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

Shiyang Huang   Wenxi Jiang   Xiaoxi Liu   Xin Liu

September 2020

Abstract

Bond mutual funds holding illiquid assets (e.g., corporate bonds) actively manage their positions in Treasuries to buffer redemption shocks. We argue and show supporting evidence that this liquidity management practice can induce fragility in Treasury prices. We find that Treasury pairs commonly held by bond funds exhibit higher return comovement than pairs with little common ownership. This effect is more pronounced during downside markets or when funds experience large outflows, but is weak for corporate bond pairs. We address endogeneity concerns by exploiting two plausibly exogenous events: the outbreak of COVID-19 and the 2003 mutual fund scandal.

Keywords: liquidity management; bond mutual fund; return comovement; financial fragility; U.S. Treasury

*We thank Hank Bessembinder, Kalok Chan, Dong Lou, Zhi Da, Li An, seminar participants at the Chinese University of Hong Kong, University of International Business and Economics, Renmin University of China, and University of Bath for helpful comments. Shiyang Huang: HKU Business School, The University of Hong Kong, huangsy@hku.hk; Wenxi Jiang: CUHK Business School, The Chinese University of Hong Kong, wenxijiang@baf.cuhk.edu.hk; Xiaoxi Liu: Bank for International Settlements, Amanda.Liu@bis.org; Xin Liu: Hanqing Advanced Institute of Economics and Finance, Renmin University of China, xinl@ruc.edu.cn. First draft: March 2019.

1 Introduction

Investors conventionally view the U.S. Treasury market as a safe haven. Regulators, however, have concerns about the increasing fragility in the Treasury market. In 2006, Jerome Powell, the current chair of the Federal Reserve, points out that "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."[1] Several recent episodes in the Treasury market exemplify this statement, including the "taper tantrum" in 2013, the "flash rally" in 2014, and the effects of the COVID-19 pandemic in March 2020.[2] So far, it is not completely clear what economic mechanism drives the increasing fragility in the most liquid market.

We argue and directly test whether the common practice of liquidity management contributes to the increased fragility in the Treasury market. Financial intermediaries performing liquidity transformation—holding illiquid assets but issuing liquid claims to investors—often face financial fragility arising from strategic complementarity among investors (e.g., Chen, Goldstein, and Jiang, 2010). To mitigate the fragility, financial intermediaries actively engage in liquidity management, that is, maintaining a large amount of cash-like or highly liquid assets—mostly Treasuries—as a buffer for investor withdraws. As a result, their tradings on Treasuries appear to be excessively sensitive to investors' demand for liquid claims (see Jiang, Li, and Wang, 2017; Choi, Hoseinzade, Shin, and Tehranian, 2020). This can potentially generate fragility and systematic risk in the Treasury market, which has been particularly relevant in recent years as the total size of open-end funds investing in illiquid assets has grown tremendously.[3]

To test the implications of liquidity management on Treasury prices, we focus on

[1]Testimony by Governor Powell on Trends in fixed-income markets (April 14, 2016), available at https://www.federalreserve.gov/newsevents/testimony/powell20160414.htm.

[2]For the discussion on the "taper tantrum," see Adrian, Fleming, Stackman, and Vogt (2015); for the discussion on the "flash rally," see the joint staff report by U.S. Department of the Treasury, the Fed, SEC, and CFTC (2016); for the discussion on the Treasury market performance during March 2020, see Duffie (2020), Fleming and Ruela (2020), He, Nagel, and Song (2020), Schrimpf, Shin, and Sushko (2020), and the Financial Stability Report (2020).

[3]As reported by the Investment Company Institute (2020), total assets under management of open-end mutual funds with primary investment in illiquid assets, such as corporate bonds, municipal bonds, and bank loans, increased from 1.3 trillion USD in 2002 to about 7.3 trillion in 2019.

U.S. open-end bond mutual funds (for brevity, we label them as "bond funds" hereafter). Bond funds are ideal for testing our argument because they have several unique features. First, bond funds usually trade two major asset classes with distinct liquidity levels, that is, U.S. Treasuries and corporate bonds. Second, detailed data on fund holdings are available at quarterly frequency for a long period, which allows us to directly analyze funds' trading behavior. Third, we can precisely measure investors' demand for liquid claims by fund flows.

To visualize how liquidity management affects Treasury prices, in Figure 1, we examine the effect of the COVID-19 pandemic in March 2020. Specifically, Figure 1 plots the daily flows of U.S. bond funds (Panel A) and the cumulative returns of two Treasury portfolios sorted by bond fund ownership at the end of 2019 (Panel B). As one can see, starting from the second week of March (the week when WHO announced the global pandemic), bond funds experienced significant fund outflows (around 5% between March 11 and 31), and Treasuries had large price declines. More importantly, the price declines on Treasuries heavily held by bond funds were much more pronounced. These patterns are consistent with our argument. That is, when bond funds experience large outflows, they liquidate Treasuries to meet investor redemption, exerting strong selling pressure on Treasuries.

We formally test our argument using bond fund holdings from 2002 to 2016. We start by showing that bond funds indeed use Treasuries as a buffer to manage their liquidity. Specifically, we examine how bond funds trade Treasuries and corporate bonds in response to fund flows. We find that bond funds disproportionately adjust their holdings of Treasuries and corporate bonds in response to fund flows. For example, with a 1% increase in fund flows, funds increase their holdings on Treasuries by about 1.13% but only increase their holdings in corporate bonds by 0.75%. Moreover, we find that the difference in the trading-to-flow sensitivity between Treasuries and corporate bonds is more pronounced when funds experience outflows. With a 1% decrease in fund flows, funds tend to decrease their holdings on Treasuries by 1.28% but only reduce their corporate bond holdings by 0.62%. These patterns suggest that bond funds use Treasuries in liquidity management, and Treasuries play a more important role when funds are redeemed by investors.

We next study the implication of liquidity management for Treasuries. Intuitively, to the extent that Treasuries are widely traded by bond funds as a liquidity buffer, Treasury prices should have systematic exposure to fund flows on bond funds. This mechanism is not new in the literature. For example, Greenwood and Thesmar (2011) and Anton and Polk (2014) find that stocks commonly held by a mutual fund tend to comove in price due to correlated fund trading. This mechanism naturally works on bond funds but has unique predictions for Treasuries and corporate bonds. As discussed earlier, bond funds' trading in Treasuries is more sensitive to fund flows than that of corporate bonds, and the trading-to-flow sensitivity among Treasuries is more pronounced when funds are redeemed. As such, we hypothesize that Treasuries commonly held by bond funds (termed as *common ownership* for brevity) should exhibit a strong excess return comovement. More importantly, such effect should be stronger when funds experience outflows. By comparison, the effect should be weaker for corporate bonds, as they are much less sensitive to flow shocks when bond funds use Treasuries as the liquidity buffer. In summary, we argue that the liquidity management practice among bond funds generates fragility in Treasuries—fund flows from bond funds generate systematic risk (in terms of excess return comovement) in the Treasury market, and this is particularly pronounced during downside markets.[4]

To test whether Treasury prices have excess exposure to fund flows, we conduct cross-sectional tests and link return comovement among Treasuries to bond fund ownership as follows. First, for each Treasury pair in each quarter, we calculate the correlation between the two securities' daily excess returns to measure return comovement. A bond's daily excess returns are computed as the residuals from a regression model that adjusts for average returns on Treasuries, investment-grade corporate bonds, and junk bonds.

We first look at the aggregate trends. Figure 2 plots the time series of average excess

[4]Our work has an intellectual link to prior studies on heightened systematic risk (i.e., contagion or excess return comovement) during crisis periods (see, King and Wadhwani, 1990; King, Sentana, and Wadhwani, 1994; Forbes and Rigobon, 2002; Rigobon, 2002; Bekaert, Harvey, and Ng, 2005).

return comovement on Treasuries (blue line) and corporate bonds (red line), as well as the total assets under management (AUM) of bond funds (bar, in billion USD). As one can see, since the early 2000s when the total AUM of bond funds started to grow quickly, the average excess return comovement among Treasuries has significantly increased from about 1% to 8%, which echoes regulators' concern about the fragility of the Treasury market (see, Powell, 2016). In sharp contrast, there is no such trend on corporate bonds. Although there are other potential driving forces, these patterns are nonetheless consistent with our main argument that the increasing size of the bond fund sector contributes to the increased fragility of the Treasury market.

We then run Fama and MacBeth (1973) regressions of the Treasury return comovement on common ownership and control for the pair's similarity in bond characteristics, including maturity, liquidity, and coupon rate. We have several findings. First, common ownership positively forecasts comovement among Treasuries. A one standard deviation increase in common ownership is associated with a 6.4% increase in the return correlation between two Treasury securities. For comparison, we examine corporate bonds but find a much smaller effect. A one standard deviation increase in common ownership is only associated with a 0.5% increase in the return correlation between two corporate bonds.

Second, we examine the asymmetry in the association between common ownership and return comovement during downside and upside markets. We measure this asymmetry in return comovement in the following steps. Within each quarter, we first sort all trading days into two equal groups (downside markets and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement for each group and take the difference in return comovement between downside and upside markets. For brevity, we denote this difference as *Down-minus-up*. Note that this asymmetry measure has a unique advantage in eliminating potential similarities in unobservable bond characteristics that may drive return comovement. After that, we run Fama-MacBeth regressions of *Down-minus-up* on common ownership to examine the asymmetric effect of common ownership on Treasuries between downside and upside markets.

Our analysis uncovers an intriguing pattern on Treasuries. The association between common ownership and Treasury return comovement is stronger during downside markets than that during upside markets. Specifically, a one standard deviation increase in common ownership is associated with 1.1% higher *Down-minus-up*, which is the difference of return comovement between downside and upside markets. The magnitude is economically meaningful, given that the average correlation of excess returns is 6.2% among Treasuries. In contrast, we do not find such a pattern on corporate bonds.[5] These results suggest that despite that the U.S. Treasury market is the most liquid one, it still has excess exposure to fund flows, especially during downside markets when bond funds tend to experience outflows. These findings echo the pattern in Figure 1 that, when bond funds were redeemed heavily during the March 2020 COVID-19 period, Treasuries heavily held by bond funds experienced large price declines.

We are aware of potential endogeneity issues related to our aforementioned findings. For example, Treasuries in the portfolio of a bond fund may have similar but unobservable fundamentals and thus naturally comove in price. While this explanation cannot reconcile the asymmetric pattern on the return comovement among Treasuries, we nonetheless exploit two natural experiments: the COVID-19 pandemic and the 2003 mutual fund scandal. Both events are plausibly exogenous shocks to common ownership. Using these two natural experiments, we find evidence consistent with our main findings. For example, during the outbreak of COVID-19 in the United States in March 2020, Treasuries experienced increased return comovement, and the pattern was stronger among Treasury pairs with high common ownership. In contrast, the pattern was substantially weaker for corporate bonds. Meanwhile, for the natural experiment of the 2003 mutual fund scandal, we run two-stage regressions following Anton and Polk (2014). In the two-stage regressions, we use the scandal (which occured from 2003Q4 through 2006Q4) as a plausibly exogenous shock to affected bond funds' ownership and find that the predicted common ownership can significantly forecast the asymmetric return comovement among

[5]In ubtabulated results, we find that there is no such asymmetric pattern on stocks, which further highlights the uniqueness of our findings on Treasuries.

Treasuries. In contrast, we do not find similar results for corporate bonds. Overall, both settings provide causal evidence that common ownership positively affects return comovement on Treasuries, particularly during downside markets. This suggests that liquidity management can mitigate the trading impact on corporate bonds but at the cost of increasing financial fragility on Treasuries.

We conduct several additional tests to corroborate the evidence. First, since liquidity management with Treasuries is more urgent when funds experience outflows, we expect that the association between common ownership and return comovement on Treasuries held by funds with fund outflows should be larger than that held by funds with fund inflows. We indeed find supporting evidence in the data. Again, we do not find a similar pattern for corporate bonds. Second, we find that bond fund ownership can negatively (positively) forecast return skewness (volatility) on individual Treasuries.

We also extend our analyses to study how common ownership affects the liquidity commonality on Treasuries. This extension is motivated by recent studies (e.g., Adrian, Fleming, Stackman, and Vogt, 2015; Fleming and Ruela, 2020) that find that even the most liquid market—the Treasury market—can experience sudden liquidity dry-ups (e.g., the "flash rally" in 2014). Similar to our findings on return comovement, we find that common ownership can positively and significantly forecast the liquidity comovement in the Treasury market.

