Bond Price Fragility and the Structure of the Mutual Fund Industry*

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We show that mutual funds with a large share of a bond issue sell their holdings of that issue to a lower extent when they experience redemptions, arguably because they attempt to avoid a drop in the bond price and the consequent negative spillovers on the unsold part of their position. Hence, ownership concentration limits bonds' exposures to flow-induced fire sales. We exploit exogenous variation in the negative spillovers of forced sales arising from the Fed's SMCCF to confirm the economic mechanism. We also explore our findings' implications for fund performance and the stability of the bond mutual fund industry.

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Mutual funds' increased role within the corporate bond market has raised concerns about financial stability.[1] Bond mutual funds invest in illiquid assets but issue liquid liabilities, which their investors can redeem on demand. When large redemptions occur, these funds may be forced to sell their holdings at fire-sale prices. Fire sales in turn can amplify the initial shock, leading to more redemptions and sales because fire-sale prices negatively affect the performance of other funds holding the same securities (Falato, Hortaçsu, Li and Shin, 2021). Vicious cycles, in which redemptions lead to fire sales and fire sales lead to more redemptions, are particularly worrisome in the case of bond funds, because low fund returns have been shown to generate outflows at an increasing rate (Goldstein, Jiang and Ng, 2017) and could, through overlapping portfolios, engender widespread contagion (Ibragimov, Jaffee and Walden, 2011; Wagner, 2011).

The extent of contagion, however, depends on how bond mutual funds liquidate their portfolios when redemptions occur. Negative spillovers are believed to be strongest if funds reduce their positions pro-rata and are mitigated if funds hold cash and liquidate their liquid holdings first (Morris, Shim and Shin, 2017). It has been largely neglected that funds may also internalize the spillovers of their trades. Specifically, intermediaries that own a large proportion of a bond issue may internalize that their sales will drive down the price of that issue and hence the value of the unsold part of their position. As a result, when facing negative shocks, funds may have an incentive to limit the sales of bond issues in which they own large shares in order to attempt to stabilize the bond's price. Not only do we provide evidence supporting this hypothesis, but we also explore the consequences of bond mutual funds' strategic behavior on the cross-section of bond returns and the stability of the bond mutual fund industry.

Consistent with our hypothesis, we show that when faced with large redemptions at the fund or industry levels, bond mutual funds decrease their positions in bond issues of which they hold a large share to a lower extent. The effects are stronger among the more illiquid high-yield bonds, for which any sales can be expected to have larger negative spillovers on prices. We show that

[1] These concerns have been voiced in the Financial Stability Board (2017), the IMF Global Financial Stability Report (2018), and more recently, in June 2019, after the LF Woodford Equity Income Fund suspended redemptions, by the Governor of the Bank of England, Mark Carney. Similar concerns are likely to have brought the Fed to heavily intervene in the bond market during the Spring 2020 in response to the COVID-19 pandemic.

these trading patterns are not driven by the relative liquidity of the securities in a fund's portfolio, or any bond-specific or fund-specific shocks.

The effects of bond mutual funds' stabilizing behavior are apparent in the cross-section of bond returns. We show for the first time that bond issues with more concentrated mutual fund ownership, as measured by the ownership share of the largest mutual fund, experience less pronounced price declines in periods of distress and have overall lower price volatility.[2] The results are again more pronounced among high-yield bonds and are robust even if we exploit within-issuer differences in ownership concentration, indicating that differences in fundamentals or the strength of the issuer's relationships with intermediaries do not drive our findings.

Importantly, a fund's stabilizing trading behavior is associated with better performance: funds whose portfolios comprise a larger fraction of positions representing large shares of outstanding bond issues perform better especially in periods of turmoil and subsequently experience fewer redemptions. Redemptions from these funds also have a smaller negative effect on the flows and performance of other funds with similar portfolios. Thus, the attempts of funds with large positions to reduce the negative spillovers of their trades not only benefit their own performance but also improve the stability of the whole mutual fund industry.

