  | Yes                | Yes                | Yes               | Yes               |
| Control $\times$ <i>Ratio of Outflow</i>                 | No                 | Yes                | No                | Yes               |
| # of Obs                                                 | 1,836,161          | 1,836,161          | 5,820,845         | 5,820,845         |

- *Ratio of Outflow*: holding-weighted proportion of the security pair's common funds whose fund flow is negative.
- The effect of fund common ownership on Treasury return comovement is stronger when more funds experience redemption.



# Illiquid funds vs. liquid funds

| DepVar:                                                | <i>Net Buy<sub>f,q</sub></i> |                     |                    |                     |
|--------------------------------------------------------|------------------------------|---------------------|--------------------|---------------------|
|                                                        | Illiquid Funds               |                     | Liquid Funds       |                     |
|                                                        | Treasuries                   | Corporate Bonds     | Treasuries         | Corporate Bonds     |
|                                                        | (1)                          | (2)                 | (3)                | (4)                 |
| <i>Fund Flow<sub>f,q</sub></i>                         | 1.205***<br>(11.4)           | 0.882***<br>(14.0)  | 1.345***<br>(14.5) | 0.657***<br>(11.1)  |
| <i>Fund Flow<sub>f,q</sub> × Out<sub>f,q</sub></i>     | 0.885***<br>(5.3)            | 0.063<br>(0.6)      | 0.173<br>(0.9)     | 0.059<br>(0.6)      |
| <i>Fund Flow<sub>f,q-1</sub></i>                       | -0.248***<br>(-3.6)          | 0.117***<br>(2.9)   | -0.104<br>(-1.6)   | 0.234***<br>(4.7)   |
| <i>Fund Flow<sub>f,q-1</sub> × Out<sub>f,q-1</sub></i> | -0.299*<br>(-1.9)            | 0.023<br>(0.2)      | -0.284**<br>(-2.1) | -0.064<br>(-0.7)    |
| <i>Fund Return<sub>f,q</sub></i>                       | -0.545<br>(-1.3)             | -0.116<br>(-0.5)    | -0.178<br>(-0.3)   | -0.206<br>(-0.7)    |
| <i>Fund Return<sub>f,q-1</sub></i>                     | -0.212<br>(-0.6)             | -0.461***<br>(-2.8) | 0.817<br>(1.2)     | -0.929***<br>(-4.0) |
| Fund Fixed effects                                     | Yes                          | Yes                 | Yes                | Yes                 |
| Quarter Fixed Effects                                  | Yes                          | Yes                 | Yes                | Yes                 |
| # of Obs                                               | 15,695                       | 15,695              | 17,829             | 17,829              |
| Adj R <sup>2</sup>                                     | 0.199                        | 0.222               | 0.236              | 0.170               |

# Number of unique securities

| Panel A: Treasuries                |                    |                      |                   |                     |
|------------------------------------|--------------------|----------------------|-------------------|---------------------|
| DepVar:                            | Corr               |                      | Down-minus-up     |                     |
|                                    | (1)                | (2)                  | (3)               | (4)                 |
| <i>Common Ownership (more TRY)</i> | 0.082***<br>(24.8) | 0.067***<br>(21.2)   | 0.006***<br>(3.2) | 0.004**<br>(2.0)    |
| <i>Common Ownership (less TRY)</i> | 0.008***<br>(6.6)  | 0.004***<br>(4.7)    | 0.001**<br>(2.0)  | 0.000<br>(0.8)      |
| <i>On-the-run Difference</i>       |                    | 0.017***<br>(4.5)    |                   | -0.012***<br>(-5.2) |
| <i>Coupon Rate Difference</i>      |                    | -0.055***<br>(-20.4) |                   | 0.008<br>(1.5)      |
| <i>Time-to-maturity Difference</i> |                    | -0.176***<br>(-21.7) |                   | -0.065***<br>(-7.5) |
| # of Obs                           | 2,185,735          | 2,185,735            | 2,185,735         | 2,185,735           |
| Panel B: Corporate Bonds           |                    |                      |                   |                     |
| DepVar:                            | Corr               |                      | Down-minus-up     |                     |
|                                    | (1)                | (2)                  | (3)               | (4)                 |
| <i>Common Ownership (more CB)</i>  | 0.006***<br>(7.8)  | 0.004***<br>(7.3)    | 0.0004<br>(1.3)   | 0.0004<br>(1.4)     |
| <i>Common Ownership (less CB)</i>  | 0.001***<br>(4.4)  | 0.000***<br>(3.9)    | 0.0000<br>(0.2)   | 0.0000<br>(0.2)     |
| <i>Liquidity Difference</i>        |                    | -0.004***<br>(-13.4) |                   | -0.0000<br>(-0.1)   |
| <i>Coupon Rate Difference</i>      |                    | -0.002***<br>(-4.3)  |                   | -0.0000<br>(-0.0)   |
| <i>Rating Difference</i>           |                    | -0.003***<br>(-7.7)  |                   | -0.0005<br>(-1.2)   |
| <i>Time-to-maturity Difference</i> |                    | -0.004***<br>(-7.4)  |                   | 0.0006<br>(1.2)     |
| # of Obs                           | 11,528,871         | 11,528,871           | 11,528,871        | 11,528,871          |