Our study contributes to several strands of literature. First, our study is closely related to the growing literature on financial fragility and liquidity management of mutual funds. When mutual funds perform liquidity transformation—holding illiquid assets but issuing liquid claims to investors—they are often subject to financial fragility due to strategic complementaries among investors (for empirical evidence, see, Chen et al., 2010; Falato, Goldstein, and Hortaçsu, 2020). To mitigate the financial fragility, mutual funds use cash or cash-like assets to manage their liquidity needs (see Chernenko and Sunderam, 2016; Aragon, Ergun, Getmansky Sherman, and Girardi, 2017; Jiang et al., 2017; Choi et al., 2020; Ma, Xiao, and Zeng, 2020). For example, Ma et al. (2020) compare the liquidity management behaviors of fixed-income mutual funds and commercial banks during the COVID-19 pandemic, and they find that fixed-income mutual funds are more aggressive than commercial banks in selling liquid assets—Treasuries. Jotikasthira, Lundblad, and Ramadorai (2012) shows that emerging market funds prefer to trade holdings in more liquid markets when accommodating fund flow shocks. Our study complements the literature by systematically and directly investigating the impact of liquidity management on the prices of the buffer assets (i.e., Treasuries). Note that our findings in corporate bonds are also related to Choi, Hoseinzade, Shin, and Tehranian (2020), who show that due to the practice of liquidity management, flow shocks have little impact on corporate bond prices.

Our study is also related to some contemporaneous studies on the mechanisms underlying the Treasury market turmoil during the COVID-19 pandemic in March 2020. For example, Duffie (2020) emphasizes the frictions in the market-making mechanism, whereas Schrimpf et al. (2020) highlights the role of margin spirals. He, Nagel, and Song (2020) focus on the interaction between leveraged investors financing with repo and dealers subject to balance sheet constraints. We complement this strand of literature by providing a novel perspective, specifically, that liquidity management could at least partially contribute to the Treasury market turmoil that occurred during the COVID-19 pandemic. Another important difference between our study and this strand of literature is that we use data over a long period and our data have rich information (e.g., detailed bond holding and fund characteristics). The data not only allow us to conduct cross-sectional tests to pin down the underlying mechanism (liquidity management), but also help demonstrate that the liquidity management practices together with the fast-growing bond fund sector have contributed to the increased fragility in the Treasury market over the past decade.

Finally, our paper is related to the large body of literature on the role of institutional trading in generating price impacts and financial fragility. Edmans, Goldstein, and Jiang (2012) and Lou (2012) show that fund flow-induced trading has a significant price impact on stock markets. Jotikasthira et al. (2012) find that the flow-induced price impact can transmit to international markets through emerging market funds. Anton and Polk (2014) show that common ownership forecasts correlation between stocks. Greenwood and Thesmar (2011) estimate the correlation between fund flows among mutual funds and link the correlated fund flows to stock return comovement. Huang, Song, and Xiang (2020) document that correlation between fund flows among mutual funds contributes to a large portion of the variance-covariance in anomaly returns. Our study contributes to this literature by focusing on the role of liquidity management. We find that the trading induced by liquidity management has different implications on Treasuries and corporate bonds. In addition, our findings highlight that liquidity management may generate a strong contagion effect during market turmoil, even in the most liquid market.

2 Data

In this section, we describe our data and methodology. In Section 2.1, we introduce data sources and sample construction. Sections 2.2 and 2.3 describe our empirical methodology. Section 2.4 presents summary statistics. The detailed of all variables are in Appendix Table A1.

2.1 Sample construction

We focus on U.S. actively managed open-end mutual funds whose majority of investment is in fixed-income securities (labeled as "bond funds"). We obtain the list of bond funds from Morningstar, and the list includes funds that fall under Morningstar global broad category of "Fixed Income" and the U.S. category group of "Taxable Bond." Morningstar also provides detailed information on bond funds' portfolio holdings, including bond CUSIP, number of shares, and market value. The holding data is on quarterly frequency and is available from July 2002. To obtain fund characteristics, including fund return and total net assets (TNA), we further match this list of bond funds with CRSP's (Center for Research in Securities Prices) survivor-bias-free U.S. mutual fund database based on fund CUSIP and ticker. Our final sample includes 2099 unique bond funds from 2002 to 2016.

We obtain data on Treasuries from the CRSP and data on corporate bonds from the Trade Reporting and Compliance Engine (TRACE) and the Mergent Fixed Income Securities Database (Mergent-FISD). The CRSP provides data on daily Treasury prices, total shares outstanding (i.e., shares held by the public), and the issuance terms. The TRACE provides detailed transaction information on corporate bond trades, including the transaction prices and volumes.[6] The Mergent-FISD provides bonds' characteristics, such as credit rating, total shares outstanding, issuer, coupon rate, and maturity date. In the Mergent-FISD, we identify corporate bonds by requiring bonds' FISD type codes to be CDEB, CLOC, CMTN, CMTZ, CP, CPAS, CPIK, or CS. Then, we drop callables, puttables, convertibles, asset-backed securities, and corporate bonds with warrants or with unusual/zero coupons. Considering potential liquidity issues with bonds that are close to maturity, we further exclude Treasuries or corporate bonds with a time to maturity of less than six months.[7] Our final sample contains 927 Treasuries and 2,224 corporate bonds.

2.2 Fund flows, trading, and common ownership

We construct variables on fund flows, fund trading, and common ownership in the following steps. First, for each fund at each quarter, we follow the literature (e.g., Lou, 2012) and calculate fund flows as follows:

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

where $Fund\ Return_{f,q}$ is fund f's net return over quarter q, and $TNA_{f,q}$ is total net assets at quarter q.

We next calculate how bond funds trade different asset classes (either Treasuries or

[6] We are aware of the reporting errors in TRACE and follow the procedure in Dick-Nielsen (2009) to deal with them.

[7] Our results are robust to alternative cutoffs, such as one year or three months.

corporate bonds). Specifically, for each asset class (e.g., Treasuries) at each quarter, we define *Net Buy* as

$$Net\ Buy_{f,q} = \frac{\sum_i^N Share_{i,f,q} P_{i,q-1} - \sum_i^N Share_{i,f,q-1} P_{i,q-1}}{\sum_i^N Share_{i,f,q-1} P_{i,q-1}}, \tag{2}$$

where $Share_{i,f,q}$ is the amount of bond i held by fund f at quarter q, $P_{i,q-1}$ is the price of bond i at quarter $q-1$, and N is the total number of bonds in the asset class (either Treasuries or corporate bonds). Clearly, *Net Buy* measures the percentage change of a fund's total holding in Treasuries or in corporate bonds, relative to its beginning-of-the-quarter holding. Note that we use the quarter-beginning prices in Equation (2) and thus our measure, *Net Buy*, is purely driven by funds' trading on Treasuries or corporate bonds.

Last, we follow Anton and Polk (2014) and calculate common ownership (denoted as *Common Ownership*) to measure the extent to which a pair of bonds is heavily held by the same funds (termed as common funds). Specifically, for a pair of bonds at each quarter, we calculate *Common Ownership* as follows:

$$Common\ Ownership_{i,j,q} = \frac{\sum_{f=1}^F (Shares_{i,f,q} \times P_{i,q} + Shares_{j,f,q} \times P_{j,q})}{Total\ Shares_{i,q} \times P_{i,q} + Total\ Shares_{j,q} \times P_{j,q}}, \tag{3}$$

where $Shares_{i,f,q}$ is the amount of bond i held by common fund f in quarter q, $Total\ Shares_{i,q}$ is the total amount outstanding of bond i at quarter q, $P_{i,q}$ is the price of bond i at quarter q, and F is the number of funds holding both bonds i and j. Following Anton and Polk (2014), we rank-transform *Common Ownership* and normalize the rank-transformed variable within the quarter to obtain a new variable, $Common\ Ownership^*$. Since we normalize *Common Ownership* within the quarter, the coefficients of this variable estimated from Fama and MacBeth (1973) regressions are comparable across time. It is also worth noting that the results are robust if we use *Common Ownership* or its rank-transformation.

2.3 Excess return comovement

We measure excess return comovement between two bonds as follows. First, we calculate daily bond returns by adjusting price changes with accrued interest (AI) and coupon payments (C). More precisely, the daily return for bond i at day t is calculated as:

$$Bond\ Return_{i,t} = \frac{P_{i,t} + AI_{i,t} + C_{i,t}}{P_{i,t-1} + AI_{i,t-1}} - 1. \tag{4}$$

For Treasuries, $P_{i,t}$ is the clean price (or the average of bid and ask, if the clean price is missing) at day-end from the CRSP. For corporate bonds, we define $P_{i,t}$ as the trading-volume-weighted intraday price, following Bessembinder, Kahle, Maxwell, and Xu (2008), who find that this price is less noisy than the day-end price.

Second, for each bond, we compute daily excess returns as the regression residuals from the following model:

$$Bond\ RetRf_{i,t} = \alpha_{i,t} + \sum_{s=0}^{2} \beta_{i,t-s} TRY_{t-s} + \sum_{s=0}^{2} \gamma_{i,t-s} IG_{t-s} + \sum_{s=0}^{2} \theta_{i,t-s} HY_{t-s} + \varepsilon_{i,t}, \tag{5}$$

where $Bond\ RetRf_{i,t}$ is bond i's daily return minus the risk-free rate at day t, and the risk-free rate is the daily rate from the one-month Treasury bill. On the right side of Equation (5), we consider the aggregate returns (in excess of the risk-free rate) of three major bond sub categories: Treasuries, investment-grade bonds, and junk bonds. We use the average daily returns across all Treasuries to proxy for Treasury market returns. We use two Barclays corporate bond market indices to proxy for the the aggregate returns from investment-grade bonds (LUACTRUU) and junk bonds (LF98TRUU). We term these three factors as TRY, IG, and HY, respectively. In addition, we include two lags for each factor to take into account of non synchronized trading. This is particularly important for corporate bonds, which potentially have days with no trading ("zero-trading days" here after).[8]

[8]Within each quarter, we drop inactive bonds that have non zero trading for less than 30 days in the quarter.

Then, for each pair of Treasuries (corporate bonds) in each quarter, we use daily excess returns to calculate the pairwise correlation as the measure of return comovement, and label this correlation as $Corr_{i,j,q}$. To examine the asymmetry in the return comovement based on market conditions, within each quarter, we sort all trading days into two equal groups (downside markets and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement among Treasuries (corporate bonds) using daily excess returns in each group and take the difference in return comovement between downside and upside markets. We denote this difference as $\textit{Down-minus-up}_{i,j,q}$.

2.4 Summary statistics

Table 1 reports summary statistics for our sample. As shown in Panel A, the market size of bond funds is increasing over time. For example, the number of bond funds increased from 935 in 2002 to 1325 in 2016. Meanwhile, for the sample period, the average assets under management (AUM) of bond funds rose from 759.7 million USD to more than 2 billion USD. During our sample period, the total AUM from all bond funds grew about fourfold, from 709.8 billion USD in 2002 to almost 3 trillion USD in 2016.

Panel B reports summary statistics for Treasuries and corporate bonds. As one can see, the average excess return correlation is 6.2% for pairs of Treasuries but is only 1.3% for corporate bonds. This is partially due to the higher heterogeneity among corporate bonds than that among Treasuries.

[Table 1 here]

3 Main Result

In this section, we first examine how bond funds use Treasuries for liquidity management (Section 3.1) and then study its implications on bond prices (Section 3.2). In Section 3.3, we address endogeneity concerns by exploiting two natural experiments: the COVID-19 pandemic and the 2003 mutual fund scandal.

3.1 Liquidity management with Treasuries

We first document that bond funds indeed actively use Treasuries to manage their liquidity. This analysis is in a spirit similar to prior studies on bond funds' liquidity management, e.g., Chernenko and Sunderam (2016), Choi et al. (2020), and Jiang et al. (2017). Whereas those studies examine the role of cash and other cash-like securities in liquidity management, we focus on how bond funds use Treasuries as a liquidity buffer. As shown in Section 3.2, using Treasuries in liquidity management has important asset pricing implications.