A possible concern with our interpretation of the empirical evidence is that the size of a bond fund's position and the bond issue's ownership concentration are endogenous. In principle, asset managers' positive expectations about the securities' future performance could explain the trading patterns we document and why bonds with concentrated ownership do better during market turmoil, even if we saturate our specifications with a plethora of fixed effects. First, we note that in periods of turmoil, funds are less likely to sell positions that are large relative to the bond issue, not just large in the fund portfolio. That is, we do not find the stabilizing behavior among small funds,

[2] Although our results are robust to alternative definitions of mutual fund ownership concentration, we note that bond issues are relatively small in size and the median number of mutual fund holders in each is just 14. As a result, the correlation between overall mutual fund ownership and the proportion of an issue held by the top three funds is over 90%. Therefore, the effects of mutual fund ownership and ownership concentration, as measured by ownership of the top three (or more) funds, are difficult to differentiate empirically. For this reason, as we discuss more extensively in Subsection 1.3, we view the proportion of an issue owned by the top mutual fund as the most appropriate measure of bond ownership concentration.

whose large positions are relatively small shares of the outstanding bond issues. Thus, for the alternative hypothesis to explain our results, one would have to argue that only managers of large funds are good at picking bonds.

Second, to sharpen our identification, we exploit the Fed's intervention following the onset of the COVID-19 crisis. On March 23, 2020, the Fed's pledged to purchase investment-grade corporate bonds with maturities of five years or less through the Secondary Market Corporate Credit Facility (SMCCF).[3] With its announcement, the Fed provided a price backstop and increased the liquidity of SMCCF-eligible bonds, thus mitigating the negative price spillovers of mutual funds' trades in these bonds (see, e.g., Haddad, Moreira and Muir, 2021). The Fed's intervention affecting eligible but not ineligible bonds introduces exogenous variation in price spillovers between eligible and ineligible bonds and allows us to use a difference-in-difference methodology to test whether the desire to limit the negative price spillovers indeed drives the stabilizing trading behavior of bond funds and its consequent effects on bond returns.

We explore how fund trading and the effect of ownership concentration on bond returns varies, before and after the Fed's intervention, distinguishing between SMCCF-eligible investment-grade bonds, ineligible investment-grade bonds, and ineligible high-yield bonds. In particular, while we expect funds experiencing outflows to sell to a lower extent all categories of bonds in which they held large shares before the Fed's announcement, the stabilizing trading behavior should be concentrated in investment-grade bonds with more than five-year maturity and high-yield bonds after the Fed provided a price backstop for investment-grade bonds with less than five-year maturity. This is indeed what we find. Our evidence that mutual funds' behavior changed for SMCCF-eligible bonds, but not for other bonds, supports our hypothesis that the internalization of negative price spillovers drives the differences in funds' behavior.

The changes in mutual funds' trading behavior after the SMCCF announcement are also reflected in bond returns. During March 2020, when the disruption arising from the pandemic became apparent, bonds with more concentrated mutual funds' ownership experienced higher

[3] These purchases were subsequently extended to fallen angels on April 9, 2020. There are few fallen angels, and we do not include them in our sample. However, our results would hold if we included them.

returns, although the effect is statistically significant only for investment-grade bonds with shorter maturity, presumably because the magnitude of redemptions made the stabilizing trades vane in less liquid securities. This suggests that very large shocks may decrease the effectiveness of funds' stabilizing trading. After the Fed's announcement, ownership structure became unrelated to the returns of investment-grade bonds eligible for purchases by the Fed, that is, the bonds in which, thanks to the Fed's backstop, the price externalities of sales were limited. In contrast, consistent with the shift in the funds' stabilizing trading behavior to a smaller set of securities after the SMCCF announcement, ownership concentration had a quantitatively larger positive effect on the returns of ineligible investment-grade and high-yield bonds that suffered flow-induced fire sales.

Not only would differences in managers' expectations on bonds in which they hold small vs. large positions have a hard time explaining why the trading patterns and the effects of ownership concentration on bond returns change before and after the Fed's announcements only for eligible bonds, but we also show that these patterns are robust if we limit unobserved heterogeneity by concentrating on investment-grade bonds with maturities in a close interval around the five-year eligibility cutoff. This helps to rule out a subtler alternative that due to various market developments and policy interventions when the COVID-19 shock occurred, funds traded short- and long-maturity bonds differently. Taken together, our difference-in-difference results support our interpretation that funds internalize the negative spillovers of their trades on their large positions and that their behavior shields the returns of bonds with concentrated ownership from negative shocks.