# During COVID-19

| Panel A: Treasuries                |                    |                       |                    |                       |                    |                    |
|------------------------------------|--------------------|-----------------------|--------------------|-----------------------|--------------------|--------------------|
| DepVar:                            | Corr               |                       |                    |                       | After-minus-before |                    |
| Timing:                            | Before March 11    |                       | After March 11     |                       |                    |                    |
|                                    | (1)                | (2)                   | (3)                | (4)                   | (5)                | (6)                |
| <i>Common Ownership</i>            | 0.150***<br>(76.5) | 0.086***<br>(60.9)    | 0.178***<br>(97.4) | 0.149***<br>(97.5)    | 0.028***<br>(16.7) | 0.062***<br>(37.2) |
| <i>On-the-run Difference</i>       |                    | 0.060***<br>(8.7)     |                    | 0.051***<br>(7.3)     |                    | -0.009<br>(-1.1)   |
| <i>Coupon Rate Difference</i>      |                    | -0.054***<br>(-33.0)  |                    | 0.031***<br>(23.9)    |                    | 0.086***<br>(47.0) |
| <i>Time-to-maturity Difference</i> |                    | -0.378***<br>(-292.6) |                    | -0.278***<br>(-198.1) |                    | 0.100***<br>(66.5) |
| # of Obs                           | 48,503             | 48,503                | 48,503             | 48,503                | 48,503             | 48,503             |
| Adj $R^2$                          | 0.082              | 0.665                 | 0.148              | 0.548                 | 0.005              | 0.127              |

| Panel B: Corporate Bonds           |                   |                     |                    |                     |                    |                    |
|------------------------------------|-------------------|---------------------|--------------------|---------------------|--------------------|--------------------|
| DepVar:                            | Corr              |                     |                    |                     | After-minus-before |                    |
| Timing:                            | Before March 11   |                     | After March 11     |                     |                    |                    |
|                                    | (1)               | (2)                 | (3)                | (4)                 | (5)                | (6)                |
| <i>Common Ownership</i>            | 0.010***<br>(9.5) | 0.006***<br>(5.6)   | 0.018***<br>(11.3) | 0.013***<br>(8.0)   | 0.008***<br>(5.2)  | 0.007***<br>(4.5)  |
| <i>Liquidity Difference</i>        |                   | -0.007***<br>(-6.7) |                    | -0.001<br>(-0.8)    |                    | 0.005***<br>(3.7)  |
| <i>Coupon Rate Difference</i>      |                   | -0.003***<br>(-3.0) |                    | -0.003**<br>(-2.2)  |                    | -0.000<br>(-0.3)   |
| <i>Rating Difference</i>           |                   | -0.004***<br>(-4.0) |                    | -0.008***<br>(-5.2) |                    | -0.004**<br>(-2.6) |
| <i>Time-to-maturity Difference</i> |                   | -0.008***<br>(-7.1) |                    | -0.007***<br>(-4.0) |                    | 0.001<br>(0.3)     |
| # of Obs                           | 63,093            | 63,093              | 63,093             | 63,093              | 63,093             | 63,093             |
| Adj $R^2$                          | 0.001             | 0.003               | 0.002              | 0.003               | 0.000              | 0.001              |

# Month beginning vs. Month end

| Panel A: Treasuries                |                    |                      |                    |                      |                     |                     |
|------------------------------------|--------------------|----------------------|--------------------|----------------------|---------------------|---------------------|
| DepVar:                            | Corr               |                      |                    |                      | End-minus-beginning |                     |
| Timing:                            | Month end          |                      | Month beginning    |                      |                     |                     |
|                                    | (1)                | (2)                  | (3)                | (4)                  | (5)                 | (6)                 |
| <i>Common Ownership</i>            | 0.117***<br>(26.9) | 0.089***<br>(17.5)   | 0.100***<br>(31.2) | 0.080***<br>(18.1)   | 0.016***<br>(4.4)   | 0.010***<br>(3.0)   |
| <i>On-the-run Difference</i>       |                    | 0.021***<br>(4.2)    |                    | -0.000<br>(-0.0)     |                     | 0.021***<br>(5.3)   |
| <i>Coupon Rate Difference</i>      |                    | -0.064***<br>(-16.4) |                    | -0.041***<br>(-8.8)  |                     | -0.023***<br>(-5.8) |
| <i>Time-to-maturity Difference</i> |                    | -0.213***<br>(-18.5) |                    | -0.176***<br>(-19.7) |                     | -0.037***<br>(-3.3) |
| # of Obs                           | 2,185,735          | 2,185,735            | 2,185,735          | 2,185,735            | 2,185,735           | 2,185,735           |
| Panel B: Corporate Bonds           |                    |                      |                    |                      |                     |                     |
| DepVar:                            | Corr               |                      |                    |                      | End-minus-beginning |                     |
| Timing:                            | Month end          |                      | Month beginning    |                      |                     |                     |
|                                    | (1)                | (2)                  | (3)                | (4)                  | (5)                 | (6)                 |
| <i>Common Ownership</i>            | 0.008***<br>(9.5)  | 0.006***<br>(8.6)    | 0.009***<br>(8.3)  | 0.007***<br>(8.3)    | -0.001<br>(-1.6)    | -0.001<br>(-1.3)    |
| <i>Liquidity Difference</i>        |                    | -0.004***<br>(-10.1) |                    | -0.005***<br>(-9.0)  |                     | 0.001<br>(0.9)      |
| <i>Coupon Rate Difference</i>      |                    | -0.001***<br>(-3.9)  |                    | -0.002***<br>(-4.0)  |                     | 0.001<br>(1.4)      |
| <i>Rating Difference</i>           |                    | -0.004***<br>(-8.0)  |                    | -0.003***<br>(-6.1)  |                     | -0.000<br>(-1.0)    |
| <i>Time-to-maturity Difference</i> |                    | -0.004***<br>(-5.2)  |                    | -0.005***<br>(-4.8)  |                     | 0.001<br>(0.8)      |
| # of Obs                           | 11,528,871         | 11,528,871           | 11,528,871         | 11,528,871           | 11,528,871          | 11,528,871          |