Similar to banks, bond funds performing liquidity transformation face potential financial fragility. That is, while bond funds heavily invest in illiquid assets (e.g., corporate bonds), they issue liquid claims (fund shares) that investors can redeem at the net asset value (NAV) anytime.[9] This liquidity mismatch between fund shares and the underlying assets can generate strategic complementarity among fund investors, leading to financial fragility of funds (e.g., Chen, Goldstein, and Jiang 2010). To mitigate the fragility, bond funds actively manage their liquidity. We argue that Treasuries play an important role in liquidity management because Treasuries are the most liquid assets and trading them is associated with low price impacts. The practice of liquidity management is common not only among bond funds but also among other open-end funds holding illiquid assets (such as bank loan funds and real estate funds) and even commercial banks (e.g., Chen, Goldstein, Huang, and Vashishtha, 2020; Ma, Xiao, and Zeng, 2020).

To verify and quantify liquidity management with Treasuries, we follow Lou (2012) and examine how funds trade Treasuries or corporate bonds in response to fund flows. To illustrate our test design, consider the following simplified example. Suppose that a fund has TNA of \$100 at the beginning of the quarter and it allocates \$20 to Treasuries and \$80 to corporate bonds. Now there is a 10% outflow during the quarter. If the fund manager does not engage in liquidity management, she will proportionally liquidate the holdings in both Treasuries and corporate bonds. That is, the fund will sell \$8 of corporate

[9]In our sample, bond funds on average allocate approximately 70% of their assets in corporate bonds.

bonds and $2 of Treasuries. As a result, the positions in Treasuries and corporate bonds will both decrease by 10%. In other words, the trading-to-flow sensitivity is one on both Treasuries and corporate bonds. In contrast, if the fund wants to avoid large price impacts in liquidating corporate bonds, it will prioritize Treasuries in liquidity management and sell relatively more Treasuries than corporate bonds, say, selling $9 of Treasuries and $1 of corporate bonds. As a result, total holdings of Treasuries will decrease by more than 10% while that of corporate bonds will decrease by less than 10%. In other words, the trading-to-flow sensitivity is larger than one on Treasuries but is smaller than one on corporate bonds.

We now use the following regression to formally examine how bond funds trade Treasuries and corporate bonds in response to fund flows:

$$\begin{aligned} Net\ Buy_{f,q} = \alpha + \beta_1 \cdot Fund\ Flow_{f,q} + \beta_2 \cdot Fund\ Flow_{f,q-1} + \\ \gamma_1 \cdot Fund\ Return_{f,q} + \gamma_2 \cdot Fund\ Return_{f,q-1} + \phi_f + \delta_q + \varepsilon_{f,q}, \end{aligned} \tag{6}$$

where $Net\ Buy$ is fund f's trading on Treasuries or corporate bonds in quarter q. We also consider including quarter fixed effects and fund fixed effects. Standard errors are double-clustered by fund and quarter. β_1 measures the trading-to-flow sensitivity of either Treasuries or corporate bonds. As illustrated in the aforementioned example, if funds use Treasuries as the liquidity buffer, β_1 should be larger than one for Treasuries but should be smaller than one for corporate bonds.

[Table 2 here]

Table 2 reports the results. Columns (1)–(4) are for Treasuries, and columns (5)–(8) are for corporate bonds. We find supporting evidence that funds' trading on Treasuries is more sensitive to fund flows than on corporate bonds. On Treasuries, the trading-to-flow sensitivity is larger than one. For example, as shown in column (1), a 1% fund inflow is associated with a 1.13% (t-statistic = 20.0) increase in Treasury holdings. In contrast, on corporate bonds, the trading-to-flow sensitivity is smaller than one. For example, as shown in column (5), a 1% fund inflow is associated with only a 0.77%

increase in corporate bond holdings (t-statistic = 20.8). The comparison of trading-to-flow sensitivity (β_1) between Treasuries and corporate bonds is consistent with bond funds using Treasuries to actively manage fund flow shocks.

In Table 2, we also find that bond funds trade Treasuries and corporate bonds in response to lagged fund flows. That is, the coefficient on lagged fund flow is -0.169 (t-statistic = -3.5) for Treasuries and is 0.196 (t-statistic = 7.7) for corporate bonds. This finding is largely consistent with liquidity management. When funds experience outflows (inflows), they initially liquidate (purchase) excess Treasuries to mitigate the price impacts on illiquid corporate bonds. These trades make bond funds' asset allocation deviate from the initial target. In the long run, bond funds will revert to trading in Treasuries and keep trading in corporate bonds to meet the initial asset allocation target.

We further examine how bond funds trade Treasuries and corporate bonds when funds experience outflows and inflows, respectively. We conjecture that the trading-to-flow sensitivity on Treasuries should be stronger when a fund experiences outflows because it is more urgent to trade Treasuries to meet investor redemption. To measure fund inflows/outflows, we define a dummy variable, $Out_{f,q}$, which equals one if $Fund\ Flow_{f,q}$ is lower than the quarter median, and zero otherwise. We include $Out_{f,q}$, $Fund\ Flow_{f,q}$, and their interaction term in the right-hand side of Equation (6). That is,

$$\begin{aligned} Net\ Buy_{f,q} = \alpha &+ \beta_1 \cdot Fund\ Flow_{f,q} + \theta_1 \cdot Fund\ Flow_{f,q} \times Out_{f,q} + \\ &\beta_2 \cdot Fund\ Flow_{f,q-1} + \theta_2 \cdot Fund\ Flow_{f,q-1} \times Out_{f,q} + \\ &\gamma_1 \cdot Fund\ Return_{f,q} + \gamma_2 \cdot Fund\ Return_{f,q-1} + \phi_f + \delta_q + \varepsilon_{f,q}. \end{aligned} \tag{7}$$

The coefficient of interest is θ_1, which measures the difference of the trading-to-flow sensitivity between fund outflows and inflows. The results in columns (3)–(4) in Table 2 are consistent with our conjecture that the trading-to-flow sensitivity on Treasuries is stronger when a fund experiences outflows. For example, as shown in column (3), the point estimate of θ_1 is 0.274 (t-statistic = 2.3) for Treasuries. By comparison, the trading-to-flow sensitivity on corporate bonds is smaller when a fund experiences outflows (see columns (7)–(8)). These results support our argument. That is, when funds experience outflows, they are subject to stronger financial fragility (consistent with the finding in Goldstein, Jiang, and Ng (2017)), and therefore prioritizing Treasuries in liquidation is urgent to stabilize fund value.[10]

We conduct cross-sectional tests to strengthen our argument. Specifically, we focus on the heterogeneity in funds' portfolio holdings. Chen, Goldstein, and Jiang (2010) document that funds that heavily invest in illiquid assets are more subject to financial fragility. Therefore, these funds should manage their liquidity more actively. We indeed find supporting evidence in our data (see Appendix Table A3).

In sum, the results in this section are consistent with our argument that bond funds use Treasuries to manage their liquidity needs, and the Treasury holdings play a more important role in presence of fund outflows.

3.2 common ownership and return comovement

In this section, we examine the asset pricing implications of liquidity management. As we document in Section 3.1, when bond funds use Treasuries as the liquidity buffer, their trading on Treasuries has excess exposure to fund flow shocks, which can generate excess return comovement in the Treasury market. This mechanism is in the same spirit as in Greenwood and Thesmar (2011) and Anton and Polk (2014).[11] Furthermore, this mechanism has unique predictions on Treasury prices in our context. Since liquidity management is more urgent when funds experience large redemptions, bond funds' trading in Treasuries tends to be more sensitive to fund flows (see Table 2), leading to increased return comovement among Treasuries during downside markets. In this sense, the liquidity management practice among bond funds could contribute to the systematic risk of the Treasury market (which we measure with return comovement), and it should be particularly pronounced during downside markets. Our analysis is closely related to prior

[10]In Appendix Table A2, we define $Out_{f,q}$ as a dummy variable that equals one when the fund flow is negative, and zero otherwise, and we find similar results.

[11]Greenwood and Thesmar (2011) and Anton and Polk (2014) focus on equity markets and find that stocks commonly held by a mutual fund tend to comove in price due to correlated trading of this fund.

studies on financial fragility that show the heightened systematic risk in terms of excess comovement in asset returns during downside markets (see, King and Wadhwani, 1990; King et al., 1994; Forbes and Rigobon, 2002; Rigobon, 2002; Bekaert et al., 2005).

To test our argument, we follow Anton and Polk (2014) and conduct cross-sectional tests to link return comovement among Treasuries to bond fund ownership using the following Fama and MacBeth (1973) regressions:

$$Corr_{i,j,q} = \alpha + \beta \cdot Common\ Ownership^{*}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}, \tag{8}$$

where $Corr_{i,j,q}$ is the excess return comovement between bonds i and j in quarter q, and the key independent variable is $Common\ Ownership^{*}_{i,j,q-1}$, which measures the extent to which bonds i and j are held by the same bond funds. $X_{i,j,q-1}$ is a vector of control variables to capture the similarities of bond characteristics that are potentially related to return correlations. For Treasuries, *On-the-run Difference* is the absolute difference in the on-the-run status, where the on-the-run status describes whether a Treasury is the most recently issued of a particular maturity. *Coupon Rate Difference* is the absolute difference in coupon rates. *Time-to-maturity Difference* is the normalized absolute difference in days to maturity. We compute Newey and West (1987) standard errors corrected by serial dependence of four lags.

[Table 3 here]

Table 3 reports the results and confirms our conjecture that Treasuries with high common ownership experience strong excess return comovement. For example, as shown in column (2), the coefficient estimate of $Common\ Ownership^{*}$ is 0.064 (t-statistic = 13.2) after including all control variables. This implies that a one standard deviation increase in $Common\ Ownership^{*}$ is associated with a 6.4% increase in the average pairwise correlation between two Treasuries. This is economically meaningful, considering that the average of excess return comovement among Treasuries is 6.2%.

We further test an auxiliary prediction of our argument: liquidity management should generate more comovement among Treasuries during downside markets than during upside markets. The prediction is motivated by the finding in Table 2 that the trading-to-flow sensitivity on Treasuries is stronger when funds experience investor redemption. Intuitively, when the Treasury market declines, bond funds experience fund outflows (see, Brooks, Katz, and Lustig, 2018), and liquidity management is more urgent, leading to a stronger association between common ownership and return comovement in Treasuries.

To empirically test this conjecture, we construct a proxy to measure the asymmetry in return comovement. Specifically, within each quarter, we first sort all trading days into two equal groups (downside markets and upside markets) based on the daily aggregate Treasury market returns. Then, we calculate return comovement for each group and take the difference in return comovement between downside and upside markets. We denote this difference as *Down-minus-up*. Since our measure of asymmetry in return comovement, *Down-minus-up*, is based on the same pair of Treasuries, this measure can effectively control for unobservable similarities in bond characteristics that may drive return comvement. Based on this measure, we run the same regression as in Equation (8) except that we replace the dependent variable with *Down-minus-up* as follows:

$$\textit{Down-minus-up}_{i,j,q} = \alpha + \beta \cdot Common\ Ownership^{*}_{i,j,q-1} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}. \quad (9)$$

Columns (3) and (4) of Table 3 confirm our conjecture. For example, as shown in column (4), a one standard deviation increase in $Common\ Ownership^{*}$ is associated with a 1.1% (t-statistic = 3.7) increase in *Down-minus-up*. In other words, for two Treasuries with high common ownership, their pairwise correlation becomes significantly higher during downside markets relative to upside markets. This result is also economically sizeable, given that the average *Down-minus-up* is 0.3%.

For comparison, we repeat the same exercises of Table 3 on corporate bonds, and Table 4 reports the results. We have two observations. First, while $Common\ Ownership^{*}$ can also significantly forecast excess return comovement on corporate bonds, the economic magnitude is much lower than that on Treasuries. For example, as shown in column (2), a one standard deviation increase in $CommonOwnership^*$ is associated with a 0.5% increase in excess return correlation between two corporate bonds. Second, more importantly, columns (3) and (4) show that there is no asymmetric effect of $Common\ Ownership^*$ on return comovement between downside and upside markets for corporate bonds. These patterns are consistent with the results in Table 2 that corporate bonds are less sensitive to flow shocks, as bond funds tend to avoid trading corporate bonds (e.g., due to high price impacts) to meet liquidity needs.

[Table 4 here]

We further conduct several tests to corroborate our evidence. First, we find that our results are robust if we exclude bonds with a time to maturity of less than a year (see Appendix Table A4). Second, we address one potential concern that the distinct pattern between Treasuries and corporate bonds is due to the high heterogeneity among corporate bonds. Since Treasuries are more homogeneous than corporate bonds, the number of unique Treasury securities (based on CUSIP) in a fund's portfolio is often smaller than corporate bonds. Therefore, it is possible that in presence of outflows, bond funds only have a small set of unique Treasury securities and are likely to induce correlated trading among them, leading to high return comovement. In Appendix Table A5, we show that this is not the case: the common ownership from bond funds holding a large number of unique Treasury securities exhibits even stronger predictability in Treasury return comovement than that from bond funds holding a small number of unique Treasuries.