Our findings have implications for how the structure of the mutual fund industry may affect financial fragility. On the one hand, large funds may execute larger trades, which potentially increase asset volatility.[4] On this basis, the Financial Stability Board has launched a consultation to consider funds with more than $100 billion in assets under management as systemically important financial institutions. On the other hand, for the mechanism we highlight, large funds, which naturally own larger shares of outstanding bond issues relative to small funds, may provide

[4] Large funds may also be able to take more risks and their large trade size may increase volatility when markets are illiquid (Chen, Du, and Sun, 2022).

greater price stability than a myriad of small funds with correlated flows. In this respect, our findings imply that not only can institutions with stable, long-term liabilities ride out transitory dislocations in market prices (Chodorow-Reich, Ghent, and Haddad, 2021), but also open-end funds trading strategically can insulate part of their portfolios from negative shocks.

We also suggest a mechanism for why Koijen and Yogo (2019) find that higher asset price volatility is associated with ownership by small, not large, institutions. Since large market players internalize the impact of their trades on security prices, particularly for illiquid securities such as corporate bonds, they may not be destabilizing as Gabaix, Gopikrishnan, Plerou, and He (2006) and Ben-David, Franzoni, Moussawi and Sedunov (2021) argue in the context of equity markets.

This paper is related to several strands of the literature. First, we contribute to the literature documenting the extent to which mutual funds introduce fragility in the corporate bond market. While funds' ability to sell liquid assets, including Treasuries and high quality corporate bonds, limits fire sales (Jiang, Li, Wang, 2021; Ma, Xiao, Zeng, 2022), when aggregate uncertainty rises, bond funds appear to stop selling their liquid asset first and scale down their portfolio pro-rata leading to outflows-induced fire sales (Jiang, Li, and Wang, 2021) and further sales from institutional investors (Cai, Han, Li and Li, 2019). This strand of the literature documents significant price distortions associated with redemptions. However, Choi, Hoseinzade, Shin, and Tehranian (2020) find little evidence that corporate bond mutual funds generate fire sales after controlling for time-varying issuer-level information, possibly because bond mutual funds hold large amounts of cash (Chernenko and Sunderam, 2020). By considering ownership concentration, our paper can help to explain why evidence of fire sales following negative shocks to bond mutual funds is mixed.

We also contribute to a strand of the literature exploring how the ownership structure of an asset affects its price volatility. Greenwood and Thesmar (2011) show that mutual fund ownership affects non-fundamental stock price volatility. This may arise from the behavior of a few concentrated owners or from correlated liquidity shocks across many owners.[5] In contrast, institutions that are not exposed to redemptions, such as insurance companies, guarantee stable ownership and limit the exposure of equity (Cella, Ellul, and Giannetti, 2013) and bonds (Barbosa and Ozdagli, 2020; Coppola, 2022) to market shocks. We show that concentrated ownership by open-end mutual funds can be stabilizing because fund managers trade strategically. The mechanism that we propose and test is particularly relevant for the corporate bond market because corporate bonds are illiquid and the negative externalities of distressed sales are potentially larger than in equity markets (Ellul, Jotikasthira, and Lundblad, 2011). In addition, firms offer a myriad of small bond issues, and each bond issue has a capitalization that is much smaller than the equity market capitalization of a typical company. It is thus particularly relevant to explore whether fund managers internalize the negative effects of their sales on the price of the issues in which they own large stakes. Our results in support of the internalization hypothesis suggest that at least in the corporate bond market, regulators should direct their attention to disperse ownership by intermediaries with correlated liquidity shocks rather than merely to large funds.

The mechanism we highlight is related to but distinct from portfolio pumping, which refers to asset managers' purchases of securities they already hold in order to inflate the prices and short-term performance at the expense of long-term performance (Bhattacharyya and Nanda, 2013; Wang, 2021). In our case, fund managers' choices of securities to sell also aim to affect the value of the positions they hold, but their behavior limits negative spillovers and undervaluation and, as we show, improves their own fund's performance during periods of turmoil.

Finally, our paper contributes to a strand of the literature documenting the effects of the COVID-19 crisis and the consequent Fed's interventions on the bond market. Falato, Goldstein, and Hortaçsu (2021) and Ma, Xiao, and Zeng (2022) document large outflows from US bond funds during February and March 2020 and the positive effects of the Fed's intervention on market

[5] We aim to capture a different mechanism from Greenwood and Thesmar (2011), who assume that mutual funds liquidate assets pro-rata. As a consequence, we do not focus on the *share of total mutual fund ownership that belongs to top funds*, but on the *share of the outstanding issue held by top fund owners*. This allows us to capture how funds internalize negative price spillovers of their trading and how ownership concentration affects the cross-section of bond returns.

stability. Kargar et al. (2021) and O'Hara and Zhou (2021) document a deterioration of liquidity conditions in the corporate bond market that was quickly reversed by the Fed's SMCCF announcements. Haddad, Moreira, and Muir (2021) document large and persistent selling pressure in the bond market, affecting especially investment-grade corporate bonds, during March 2020. To the best of our knowledge, we are the first to focus on the effect of the Fed's policies on mutual funds' strategic trading, which in turn helps explain the cross-section of the returns also for bonds not directly targeted by the Fed.

1. Data Sources and Descriptive Statistics

1.1 Sample Funds

We obtain data on bond mutual fund holdings from Morningstar, data on fund characteristics from Morningstar Direct and the CRSP Mutual Funds database, data on bond characteristics from Mergent's Fixed Income Securities Database (FISD), and data on corporate bond transactions from FINRA's enhanced TRACE database. In the first part of the analysis, our main sample covers the period from 1/2003 to 12/2019. In the second part of the analysis, when we consider the consequences of the COVID-19 shock and the Fed's intervention, the sample period is 3/2020 – 9/2020 (that is, the month of the COVID-19 shock to six months after). Detailed variable definitions are in the Appendix.

We focus on open-end mutual funds classified by Morningstar as taxable bond funds. There are a total of 2,240 unique funds, but, given our focus on the corporate bond market, our main analysis includes only 1,016 funds, for which corporate bonds are at least 50% of the portfolio holdings (of these, 484 invest mostly in investment-grade bonds, while 532 invest mostly in high-yield bonds). These funds also have less liquid portfolios and are more likely to create concerns for financial stability. Also, because of this restriction, our sample includes only seven bond index funds (out of 77).

Using Morningstar along with Morningstar Direct and CRSP, we construct a survivorship bias-free dataset that includes information on a variety of fund characteristics, such as total net assets under management (TNA), returns, flows, fees, and fund-level bond holdings. While the

SEC requires mutual funds to report holdings on a quarterly basis, some funds voluntarily report their holdings more frequently. Approximately 74% of the fund reporting-period observations in our sample are monthly, while the remaining are quarterly. Our changes in position variables thus vary between funds based on reporting frequency. Omitting observations for funds that do not report monthly holdings leaves our results unaffected.

Table 1, Panel A reports descriptive statistics for various fund attributes, with the first five columns highlighting the main sample (42,251 fund-reporting period observations) and the remaining dedicated to the COVID-19 sample. The distribution of fund TNA is positively skewed, with the average of approximately $1.25 billion and the median of only $0.33 billion. The median fund has negligible rear load fee, and institutional share classes account for about 50% of TNA. Consistent with the growth in bond mutual funds documented by Goldstein et al. (2017), our sample funds experience significant inflows. The average monthly fund flow is 0.6% of TNA, with the 10th and 90th percentiles at -3.0% and 5.2%, respectively, indicating significant variation across funds and over time.

The average fund holds 12.2% of its portfolio in liquid securities, which include 6.6% in cash and cash equivalents and 5.6% in government bonds, and 77.5% in corporate bonds. Due to our screening, our sample funds are disproportionately high-yield, which is reflected in the average credit quality of their corporate bond holdings. In addition, compared to the average corporate bond (see Table 1, Panel C), the bond issues held by our sample funds are on average more liquid, younger, and larger.

1.2 Funds' Position Size and Its Determinants

Table 1, Panel B reports descriptive statistics for the funds' corporate bond positions, with the first five columns again highlighting the main sample (11,312,852 fund-bond-reporting period observations). Funds turnover about 17% of their existing positions in a month, which is equivalent to about 200% over a year. Conditional on holding a particular bond at the beginning of the period, the funds increase and decrease the position 6% and 11% of the times, respectively. The average change in position is a decrease of 4.6%.