In sum, the results in this section along with those in Section 3.1 suggest that bond funds use Treasuries in liquidity management, and this liquidity management practice at least partially contributes to the financial fragility in the Treasuries market.

3.3 Endogeneity Issues

Although the results in Section 3.2 are consistent with our argument that the liquidity management by bond funds leads to financial fragility (in terms of excess return movement, particularly during downside markets) on Treasury prices, we are well aware of potential endogeneity issues. For example, Treasuries in the portfolio of a bond fund may have similar but unobservable fundamentals and thus naturally comove in prices. While this explanation cannot reconcile the asymmetric pattern of return comovement between upside and downside markets, we nonetheless exploit two natural experiments: the COVID-19 pandemic and the 2003 mutual fund scandal.[12]

3.3.1 Natural experiment I: COVID-19

In this section, we use the recent outbreak of COVID-19 as an exogenous shock to fund flows and study how common ownership affects return comovement in Treasuries and corporate bonds.

On March 11, 2020, the WHO announced that COVID-19 had become a global pandemic.[13] As the outbreaks in the United States and other countries brought unprecedented uncertainty to the global economy, bond funds started to experience significant outflows starting in the second week of March 2020. As shown in Panel A of Figure 1, the average daily flow decreased from about 0.12% in the first week of March to about −0.65% following the announcement. The total capital flow out from the bond funds in our sample between March 11 and the end of the month equaled 4.97% of their pre-event TNA. This pattern is consistent with the contemporaneous study of Falato et al. (2020).

During the same period, the Treasury market experienced unprecedented turmoil. In Panel B of Figure 1, we plot the cumulative returns of two portfolios of Treasuries, equally split by bond fund ownership.[14] We make several observations. First, in the first week of March, both portfolios experienced an increase in prices, potentially due to the flight to liquidity as COVID-19 broke out in China, Italy, and Spain. Starting in the second week

[12]Because our measure of the asymmetry in return comovement, *Down-minus-up*, compares the excess return comovement of the same pair of Treasuries in downside and upside markets within the same quarter, this measure can effectively control for unobservable similarities in bond characteristics that may drive return comovement.

[13]"WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020," https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020.

[14]Since fund ownership varies across bonds' maturity, here we rank fund ownership within three different time-to-maturity groups separately: six months to three years, three to seven years, and above seven years.

of March, however, Treasuries experienced large price declines. More importantly, the price declines were more pronounced among Treasuries heavily held by bond funds. For comparison, we also examine the cumulative returns of two corporate bond portfolios, equally split by bond fund ownership. As shown in Panel C of Figure 1, unlike the patterns on Treasuries, the difference of price declines between the two corporate bond portfolios was not statistically significant. Although other potential mechanisms might cause this turmoil in the Treasury market (see, Duffie, 2020; Fleming and Ruela, 2020; He, Nagel, and Song, 2020; Schrimpf, Shin, and Sushko, 2020), the patterns in Figure 1 are consistent with bond funds' liquidity management practices making the price of Treasuries that funds hold more sensitive to outflow shocks.

To formally examine the causal relationship between common ownership and return comovement, we use a difference-in-difference (diff-in-diff) analysis around the WHO's COVID-19 pandemic announcement. Specifically, we focus on the data in the first quarter of 2020 and run the following regression:

$$Corr_{i,j,m} = \alpha + \beta \cdot Treat_{i,j} \times After_m + \theta_1 \cdot Treat_{i,j} + \theta_2 \cdot After_m + \theta_3 \cdot X_{i,j,2019} + \varepsilon_{i,j,m}, \quad (10)$$

where $m = 0$ indicates the period before March 11, 2020, and $m = 1$ indicates the period on and after March 11 within the first quarter of 2020. Common ownership is calculated based on fund holding data at the end of 2019. $Treat_{i,j}$ is a dummy variable that equals one if the security pair i and j has common ownership above the median, and zero otherwise.[15] $After_m$ is a dummy variable that equals one if $Corr_{i,j,m}$ is computed on and after March 11, 2020 (i.e., when $m = 1$), and zero otherwise. $X_{i,j,2019}$ denotes the same set of control variables as in Table 3 at the end of 2019. We argue that when the global pandemic announcement caused large fund outflows from bond funds (justified in Panel A of Figure 1), bond funds aggressively liquidated Treasuries to meet investor redemption, leading to excess return comovement among Treasuries. Given that the post-

[15] Results are robust to using the continuous variable of *Common Ownership* rather than the dummy variable.

event period features persistent fund outflows and downside markets, we do not need to use *Down-minus-up* on the left-hand side of the regression. Here, we expect β in Equation (10) to be positive.

Table 5 reports the results. Panel A provides summary statistics, and Panel B reports the regressions results of the diff-in-diff analysis. The statistics in Panel A are largely consistent with our conjecture. Specifically, the average $Corr$ of Treasury pairs was about 14.2% before the WHO's announcement and increased to 17.8% afterward. By comparison, the average $Corr$ of corporate bond pairs remained almost unchanged.

[Table 5 here]

Panel B of Table 5 reports the results of the diff-in-diff regressions for both Treasuries and corporate bonds. We have several findings. First, Treasuries with high common ownership experienced a larger increase in return comovement than those with low common ownership. For example, as implied in column (2) of Panel B, the average pairwise correlation between two Treasuries with low common ownership increased by 1.5% (t-statistic = 5.1) after the pandemic announcement. At the same time, Treasuries with high common ownership experienced a 5.7% increase in excess return comovement. The difference of increased return comovement between these two groups is not only statistically significant (t-statistic = 9.4), but also economically sizable, considering the mean of $Corr$ before the event was about 14.2%.

Second, for corporate bonds, we observe that the return comovement on corporate bonds with high common ownership barely changed after the pandemic announcement. The corporate bonds with low common ownership experienced a slight decrease in return comovement.

Overall, the results in this section are consistent with our main analysis in Section 3.2 and help pin down the causal link between common ownership and return comovement among Treasuries.

3.3.2 Natural experiment II: The 2003 mutual fund scandal

In this section, we exploit another natural experiment—the 2003 mutual fund scandal—to further establish the causal link between fund common ownership and the asymmetric return comovement (*Down-minus-up*) among Treasuries. We choose this setting because the scandal had a negative impact on affected funds' flow from 2003Q4 to 2006Q4 (McCabe, 2009; Anton and Polk, 2014; Koch, Ruenzi, and Starks, 2016) but was unlikely to be related to bond characteristics.[16]

We follow Anton and Polk (2014) and use a two-stage instrumental variable regression to examine the causal relationship between fund common ownership and *Down-minus-up*, which measures the difference of return comovement between downside and upside markets. The instrumental variable is the ratio of the total value held by common scandal funds of a security pair over the total value held by all common funds (labeled as *Ratio*). The sample period for this test is from 2004Q1 to 2006Q4.

Table 6 reports the results. Panel A reports results from the first stage, and Panel B presents the results from the second stage. As shown in Panel A, the coefficient estimate of *Ratio* is highly significant and negative for both Treasuries and corporate bonds, which is consistent with prior studies showing that the mutual fund scandal had large impacts on fund ownership.

[Table 6 here]

In Panel B (the second-stage regression), we use the fitted *Common Ownership** (denoted as $\widehat{Common\ Ownership}^*$) from the first stage to predict cross-sectional variations in *Down-minus-up* of a security pair, and we find that $\widehat{Common\ Ownership}^*$ is significantly and positively associated with subsequent *Down-minus-up* for Treasuries. In contrast, we do not find such an effect on corporate bonds. Overall, the analyses based on the 2003 mutual fund scandal further support the causal link between liquidity management and financial fragility in the Treasury market.

[16] As estimated by Kisin (2011), funds from implicated mutual fund families lose 14.1% of their capital within one year and 24.3% within two years. These outflows continued from 2003Q4 through 2006Q4.

4 Further Discussion

In this section, we conduct several additional tests to corroborate our evidence. We also examine how bond fund ownership affects the liquidity of the Treasury market, which adds to the ongoing discussion on the financial stability of the Treasury market.

4.1 Common funds inflows versus. outflows

We provide further support for our argument by exploring the cross-sectional variations in bond funds' flows. As we show in Section 3.1, bond funds prefer to liquidate Treasuries first to meet redemption when they experience outflows, and thus the trading-to-flow sensitivity on Treasuries is higher for outflows than for inflows. In this sense, given the same level of common ownership, Treasuries should comove more when their common funds experience large outflows. To test this conjecture, we run the following regressions:

$$\begin{aligned} Corr_{i,j,q} = \alpha + \beta_1 \cdot Common\ Ownership^{*}_{i,j,q-1} + \\ \beta_2 \cdot Common\ Ownership^{*}_{i,j,q-1} \times Ratio\ of\ Outflow_{i,j,q} + \\ \beta_3 \cdot Ratio\ of\ Outflow_{i,j,q} + \theta \cdot X_{i,j,q-1} + \varepsilon_{i,j,q}, \end{aligned} \tag{11}$$

where for bonds i and j at quarter q, $Ratio\ of\ Outflow_{i,j,q}$ is the fraction of the pair's common funds with fund outflows (i.e., $Out_{f,q} = 1$). A larger value of $Ratio\ of\ Outflow_{i,j,q}$ means that more common funds holding bonds i and j experience outflows. We expect β_2 to be positive for Treasury pairs.

[Table 7 here]

Table 7 reports the results and confirms our conjecture. As shown in columns (1) and (2), the coefficient estimates of β_2 are significant and positive, which suggest that the effect of common ownership on Treasury return comovement is stronger when more funds experience redemption. On the contrary, we do not observe such a pattern for corporate bonds (see columns (3) and (4)).

4.2 Month end versus month begin

Although the findings in Section 4.1 are consistent with the conjecture that the effect of liquidity management on excess Treasury return comovement is more pronounced when funds experience outflows, there is one potential alternative explanation. That is, fund investors may anticipate the decline in the Treasury market and thus are more likely to withdraw their investment from funds with more Treasury holdings. This possibility can also generate a strong association between common ownership and Treasuries' return comovement in presence of fund outflows. To address this concern, we follow prior studies (e.g., Ogden 1990; Etula, Rinne, Suominen, and Vaittinen 2020) and identify the well-anticipated times when bond funds are subject to redemption pressure, that is, month ends. Existing literature shows that there is a strong seasonality in fund flows because some investors (such as pension schemes) need to redeem their fund shares to meet scheduled end-of-month payouts.

Taking advantage of the plausible exogenous seasonality in fund flows, we examine the excess return comovement among Treasuries at month ends when bond funds face outflows. To implement the test, we take several steps. First, following the timeline in Etula, Rinne, Suominen, and Vaittinen (2020), we define month ends as the five-day window [t-8, t-4], and month begins as the five-day window [t-1, t+3], where t is the last trading day of each month. For each pair of bonds at each quarter, we calculate the excess return comovement for month ends and month begins, separately. To measure the asymmetry in excess return comovement, we calculate the difference of return comovement between month-ends and month-begins and denote this difference as *End-minus-begin*. After that, we run regressions similar to those in Tables 3 and 4.

Table A7 reports the results. We find that common ownership positively forecasts excess return comovement at month ends and month begins on both the Treasury and corporate bond markets, and the effect is much smaller for corporate bonds. More importantly, common ownership only positively forecasts *End-minus-begin* on Treasuries.

4.3 Liquidity Commonality

Motivated by recent studies (Schrimpf, Shin, and Sushko, 2020; Fleming and Ruela, 2020, e.g.,) that document a liquidity dry-up in Treasuries during the COVID-19 crisis, we use the sample spanning a long period (from 2002 to 2016) and conduct cross-sectional tests to study whether common ownership can generate liquidity commonality in Treasuries.

To carry out our tests, we measure liquidity commonality of Treasuries in the following steps. First, for each Treasury in a quarter, we identify the day with the maximum bid-ask spread. Second, if this day's bid-ask spread is higher than the highest bid-ask spreads over the previous four quarters, this day is defined as a liquidity dry-up event. Then, to measure the liquidity commonality, we examine whether two Treasuries simultaneously experience the liquidity dry-up event. Specifically, for each Treasury pair at each quarter, we define a dummy variable, *Common Dry-ups*, which equals one if these two Treasuries have liquidity dry-ups within the same calendar week or within seven trading days. Then, we run the Fama-MacBeth regressions of Equation (8) but replace the dependent variable with *Common Dry-ups*. Not surprisingly, the mean of *Common Dry-ups* is small and equals 0.007 in our sample.

[Table 8 here]

Table 8 reports the results. We find that Treasury pairs with high common ownership tend to experience liquidity dry-ups together. For example, as shown in column (4), a one standard deviation increase in $Common\ Ownership^{*}$ is associated with a 0.002 (*t*-statistics = 2.4) increase in *Common Dry-ups*. This magnitude is economically sizeable, given the mean of *Common Dry-ups* of 0.007.

4.4 Implications to Individual Treasuries

Last, we explore asset pricing implications on individual Treasuries. While the excess return comovement and liquidity commonality are more relevant in the context of financial fragility, our argument also implies that fund ownership can potentially induce excessive volatility, negative return skewness, and liquidity dry-ups on individual Treasuries.

To study the asset pricing implications on individual Treasuries, we run the Fama-MacBeth regressions where the key independent variable is bond fund ownership (denoted as *Ownership*). We consider various dependent variables: return skewness, return volatility, or liquidity range. Here, return skewness and return volatility are computed using daily excess returns. We measure liquidity range as the difference between the maximum and minimum daily bid-ask spread within the quarter. Intuitively, liquidity range measures the size of swings in liquidity. Table 9 reports the results. We find that fund ownership significantly and negatively forecasts return skewness. Meanwhile, fund ownership significantly and positively forecasts return volatility and liquidity range. These results are aligned with our findings on return comovement, *Down-minus-up*, and liquidity commonality.

[Table 9 here]

5 Conclusion

In recent years, the U.S. Treasury market (the most liquid market in the world) has become more fragile, as was seen in the "flash rally" episode in 2014 and the turmoil during the outbreak of COVID-19. Given the importance of Treasuries in the global financial system, it is necessary to understand the underlying economic mechanism through which the fragility arises.

We argue and empirically test whether the liquidity management practices can contribute to the increasing fragility in the Treasury market. We have several empirical findings to support our argument. First, we document that bond funds actively trade Treasuries to manage their liquidity needs, as the trading-to-flow sensitivity is larger on Treasuries than that on corporate bonds. Meanwhile, the trading-to-flow sensitivity on Treasuries is stronger when funds experience outflows than when they experience inflows, which suggests that liquidity management using Treasuries is more urgent in the presence of large redemptions. Second, we study the asset pricing implications of liquidity management on Treasuries and show that liquidity management induces Treasuries to have excess exposure to flow shocks on bond funds. That is, Treasuries that are commonly owned by bond funds tend to comove more in prices, and this pattern is stronger during downside markets. Third, we use the outbreak of COVID-19 and the 2003 mutual fund scandal to pin down the causal relationship between common ownership and Treasury return comovement.

We are well aware that the economic magnitude we document in this study could not perfectly match what happened in the "flash rally" and the COVID-19 crisis. This is likely because our sample only includes U.S. open-end bond mutual funds. But, given the widespread practice of liquidity management using Treasuries, the economic mechanism documented in our study can naturally apply to other financial intermediaries performing liquidity transformation. Thus, we believe that our findings can shed some light on the discussion of possible causes for the increasing fragility in the world's most liquid asset market.

References

Adrian, Tobias, Michael J. Fleming, Daniel Stackman, and Erik Vogt, 2015, Has U.S. Treasury Market Liquidity Deteriorated?, Liberty Street Economics 20150817, Federal Reserve Bank of New York.

Anton, Miguel, and Christopher Polk, 2014, Connected stocks, *Journal of Finance* 69, 1099–1127.

Aragon, George O, A Tolga Ergun, Mila Getmansky Sherman, and Giulio Girardi, 2017, Hedge fund liquidity management, *Available at SSRN 3033930* .

Bekaert, Geert, Campbell R. Harvey, and Angela Ng, 2005, Market integration and contagion, *The Journal of Business* 78, 39–69.

Bessembinder, Hendrik, Kathleen M. Kahle, William F. Maxwell, and Danielle Xu, 2008, Measuring Abnormal Bond Performance, *Review of Financial Studies* 22, 4219–4258.

Brooks, Jordan, Michael Katz, and Hanno Lustig, 2018, Post-FOMC announcement drift in US bond markets, Technical report, National Bureau of Economic Research.

Chen, Qi, Itay Goldstein, Zeqiong Huang, and Rahul Vashishtha, 2020, Liquidity transformation and fragility in the US banking sector, *Working Paper* .

Chen, Qi, Itay Goldstein, and Wei Jiang, 2010, Payoff complementarities and financial fragility: Evidence from mutual fund outflows, *Journal of Financial Economics* 97, 239–262.

Chernenko, Sergey, and Adi Sunderam, 2016, Liquidity transformation in asset management: Evidence from the cash holdings of mutual funds, Working Paper 22391, National Bureau of Economic Research.

Choi, Jaewon, Saeid Hoseinzade, Sean Seunghun Shin, and Hassan Tehranian, 2020, Corporate bond mutual funds and asset fire sales, *Journal of Financial Economics* forthcoming.

Dick-Nielsen, Jens, 2009, Liquidity biases in trace, *Journal of Fixed Income* 19, 43–55.

Duffie, Darrell, 2020, Still the world's safe haven? Redesigning the US Treasury market after the COVID-19 crisis, *Hutchins Center Working Paper* .

Edmans, Alex, Itay Goldstein, and Wei Jiang, 2012, The real effects of financial markets: The impact of prices on takeovers, *Journal of Finance* 67, 933–971.

Etula, Erkko, Kalle Rinne, Matti Suominen, and Lauri Vaittinen, 2020, Dash for cash: Monthly market impact of institutional liquidity needs, *Review of Financial Studies* 33, 75–111.

Falato, Antonio, Itay Goldstein, and Ali Hortaçsu, 2020, Financial fragility in the COVID-19 crisis: The case of investment funds in corporate bond markets, *National Bureau of Economic Research Working Paper 27559* .

Fama, Eugene F, and James D MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607–636.

Financial Stability Report, 2020, `https://www.federalreserve.gov/publications/2020-may-financial-stability-report-purpose.htm`.

Fleming, Michael J, and Francisco Ruela, 2020, How liquid is the new 20-year treasury bond? `https://libertystreeteconomics.newyorkfed.org/2020/07/how-liquid-is-the-new-20-year-treasury-bond.html`.

Forbes, Kristin J, and Roberto Rigobon, 2002, No contagion, only interdependence: Measuring stock market comovements, *The Journal of Finance* 57, 2223–2261.

Goldstein, Itay, Hao Jiang, and David T Ng, 2017, Investor flows and fragility in corporate bond funds, *Journal of Financial Economics* 126, 592–613.

Greenwood, Robin, and David Thesmar, 2011, Stock price fragility, *Journal of Financial Economics* 102, 471–490.

He, Zhiguo, Stefan Nagel, and Zhaogang Song, 2020, Treasury inconvenience yields during the COVID-19 crisis, Working Paper 27416, National Bureau of Economic Research.

Huang, Shiyang, Yang Song, and Hong Xiang, 2020, Noise trading and asset pricing factors, *Available at SSRN 3359356* .

Investment Company Institute, 2020, Investment company fact book: A review of trends and activities in the investment company industry `https://www.icifactbook.org/`.

Jiang, Hao, Dan Li, and Ashley Wang, 2017, Dynamic liquidity management by corporate bond mutual funds, *Available at SSRN 2776829* .

Joint Staff Report: The U.S. Treasury Market on October 15, 2014, 2016, `https://www.federalreserve.gov/newsevents/testimony/powell20160414.htm`.

Jotikasthira, Chotibhak, Christian Lundblad, and Tarun Ramadorai, 2012, Asset fire sales and purchases and the international transmission of funding shocks, *Journal of Finance* 67, 2015–2050.

King, Mervyn, Enrique Sentana, and Sushil Wadhwani, 1994, Volatility and links between national stock markets, *Econometrica* 62, 901–933.

King, Mervyn A, and Sushil Wadhwani, 1990, Transmission of volatility between stock markets, *Review of Financial Studies* 3, 5–33.

Kisin, Roni, 2011, The impact of mutual fund ownership on corporate investment: Evidence from a natural experiment, *Available at SSRN 1828183* .

Koch, Andrew, Stefan Ruenzi, and Laura Starks, 2016, Commonality in liquidity: A demand-side explanation, *The Review of Financial Studies* 29, 1943–1974.

Lou, Dong, 2012, A flow-based explanation for return predictability, *Review of Financial Studies* 25, 3457–3489.

Ma, Yiming, Kairong Xiao, and Yao Zeng, 2020, Mutual fund liquidity transformation and reverse flight to liquidity, *Available at SSRN 3640861* .

McCabe, Patrick E, 2009, The economics of the mutual fund trading scandal, *Available at SSRN 1370489* .

Newey, Whitney K, and Kenneth D West, 1987, Hypothesis testing with efficient method of moments estimation, *International Economic Review* 777–787.

Ogden, Joseph P, 1990, Turn-of-month evaluations of liquid profits and stock returns: A common explanation for the monthly and January effects, *Journal of Finance* 45, 1259–1272.

Powell, Jerome, 2016, Trends in fixed-income markets `https://www.federalreserve.gov/newsevents/testimony/powell20160414.htm`.

Rigobon, Roberto, 2002, Contagion: How to measure it?, in *Preventing Currency Crises in Emerging Markets*, 269–334 (University of Chicago Press).

Schrimpf, Andreas, Hyun Song Shin, and Vladyslav Sushko, 2020, Leverage and margin spirals in fixed income markets during the COVID-19 crisis `https://www.bis.org/publ/bisbull02.htm`.

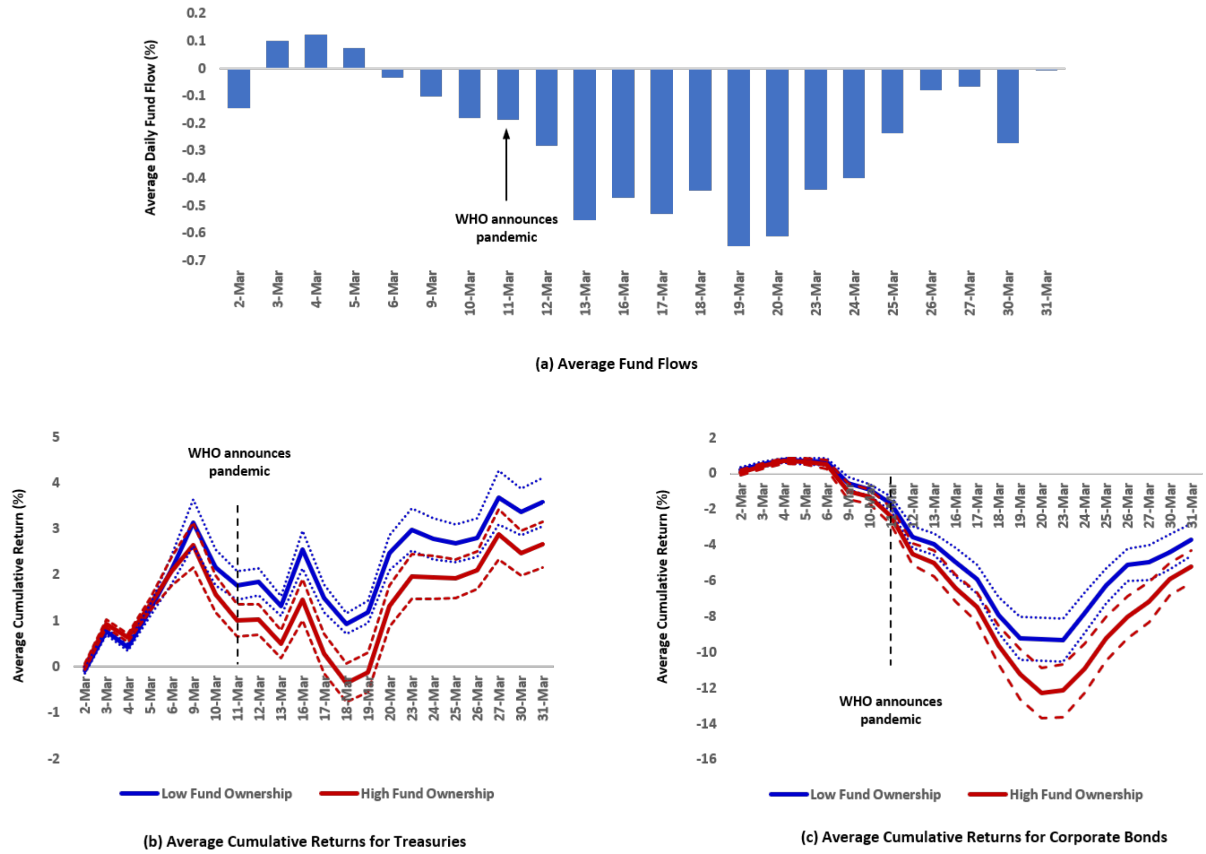

Figure 1. Bond fund flows and cumulative returns for Treasuries and corporate bonds in March 2020

This figure plots (a) the averages of daily bond fund flows (%), (b) the cumulative returns (%) of Treasury portfolios sorted by bond fund ownership, and (c) the cumulative returns (%) of corporate bond portfolios sorted by bond fund ownership in March 2020. The vertical line represents the WHO pandemic announcement date, March 11, 2020. Bond fund ownership equals the fraction of bond shares owned by bond funds and is calculated at the end of 2019. Since fund ownership varies across bonds' maturity, we rank fund ownership within three different time-to-maturity groups separately: six months to three years, three to seven years, and above seven years.