Just like the fund's TNA, the fund's position size in a bond, relative to the bond issue size, is positively skewed with an average of 0.6%, a median of only 0.2%, and a 90th percentile of 1.5%. Summing across all funds in the same family, we find that the family's position size is about 2-3 times as large (equivalent to 2-3 funds in the same family holding the same bond) and is similarly positively skewed.

In the cross-section, the main determinant of fund position size is the fund's asset size. The logarithm of the funds' TNA explains 47% of the variation in funds' average position size and 46% of the variation in the fraction of a fund's portfolios that consists of positions in the top size decile. Put differently, large funds hold more large positions in outstanding issues. All other fund characteristics in Table 1, Panel A collectively explain just another 8-9% of the variation in the fraction of large positions in a fund's portfolio.

Nonetheless, there is a significant overlap in position size between small and large funds. For example, if we split the sample into funds with TNA above and below the median on each report date, we find that the 25th percentile of position size for funds with TNA above the median is about the same as the 75th percentile of the position size for funds with TNA below the median. The impact of larger funds trading in their small positions can thus be thought of as similar to that of smaller funds.

Interestingly, the average position size, as well as the fraction of large positions in the portfolios of funds with TNA above the median, increases by about 5-10% following periods of large individual or aggregate outflows and reverts back to the mean in about six months. This is consistent with the idea that in periods of turmoil funds avoid liquidating positions that may cause negative price spillovers to their portfolios. Such a strategy, however, leads to portfolio under-diversification and is reversed in normal times, when negative spillovers are smaller or less likely to arise.

1.3 Bond-Level Data and Ownership Concentration

Following Bessembinder et al. (2018) and Anand et al. (2021), we consider only bonds in the FISD database that are classified as non-puttable U.S. Corporate Debentures and U.S. Corporate

Bank Notes (bond type-CDEB or USBN). Our sample includes a total of 32,006 distinct bond issues (CUSIPs), which satisfy the above restriction and are held by mutual funds at some point in time. Table 1, Panel C reports descriptive statistics on the characteristics of these bonds, with the first five columns again highlighting the main sample (1,514,632 bond-month observations).

On average, the bond maturity is 8.7 years, the issue size is $593 million, and the bond age is 4.5 years. Approximately 67% of the bond-month observations are for investment-grade bonds.[6] Together, all taxable mutual funds own about 10% of the average bond issue in our sample.

Throughout the analysis, we measure the incentives of the mutual fund owners to internalize the negative price spillovers of their trades using the proportion of the outstanding bond issue held by the top mutual fund owner.[7] The reason for doing so, instead of considering the top N ($N > 1$) owners, is that the median bond issue is held by 14 mutual funds and the funds' TNAs are highly positively skewed. Thus, as we consider the share of a bond issue held by an increasing number of fund owners, our measure of internalization incentives at the bond level becomes highly correlated with the share of the outstanding bond issue held by all mutual funds (the correlation would be 90% if we considered the top three mutual fund owners).

On average, the top mutual fund owner holds 3.5% of a bond issue and the top family owner 4.6%. The share of the top mutual fund owner exhibits significant variation across bonds and over time. For example, the 10th and 90th percentiles of the top fund ownership are 0.4% and 8.0%, respectively. Given the size of these large positions, ownership concentration should not necessarily lead to lower liquidity. Nevertheless, to make sure that differences in liquidity do not drive our findings, we control for bond turnover and the relative liquidity of a bond in a fund's portfolio.

[6] A bond is investment-grade if its credit rating is equivalent to BBB- or better. The credit ratings are from Moody's, S&P, and Fitch. If the ratings are available from all three agencies, we use the middle rating. If the ratings are available from two agencies, we use the worse rating.

[7] We study funds' strategic trading behavior, and aim to capture its general equilibrium effect, which depends on *the share of the outstanding bond issue* held by the top fund owner (par amount held by the top fund owner divided by the issue size). It would be incorrect for us to focus on *the share of total mutual fund ownership* held by the top fund (par amount held by the top fund owner divided by par amount held by all funds). The share of total mutual fund ownership held by the top fund can be large in bonds with low mutual fund ownership (e.g., bonds that are held by just 1-2 funds), even if the top fund has a small position and does not internalize the spillovers of its trades. Presumably for this reason, Huang et al. (2022) find that such a variable is positively related to their proxy for bond price volatility

Unsurprisingly, the top mutual fund owners have larger shares in smaller issues. Top mutual fund ownership is also higher in issues with a higher proportion of mutual fund ownership in general. Mutual fund ownership tends to be higher in bonds with short- and medium-term maturity, while long-term bonds are typically held by insurance companies.