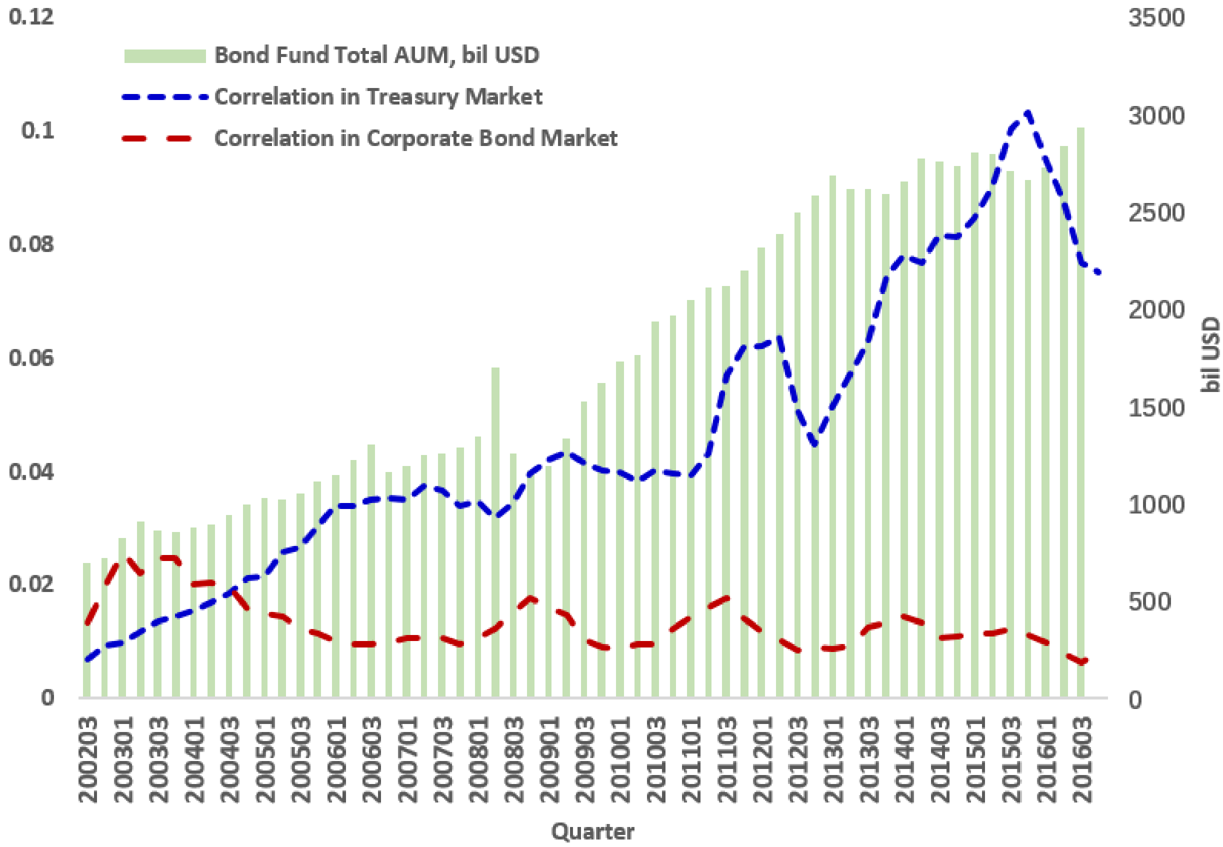

Figure 2. Return comovement in the Treasury and corporate bond markets

This figure plots the time-series average of excess return correlations among Treasuries (blue line) and corporate bonds (red line) from 2002Q3 to 2016Q4, as well as the total assets under management from all bond funds (bar, in billion USD). Daily excess returns are computed as the residuals from a regression model that includes daily average returns on all Treasuries, investment-grade corporate bonds, junk bonds, and their two lags.

Table 1. Summary Statistics

This table reports descriptive statistics of our sample. Panel A reports the summary statistics of bond funds, while Panel B reports the summary statistics for Treasuries and corporate bonds, respectively. *Corr* is the excess return correlation between two securities in a quarter. To measure the asymmetry in return comovement during downside and upside markets, we sort all trading days into two equal groups (downside and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement for each group and take the difference in return comovement between downside and upside markets. We denote this difference as *Down-minus-up*. *# of Common Funds* is the number of funds holding a pair of securities. These funds are termed as common funds. *Common Ownership* is the proportion of total market value of a security pair held by all common funds. *On-the-Run Difference* is the absolute difference in on-the-run status, where on-the-run status is a dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Coupon Rate Difference* is the absolute difference between two corporate bonds' coupon rates. *Time-to-maturity Difference* is the normalized absolute difference between two securities' days to maturity. *Liquidity Difference* is the absolute difference between two securities' fraction of zero-trading days; *Rating Difference* is the absolute difference between two corporate bonds' numeric-transformed credit rating. Our sample is from 2002Q3 through 2016Q4.

Panel A: Summary Statistics for Bond Funds

Year	# of bond funds	Average fund TNA ($M)	Median fund TNA ($M)	Total AUM ($B)
2002	935	759.7	217.5	709.8
2003	1017	851.9	233.0	866.0
2004	1030	899.2	231.6	926.5
2005	1047	1010.0	244.3	1057.2
2006	1080	1120.2	235.3	1209.8
2007	1105	1129.1	245.3	1247.5
2008	1106	1236.6	246.7	1368.7
2009	1092	1300.5	283.2	1419.7
2010	1090	1697.8	365.2	1851.1
2011	1151	1842.3	368.3	2119.7
2012	1165	2103.4	406.9	2446.8
2013	1183	2224.7	410.4	2629.6
2014	1254	2178.5	364.2	2731.6
2015	1302	2110.0	345.8	2746.7
2016	1325	2138.6	343.1	2834.6
Average	1125	1506.8	302.7	1744.4

Table 1. Continued

Panel B: Summary Statistics for Treasuries and Corporate Bonds

	mean	std	p10	p25	p50	p75	p90	N
(a) Treasuries								
Corr	0.062	0.426	-0.488	-0.225	0.027	0.328	0.707	1,533,640
Down-minus-up	0.003	0.316	-0.398	-0.197	-0.003	0.196	0.407	1,533,640
# of Common Funds	6.089	6.591	0.103	1.638	4.741	8.276	12.793	1,533,640
Common Ownership	0.010	0.016	0.000	0.001	0.006	0.013	0.023	1,533,640
On-the-run Difference	0.062	0.241	0.000	0.000	0.000	0.000	0.000	1,533,640
Coupon Rate Difference	2.619	2.235	0.334	0.879	2.006	3.748	5.961	1,533,640
Time-to-maturity Difference	7.403	7.220	0.654	1.868	4.754	10.941	19.723	1,533,640
(b) Corporate bonds								
Corr	0.013	0.161	-0.180	-0.088	0.008	0.107	0.206	9,072,186
Down-minus-up	-0.001	0.257	-0.327	-0.171	-0.001	0.169	0.325	9,072,186
# of Common Funds	1.711	2.579	0.000	0.000	0.724	2.569	4.828	9,072,186
Common Ownership	0.009	0.017	0.000	0.000	0.001	0.011	0.025	9,072,186
Liquidity Difference	0.183	0.159	0.012	0.049	0.143	0.288	0.414	9,072,186
Coupon Rate Difference	1.948	1.474	0.293	0.759	1.644	2.848	4.052	9,072,186
Rating Difference	3.834	3.420	0.259	1.207	3.069	5.414	8.724	9,072,186
Time-to-maturity Difference	6.081	7.736	0.487	1.349	3.363	7.701	16.372	9,072,186

Table 2. Fund Trading and Fund Flows

This table reports the regression results of fund trading on fund flows for Treasuries and corporate bonds. $Net\ Buy_{f,q}$ is calculated as the percentage change of fund f's total holdings in Treasuries or corporate bonds in quarter q, relative to its beginning-of-the-quarter holdings. $Fund\ Flow_{f,q}$ and $Fund\ Return_{f,q}$ represent quarterly fund flows and fund return for fund f in quarter q. $Out_{f,q}$ is a dummy variable that equals one if the fund flow for fund f in quarter q is lower than the quarter median, and zero otherwise. Variables are winsorized by quarter at the 5^{th} and 95^{th} percentiles. Our sample is from 2002Q3 through 2016Q4. Standard errors are clustered by fund and quarter, and the t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

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	No	Yes	No	Yes	No	Yes	No	Yes
Quarter Fixed	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

Table 3. Common ownership and Treasury Return Comovement

This table reports the results from Fama-MacBeth regressions of Treasury pairs' return comovement in quarter q on their common ownership in quarter $q-1$. *Corr* is the excess return correlation between a pair of Treasuries in a quarter. To measure the asymmetry in return comovement during downside and upside markets, we sort all trading days into two equal groups (downside and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement for each group and take the difference in return comovement between downside and upside markets. We denote this difference as *Down-minus-up*. *Common Ownership* is the proportion of total market value of a Treasury pair held by all bond funds that hold both of them in a quarter. *Common Ownership** is the normalized and then rank-transformed *Common Ownership*. *On-the-Run Difference* is the absolute difference in on-the-run status, where on-the-run status is a dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Coupon Rate Difference* is the absolute difference between two Treasuries' coupon rates. *Time-to-maturity Difference* is the normalized absolute difference between two Treasuries' days-to-maturity. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. The sample period is from 2002Q3 through 2016Q4.

DepVar:	Corr		Down-minus-up	
	(1)	(2)	(3)	(4)
Common Ownership*	0.090***	0.064***	0.016***	0.011***
	(25.6)	(13.2)	(6.3)	(3.7)
On-the-run Difference		0.079***		-0.013***
		(10.7)		(-3.8)
Coupon Rate Difference		-0.022***		0.005*
		(-13.5)		(1.7)
Time-to-maturity Difference		-0.166***		-0.061***
		(-19.9)		(-6.1)
# of Obs	1,533,640	1,533,640	1,533,640	1,533,640

Table 4. Common ownership and Corporate Bond Return Comovement

This table reports the results from Fama-MacBeth regressions of corporate bond pairs' return comovement in quarter q on their common ownership in quarter $q-1$. *Corr* is the excess return correlation between a pair of corporate bonds in a quarter. To measure the asymmetry in return comovement during downside and upside markets, we sort all trading days into two equal groups (downside and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement for each group and take the difference in return comovement between downside and upside markets. We denote this difference as *Down-minus-up*. *Common Ownership* is the proportion of total market value of a corporate bond pair held by all bond funds that hold both of them in a quarter. *Common Ownership** is the normalized and then rank-transformed *Common Ownership*. *Liquidity Difference* is the absolute difference between two corporate bonds' fraction of zero-trading days. *Coupon Rate Difference* is the absolute difference between two corporate bonds' coupon rates. *Rating Difference* is the absolute difference between two corporate bonds' numeric-transformed credit rating. *Time-to-maturity Difference* is the normalized absolute difference between two corporate bonds' days-to-maturity. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. The sample period is from 2002Q3 through 2016Q4.

DepVar:	Corr		Down-minus-up	
	(1)	(2)	(3)	(4)
*Common Ownership**	0.007***	0.005***	0.0003	0.0003
	(12.2)	(10.0)	(0.7)	(0.8)
Liquidity Difference		-0.021***		0.0011
		(-11.1)		(0.5)
Coupon Rate Difference		-0.001***		-0.0001
		(-2.9)		(-0.5)
Rating Difference		-0.001***		-0.0001
		(-5.4)		(-0.5)
Time-to-maturity Difference		-0.003***		0.0004
		(-9.7)		(0.9)
# of Obs	9,072,186	9,072,186	9,072,186	9,072,186

Table 5. Natural Experiment: COVID-19

This table reports the results based on the COVID-19 outbreak in the first quarter of 2020. Panel A reports the summary statistics. $Corr$ is the excess return correlation of a pair of securities, computed both before and after March 11, 2020 within the first quarter of 2020. Panel B reports the results from difference-in-difference regressions. $Treat$ is a dummy variable that equals one if the common ownership of a security pair is above median, and zero otherwise. Common ownership is the proportion of total market value of a security pair held by all bond funds that hold both of them by the end of 2019. $After$ is a dummy variable that equals one if $Corr$ is computed after March 11, 2020, and zero otherwise. All control variables are the same as the ones in Tables 3 and 4. Robust t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

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

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

Table 6. Natural Experiment: Mutual Fund Scandal

This table reports the results from two-stage least squares regressions based on the 2003 mutual fund scandal. The instrumental variable is the ratio of the total value held by common scandal funds of a security pair over the total value held by all common funds (*Ratio*). *Common Ownership* is the proportion of total market value of a security pair held by all bond funds that hold both of them in a quarter. *Common Ownership** is the normalized and then rank-transformed *Common Ownership*. *Common Ownership*200309* is the level of *Common Ownership** as of September 2003. $\widehat{\textit{Common Ownership}}^*$ is the fitted *Common Ownership** from the first stage. The sample period is from 2004Q1 through 2006Q4. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

Panel A: First Stage Regression		
DepVar:	*Common Ownership**	
	Treasuries	Corporate Bonds
	(1)	(2)
Ratio	-0.136***	-0.218***
	(-7.3)	(-8.7)
*Common Ownership200309**	0.482***	0.591***
	(16.4)	(13.6)
On-the-run Difference	0.206***	
	(3.6)	
Liquidity Difference		-0.342***
		(-11.9)
Coupon Rate Difference	-0.075***	0.006
	(-24.0)	(1.8)
Rating Difference		-0.000
		(-0.3)
Time-to-maturity Difference	-0.090***	-0.018***
	(-9.5)	(-4.9)
# of Obs	51,560	908,179
Adj R^2	0.314	0.398

Panel B: Second Stage Regression				
DepVar:	Down-minus-up			
	Treasuries		Corporate Bonds	
	(1)	(2)	(3)	(4)
$\widehat{\textit{Common Ownership}}*$	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

Table 7. Common ownership and Return Comovement: Outflow Funds versus Inflow Funds

This table reports the results from Fama-MacBeth regressions of return comovement on common ownership, *Ratio of Outflow*, and their interaction for Treasuries and corporate bonds. *Corr* is the excess return correlation between a pair of securities. We define common funds for a security pair as the bond funds that hold both of the securities in the pair. *Common Ownership* is the proportion of total market value of a security pair held by all common funds in a quarter. *Common Ownership** is the normalized and then rank-transformed *Common Ownership*. *Ratio of Outflow* is the proportion of the security pair's common funds whose fund flow is below quarter median. Control variables are the same as in Tables 3 and 4. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at %, 5% and 10%, respectively. The sample period is from 2002Q3 through 2016Q4.

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** × *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 × *Ratio of Outflow*	No	Yes	No	Yes
# of Obs	1,285,706	1,285,706	4,033,587	4,033,587

Table 8. Liquidity Commonality among Treasuries

This table reports the results from Fama-MacBeth regressions of Treasury pairs' liquidity commonality in quarter q on their common ownership in quarter $q-1$. We measure liquidity commonality for each Treasury pair in the following steps. First, for each Treasury at each quarter, we identify the day with maximum bid-ask spread. This day is defined as a liquidity dry-up event if its bid-ask spread exceeds all bid-ask spreads in the previous four quarters. To measure liquidity commonality, we examine whether two Treasuries simultaneously experience liquidity dry-ups. Specifically, for each Treasury pair at each quarter, we define a dummy variable, *Common Dry-ups*, which equals one if these two Treasuries have liquidity dry-ups within the same calendar week (columns (1)–(2)) or within seven trading days (columns (3)–(4)). *Common Ownership* is the proportion of total market value of a Treasury pair held by all bond funds that hold both of them in a quarter. *Common Ownership** is the normalized and then rank-transformed *Common Ownership*. *On-the-Run Difference* is the absolute difference in on-the-run status, where on-the-run status is a dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Coupon Rate Difference* is the absolute difference between two Treasuries' coupon rates. *Time-to-maturity Difference* is the normalized absolute difference between two Treasuries' days to maturity. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. The sample period is from 2002Q3 through 2016Q4

DepVar:	*Common Dry-ups*			
	(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

Table 9. Skewness, Volatility, and Liquidity Range for Individual Treasuries

This table reports the results from Fama-MacBeth regressions of individual Treasuries' characteristics on their fund ownership. *Skewness* is the skewness of the daily excess returns of a Treasury in a quarter. *Volatility* is the standard deviation of the daily excess returns of a Treasury in a quarter. *Liquidity Range* is defined as the difference between the maximum and minimum daily bid-ask spread within the quarter. *Ownership* is the proportion of total market value of a Treasury held by all bond funds in a quarter. *Ownership** is the normalized and then rank-transformed *Ownership*. *On-the-run* is a dummy variable that equals one if the Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Coupon Rate* is coupon rate expressed in percentage. *Time-to-maturity* is the normalized days to maturity. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. The sample period is from 2002Q3 through 2016Q4.

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

Table A1. Variable Definition

Variable	Definition
Corr	The realized pairwise correlation of the daily excess returns between securities i and j in quarter q
Down-minus-up	To measure the asymmetry in return comovement during downside and upside markets, we sort all trading days into two equal groups (downside and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement for each group and take the difference in return comovement between downside and upside markets. We denote this difference as *Down-minus-up*.
Common Ownership	The market value held by all funds commonly holding a pair of bonds over the sum of the total market value of the two bonds
*Common Ownership**	The normalized and then rank-transformed *Common Ownership*
Time-to-maturity	Remaining days to maturity, i.e., the days between the quarter-end and maturity date.
Time-to-maturity Difference	The absolute difference in *Time-to-maturity* between two securities
Coupon Rate	Coupon rate expressed in percentage
Coupon Rate Difference	The absolute difference in *Coupon Rate* between two securities
On-the-run	A dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise
On-the-run Difference	The absolute difference of *On-the-run* between two Treasuries
Liquidity Difference	The absolute difference in the fraction of zero-trading days between two corporate bonds
Rating Difference	The absolute difference in the numeric-transformed credit rating between two corporate bonds. The main rating information of corporate bonds is from Moody's. If there is no rating from Moody's then the rating is from S&P, and if there is no rating from either Moody's or S&P, the rating is from Fitch. An Aaa rating is translated as 1 and a C rating is translated as 21. The other ratings are assigned accordingly.
Net Buy	The percentage change of a fund's total holding in Treasuries or corporate bonds, relative to its beginning-of-the-quarter holding
Fund Flow	Quarterly fund flows
Out	A dummy variable that equals one if *Fund Flow* is lower than the quarter median, and zero otherwise. An alternative *Out* used in the Appendix Tables A2 and A3 is defined as a dummy variable that equals one if *Fund Flow* is negative, and zero otherwise.
Fund Return	Quarterly fund returns
Ratio of Outflow	The proportion of the security pair's common funds whose flow is below sample median. Common funds for a security pair are the bond funds that hold both of the securities in the pair
Common Dry-ups	We measure liquidity commonality for each Treasury pair in the following steps. First, for each Treasury at each quarter, we identify the day with the maximum bid-ask spread. This day is defined as a liquidity dry-up event if its bid-ask spread exceeds all bid-ask spreads in the previous four quarters. To measure liquidity commonality, we examine whether two Treasuries simultaneously experience liquidity dry-ups. Specifically, for each Treasury pair at each quarter, we define a dummy variable, *Common Dry-ups*, which equals one if these two Treasuries have liquidity dry-ups within the same calendar week or within seven trading days.
Skewness	The skewness of the daily excess returns of a Treasury in a quarter
Volatility	The standard deviation of the daily excess returns of a Treasury in a quarter
Liquidity Range	We measure liquidity range as the difference between the maximum and minimum daily bid-ask spread within the quarter.

Table A2. Fund Flows and Liquidity Management: Alternative Definition for *Out*.

This table reports the regression results for fund trading on fund flows for Treasuries and corporate bonds. $Net\ Buy_{f,q}$ is calculated as the percentage change of fund f's total holdings in Treasuries or corporate bonds in quarter q, relative to its beginning-of-the-quarter holdings. $Fund\ Flow_{f,q}$ and $Fund\ Return_{f,q}$ represent quarterly fund flows and fund return for fund f in quarter q. $Out_{f,q}$ is a dummy variable that equals one when the fund flow for fund f is negative in quarter q, and zero otherwise. Variables are winsorized by quarter at the 5^{th} and 95^{th} percentiles. Standard errors are adjusted for heteroscedasticity and clustered by fund and quarter. t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. The sample is from 2002Q3 through 2016Q4.

DepVar:	$Net\ Buy_{f,q}$			
	Treasuries		Corporate Bonds	
	(1)	(2)	(3)	(4)
$Fund\ Flow_{f,q}$	1.048***	1.052***	0.821***	0.811***
	(15.0)	(15.0)	(13.5)	(12.7)
$Fund\ Flow_{f,q} \times Out_{f,q}$	0.270**	0.234*	-0.159*	-0.185*
	(2.2)	(1.8)	(-1.6)	(-1.8)
$Fund\ Flow_{f,q-1}$	-0.137**	-0.106*	0.210***	0.197***
	(-2.1)	(-2.0)	(5.6)	(5.6)
$Fund\ Flow_{f,q-1} \times Out_{f,q-1}$	-0.095	-0.174	-0.057	-0.059
	(-0.7)	(-1.5)	(-0.7)	(-0.8)
$Fund\ Return_{f,q}$	-0.704***	-0.630**	0.040	-0.128
	(-3.4)	(-2.4)	(0.1)	(-0.5)
$Fund\ Return_{f,q-1}$	0.094	0.227	-0.458**	-0.636***
	(0.5)	(0.8)	(-2.5)	(-3.0)
Fund Fixed Effects	No	Yes	No	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes
# of Obs	26,638	26,560	26,638	26,560
Adj R^2	0.067	0.162	0.079	0.098

Table A3. Fund Flows and Liquidity Management: Illiquid Funds versus Liquid Funds

This table reports the regression results of fund trading on fund flows for illiquid funds and liquid funds. We define illiquid funds as the ones whose portfolio weights on corporate bonds is higher than the quarter median. The rest of the funds are defined as liquid funds. Columns (1)–(2) report the results for illiquid funds, while columns (3)–(4) report the results for liquid funds. $Net\ Buy_{f,q}$ is calculated as the percentage change of fund f's total holdings in Treasuries or corporate bonds in quarter q, relative to its beginning-of-the-quarter holdings. $Fund\ Flow_{f,q}$ and $Fund\ Return_{f,q}$ represent quarterly fund flows and fund return for fund f in quarter q. $Out_{f,q}$ is a dummy variable that equals one when the fund flow for fund f is negative in quarter q, and zero otherwise. Variables are winsorized by quarter at the 5^{th} and 95^{th} percentiles. Standard errors are adjusted for heteroscedasticity and clustered by fund and quarter. t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. The sample is from 2002Q3 through 2016Q4.