For each bond-month, we calculate the return as the prorated coupon plus the change in value-weighted average price (VWAP) of the bond from the last day on which there are transactions in the previous month to the last day on which there are transactions in the current month, divided by the VWAP on the last day of the previous month. We compute returns only if the VWAP can be calculated in the last 10 days of each month. A total of 1,063,873 bond-month observations have non-missing returns. The average bond return in our sample is about 29 basis points per month. Bond returns vary significantly across bonds and over time, with the 10^{th} and 90^{th} percentiles equal to -2.0% and 2.8% per month, respectively. Bond prices also vary significantly within a month, with the average price range equal to 3.1%.

We define potential flow-induced fire sales (FIFS) similarly to Edmans, Goldstein, and Jiang (2012) with a slight modification on the flow cutoff (more details in the Appendix). Specifically, FIFSs aim to measure the notional selling pressure that a bond would experience if the mutual funds owners liquidated their portfolio pro-rata when they experience large redemptions (flows in the bottom decile). Coherently with our measure of mutual funds' ownership concentration, we weigh the extreme outflows (flows in the bottom decile), by the share of the outstanding bond issue owned by the mutual funds experiencing the outflows.[8]

In the same spirit, following Greenwood and Thesmar (2011), we measure bond price fragility as the expected volatility of trading by the mutual funds based on the past variance and covariance of flows they experienced and under the assumption of pro-rata trading in response to flows. FIFS and bond price fragility have been shown to capture the destabilizing effects of mutual

[8] Since our proxy for FIFSs does not use the fund's TNA and the bond price to value of a position, we do not incur the criticism raised by Wardlaw (2020) that the FIFSs as defined by Edmans, Goldstein, and Jiang (2012) are mechanically related to returns.

fund ownerships and flows, from which we isolate the stabilizing effects of mutual funds' ownership concentration.

Both FIFS and bond price fragility are smaller in magnitude for the corporate bonds in our sample than for the stocks in Edmans et al. (2012) and in Greenwood and Thesmar (2011), respectively, for two reasons. First, aggregate mutual fund ownership is smaller for bonds than for stocks. Second, our observations are monthly and hence we use monthly flows, while both Edmans et al. (2012) and Greenwood and Thesmar (2011) use quarterly flows.

1.4 The COVID-19 Sample

The last three columns of Table 1, Panels A, B, and C report the means of fund-, position-, and bond-level variables for the two sub-periods of our COVID-19 sample –COVID shock (3/2020) and post-Fed intervention (4/2020-9/2020). The sample criteria are the same as those used to create the main sample, except that we do not apply the 50% threshold for the portfolio share of corporate bonds. Instead, to have more statistical power over a short sample period, we keep all bond funds that hold corporate bonds. The significance of the COVID-19 shock is apparent. The average monthly fund flows and returns are -4.6% and -9.2%, respectively; [9] 87% of funds experience outflows and virtually all funds experience negative returns. As a result of the large outflows, funds liquidate a large number of corporate bond positions. Of all the funds' corporate bond positions entering the shock period, 16.4% are reduced or eliminated (compared with 10.9% in the main sample and 10.1% in the post-Fed intervention period). The average change in position is a decrease of 9.1% (compared with a decrease of 4.6% in the main sample and a decrease of 4.9% in the post-Fed intervention period). The post-Fed-intervention period is similar to the main sample along most dimensions, except that the average fund return exhibits a strong rebound.

The COVID-19 shock appears to be associated with extremely negative returns and high volatility for corporate bonds. The average return in March 2020 is -7.4%, over three times lower

[9] Despite the large negative number, the average fund flow still underestimates the full extent of market stress. Large funds experience larger outflows, and so the aggregate net outflow of all funds is about -6.1%, similar in magnitude to the estimate of Falato, Goldstein, and Hortacsu (2021).

than the 10th percentile of the main sample (-2.0%), and the average price range is 18.6%, about three times the 90th percentile of the main sample (6.2%). Following the Fed's intervention, bond prices rebound strongly, resulting in an average monthly return of 1.8%. Volatility subsides, but remains elevated, as indicated by the average price range of 4.8%, over 50% larger than the average in the main sample.