DepVar:	$Net\ Buy_{f,q}$			
	Iliquid Funds		Liquid Funds	
	Treasuries	Corporate Bonds	Treasuries	Corporate Bonds
	(1)	(2)	(3)	(4)
$Fund\ Flow_{f,q}$	1.003***	0.936***	1.118***	0.651***
	(10.8)	(12.4)	(13.1)	(8.1)
$Fund\ Flow_{f,q} \times Out_{f,q}$	0.479***	-0.185*	-0.075	-0.152
	(2.9)	(-1.7)	(-0.4)	(-1.0)
$Fund\ Flow_{f,q-1}$	-0.138*	0.132***	-0.031	0.210***
	(-2.0)	(3.4)	(-0.4)	(3.8)
$Fund\ Flow_{f,q-1} \times Out_{f,q-1}$	-0.159	-0.041	-0.120	0.018
	(-1.0)	(-0.5)	(-0.8)	(0.2)
$Fund\ Return_{f,q}$	-0.820**	-0.167	0.125	-0.006
	(-2.1)	(-0.7)	(0.2)	(-0.0)
$Fund\ Return_{f,q-1}$	-0.205	-0.405**	1.016	-1.013***
	(-0.6)	(-2.4)	(1.5)	(-2.8)
Fund FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
# of Obs	15,739	15,739	10,362	10,362
Adj R^2	0.158	0.137	0.203	0.086

Table A4. Common ownership and Return Comovement: Alternative Sample Selection on Time-to-Maturity

This table reports the results from Fama-MacBeth regressions of a security pair's excess return comovement in quarter q on their common ownership in quarter $q-1$. Securities with a time-to-maturity of less than one-year are excluded from the sample. *Corr* is the excess return correlation between a pair of securities in a quarter. To measure the asymmetry in return comovement during downside and upside markets, we sort all trading days into two equal groups (downside and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement for each group and take the difference in return comovement between downside and upside markets. We denote this difference as *Down-minus-up*. *Common Ownership* is the proportion of total market value of a security pair held by all bond funds that hold both of them in a quarter. *Common Ownership** is the normalized and then rank-transformed *Common Ownership*. *On-the-Run Difference* is the absolute difference in on-the-run status, where on-the-run status is a dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Liquidity Difference* is the absolute difference between two corporate bonds' fraction of zero-trading days. *Rating Difference* is the absolute difference between two corporate bonds' numeric-transformed credit rating. *Coupon Rate Difference* is the absolute difference between two securities' coupon rates. *Time-to-maturity Difference* is the normalized absolute difference between two securities' days-to-maturity. Panel A reports the results for Treasuries and Panel B reports the results for corporate bonds. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.The sample period is from 2002Q3 through 2016Q4.

Panel A: Treasuries				
DepVar:	Corr		Down-minus-up	
	(1)	(2)	(3)	(4)
*Common Ownership**	0.106***	0.070***	0.021***	0.013***
	(20.9)	(13.1)	(6.3)	(3.4)
On-the-run Difference		0.078***		-0.017***
		(10.7)		(-3.4)
Coupon Rate Difference		-0.026***		0.004
		(-12.1)		(1.5)
Time-to-maturity Difference		-0.184***		-0.069***
		(-17.4)		(-6.3)
# of Obs	1,275,495	1,275,495	1,275,495	1,275,495
Panel B: Corporate Bonds				
DepVar:	Corr		Down-minus-up	
	(1)	(2)	(3)	(4)
*Common Ownership**	0.007***	0.005***	0.0004	0.0002
	(12.2)	(9.4)	(0.8)	(0.5)
Liquidity Difference		-0.024***		-0.0008
		(-10.8)		(-0.3)
Coupon Rate Difference		-0.001***		-0.0002
		(-2.8)		(-0.6)
Rating Difference		-0.001***		-0.0001
		(-6.1)		(-0.6)
Time-to-maturity Difference		-0.003***		0.0003
		(-9.5)		(0.6)
# of Obs	7,548,190	7,548,190	7,548,190	7,548,190

Table A5. Common ownership and Return Comovement: The Number of Unique Securities

This table reports the results from Fama-Macbeth regressions of a security pair's excess return comomvement in quarter q on their common ownership in quarter $q-1$. *Common Ownership* $(more\ TRY)^*$ $(Common\ Ownership\ (more\ CB)^*)$ is the normalized and then rank-transformed *Common Ownership* from common funds holding an above-median number of unique Treasury (corporate bond) securities, while *Common Ownership* $(less\ TRY)^*$ $(Common\ Ownership\ (less\ CB)^*)$ is the normalized and then rank-transformed *Common Ownership* from common funds holding a below-median number of unique Treasury (corporate bond) securities. *Corr* is the excess return correlation between a pair of securities in a quarter. To measure the asymmetry in return comovement during downside and upside markets, we sort all trading days into two equal groups (downside and upside markets) based on the aggregate Treasury market returns. We then calculate return comovement for each group and take the difference in return comovement between downside and upside markets. We denote this difference as *Down-minus-up*. *On-the-Run Difference* is the absolute difference in on-the-run status, where on-the-run status is a dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Liquidity Difference* is the absolute difference between two corporate bonds' fraction of zero-trading days. *Rating Difference* is the absolute difference between two corporate bonds' numeric-transformed credit rating. *Coupon Rate Difference* is the absolute difference between two securities' coupon rates. *Time-to-maturity Difference* is the normalized absolute difference between two securities' days to maturity. Panel A reports the results for Treasuries and Panel B reports the results for corporate bonds. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. The sample is from 2002Q3 through 2016Q4.

Panel A: Treasuries				
DepVar:	Corr		Down-minus-up	
	(1)	(2)	(3)	(4)
*Common Ownership (more TRY)**	0.085***	0.063***	0.015***	0.011***
	(20.3)	(12.5)	(5.8)	(3.7)
*Common Ownership (less TRY)**	0.035***	0.009***	0.003**	0.001
	(12.5)	(6.0)	(2.5)	(0.5)
On-the-run Difference		0.078***		-0.012***
		(10.3)		(-3.7)
Coupon Rate Difference		-0.022***		0.005*
		(-13.0)		(1.7)
Time-to-maturity Difference		-0.166***		-0.061***
		(-19.8)		(-6.0)
# of Obs	1,533,640	1,533,640	1,533,640	1,533,640

Panel B: Corporate Bonds				
DepVar:	Corr		Down-minus-up	
	(1)	(2)	(3)	(4)
*Common Ownership (more CB)**	0.005***	0.003***	0.000	0.000
	(10.7)	(8.3)	(1.1)	(1.3)
*Common Ownership (less CB)**	0.005***	0.004***	0.000	0.000
	(9.6)	(9.5)	(0.3)	(0.2)
Liquidity Difference		-0.020***		0.001
		(-11.0)		(0.6)
Coupon Rate Difference		-0.001***		-0.000
		(-2.8)		(-0.5)
Rating Difference		-0.001***		-0.000
		(-5.7)		(-0.5)
Time-to-maturity Difference		-0.003***		0.000
		(-9.3)		(1.1)
# of Obs	9,072,186	9,072,186	9,072,186	9,072,186

Table A6. Natural Experiment: COVID-19

This table reports the ordinary least squares results based on the COVID-19 outbreak in 2020, for Treasuries (Panel A) and corporate bonds (Panel B). *Corr* is the excess return correlation between a pair of securities. In columns (1)–(2), the excess return correlation for a pair of securities is computed before March 11th in the first quarter of 2020. In columns (3)–(4), the excess return correlation for a pair of securities is computed after March 11 in the first quarter of 2020. To examine the asymmetry in return comovement, for each pair of securities, we take the difference in the excess return correlations after and before the pandemic announcement. We denote this difference as *After-minus-before*. *On-the-Run Difference* is the absolute difference in on-the-run status, where on-the-run status is a dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Liquidity Difference* is the absolute difference between two corporate bonds' fraction of zero-trading days. *Rating Difference* is the absolute difference between two corporate bonds' numeric-transformed credit rating. *Coupon Rate Difference* is the absolute difference between two securities' coupon rates. *Time-to-maturity Difference* is the normalized absolute difference between two securities' days-to-maturity. Panel A reports the results for Treasuries and Panel B reports the results for corporate bonds. Robust t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.

Panel A: Treasuries

DepVar:	Corr				After-minus-before	
Timing:	Before March 11		After March 11			
	(1)	(2)	(3)	(4)	(5)	(6)
*Common Ownership**	0.137***	0.068***	0.169***	0.136***	0.032***	0.068***
	(68.8)	(40.8)	(93.6)	(81.5)	(19.7)	(41.5)
On-the-run Difference		0.088***		0.069***		-0.019**
		(10.6)		(8.9)		(-2.3)
Coupon Rate Difference		-0.035***		0.022***		0.057***
		(-28.9)		(22.7)		(47.4)
Time-to-maturity Difference		-0.332***		-0.247***		0.085***
		(-191.4)		(-149.2)		(50.9)
# of Obs	48,503	48,503	48,503	48,503	48,503	48,503
Adj R^2	0.072	0.515	0.142	0.450	0.007	0.109

Panel B: Corporate Bonds

DepVar:	Corr				After-minus-before	
Timing:	Before March 11		After March 11			
	(1)	(2)	(3)	(4)	(5)	(6)
*Common Ownership**	0.009***	0.005***	0.016***	0.010***	0.007***	0.005***
	(9.3)	(4.9)	(10.5)	(6.2)	(4.6)	(3.1)
Liquidity Difference		-0.053***		-0.012		0.041***
		(-6.9)		(-1.0)		(3.7)
Coupon Rate Difference		-0.002***		-0.003**		-0.000
		(-3.3)		(-2.4)		(-0.3)
Rating Difference		-0.002***		-0.003***		-0.002**
		(-3.7)		(-5.0)		(-2.6)
Time-to-maturity Difference		-0.005***		-0.007***		-0.002
		(-4.8)		(-4.2)		(-1.1)
# 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

Table A7. Common ownership and Return Comovement: Month End versus Month Begin.

This table reports the results from Fama-Macbeth regressions of a security pair's excess return comovement on common ownership during month end and month begin, for Treasuries (Panel A) and corporate bonds (Panel B). Following Etula, Rinne, Suominen, and Vaittinen (2020), we define month end as the five-day window [t-8,t-4], and month begin as the five-day window [t-1,t+3], where t is the last trading day of each month. *Corr* is the excess return correlation between a pair of securities. In columns (1)–(2), the excess return correlation of a pair of securities is computed at month-ends in a quarter. In columns (3)–(4), the excess return correlation of a pair of securities is computed at month-begins in a quarter. To examine the asymmetry in return comovement, for each pair of securities, we take the difference in the excess return correlations between month ends and month begins. We denote this difference as *End-minus-begin*. *On-the-Run Difference* is the absolute difference in on-the-run status, where on-the-run status is a dummy variable that equals one if a Treasury is the most recently issued Treasury of a particular maturity, and zero otherwise. *Liquidity Difference* is the absolute difference between two corporate bonds' fraction of zero-trading days. *Rating Difference* is the absolute difference between two corporate bonds' numeric-transformed credit rating. *Coupon Rate Difference* is the absolute difference between two securities' coupon rates. *Time-to-maturity Difference* is the normalized absolute difference between two securities' days to maturity. Heteroscedasticity and auto-correlation-consistent Newey-West (1987) t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively.The sample is from 2002Q3 through 2016Q4.

Panel A: Treasuries

DepVar:	Corr				End-minus-begin	
Timing:	Month end		Month begin			
	(1)	(2)	(3)	(4)	(5)	(6)
*Common Ownership**	0.106***	0.076***	0.092***	0.068***	0.015***	0.008*
	(15.8)	(10.1)	(23.8)	(11.7)	(3.0)	(1.8)
On-the-run Difference		0.076***		0.076***		0.000
		(7.7)		(9.6)		(0.0)
Coupon Rate Difference		-0.024***		-0.016***		-0.008***
		(-13.8)		(-12.1)		(-4.2)
Time-to-maturity Difference		-0.203***		-0.164***		-0.039***
		(-16.4)		(-18.6)		(-3.1)
# of Obs	1,533,640	1,533,640	1,533,640	1,533,640	1,533,640	1,533,640

Panel B: Corporate Bonds

DepVar:	Corr				End-minus-begin	
Timing:	Month end		Month begin			
	(1)	(2)	(3)	(4)	(5)	(6)
*Common Ownership**	0.008***	0.006***	0.008***	0.006***	-0.000	-0.000
	(8.4)	(6.7)	(10.6)	(10.4)	(-0.3)	(-0.4)
Liquidity Difference		-0.023***		-0.023***		0.001
		(-8.1)		(-7.2)		(0.2)
Coupon Rate Difference		-0.001**		-0.001***		0.000
		(-2.3)		(-2.8)		(0.4)
Rating Difference		-0.001***		-0.001***		-0.000
		(-5.5)		(-4.2)		(-1.2)
Time-to-maturity Difference		-0.004***		-0.003***		-0.000
		(-7.8)		(-5.7)		(-0.5)
# of Obs	9,072,186	9,072,186	9,072,186	9,072,186	9,072,186	9,072,186