2. Portfolio Liquidation and Position Size

We conjecture that managers that own a large share of an outstanding bond issue take into account that their sales can have a large negative effect on the bond price. By restricting the sales of the bonds in which they hold large shares during periods of market turmoil, fund managers can limit price drops and the negative feedback effects on the unsold part of their position. Thus, we expect that fund managers sell these bonds to a lower extent when they experience redemptions.

Table 2 explores whether the data support our conjecture. To focus on times of redemptions and flow-driven asset sales, we consider periods in which the aggregate outflows from bond mutual funds are in the top decile of our sample. We estimate the following fund (*f*)-bond (*b*)-time (*t*) level equation:

$$\begin{aligned} Position\ change(f,b,t) = \alpha + \beta \times Top\ decile\ of\ fund\ position\ size_{f,b,t} + \\ \boldsymbol{\Delta_{b,t}} + \boldsymbol{\gamma_{f,t}} + \varepsilon_{f,b,t}. \end{aligned} \tag{1}$$

Our variable of interest, $Top\ decile\ of\ fund\ position\ size_{f,b,t}$, takes value one if a position is in the top decile of our fund-bond-time dataset. Since the dependent variable is defined as the percentage change in a fund's holdings, we expect that $\beta = 0$ if mutual funds liquidate their positions pro-rata. If instead mutual funds internalize the negative spillovers of their trades, we expect $\beta > 0$, which would imply that fund managers renounce to some benefits from diversification to limit negative feedback effects.

By including the interactions of fund and time fixed effects, $\gamma_{f,t}$, we absorb any time-varying fund characteristics, including cash-holdings and extent of redemptions, and evaluate which positions a fund chooses to liquidate to a larger extent within its portfolio. Depending on the specification, the matrix, $\Delta_{b,t}$, includes either parametric controls for bond characteristics, such as stable ownership by insurance companies, turnover, age, and bond issue size (columns 1 to 3 and 7), which allow us to capture the liquidity of a bond issue (Edwards, Harris, and Piwowar, 2007; Ellul et al., 2015; Jiang et al., 2021), or interactions of bond issue and time fixed effects (columns 4 to 6).

Table 2 clearly shows that funds that hold a large share of an outstanding issue decrease their position in that issue to a lower extent when they experience turmoil. For example, the estimates in column 1 of Table 2 suggest that when the aggregate outflows are in the top decile of our sample, funds decrease positions in which their share of the outstanding issue is in the top decile of our fund-bond-time sample by about 1.45% less than otherwise similar positions in which they own a smaller share of the outstanding issue (relative to the mean position change of -5.20% in this sample). Results are quantitatively and qualitatively similar in columns 4 to 6, where we absorb bond heterogeneity by including the interactions of bond issues and time fixed effects.

The estimates demonstrate that during the same period of turmoil, mutual funds with a large share of an outstanding bond issue sell that bond issue less than other mutual fund owners, irrespective of its liquidity and other time-varying characteristics. The effect appears to be largely driven by high-yield bonds (columns 3 and 6). This is unsurprising because investment-grade bonds are more liquid and sales have smaller negative effects on their price. Internalizing the negative effects on the unsold parts of their positions, fund managers sell high-yield bonds in which they hold large positions to a lower extent when they experience negative shocks, even though selling small positions may increase trading costs (Edwards, Harris and Piwowar, 2007).[10]

While the coefficient on top decile of fund position size is not statistically significant for investment-grade corporate bonds in columns 2 and 5, further examination shows that funds try to stabilize the prices of these bonds too. The reason for the insignificant results is that funds that hold

[10] Put differently, any differences in execution costs that would be positively related to fund and position size would go against our findings because execution costs tend to be smaller when funds liquidate large positions (Edwards, Harris, and Piwowar, 2007).

mostly investment-grade corporate bonds also hold significant quantities of other investment-grade bonds, such as Treasuries. Since these other investment-grade bonds are more liquid, investment-grade bond funds can liquidate them to meet redemptions without touching most of their corporate bonds. However, recognizing that even these funds need to liquidate their corporate bond holdings if they experience very large redemptions, we repeat the regressions in Table 2 under more extreme scenarios. Table IA.1 shows that if the aggregate outflows are in the top 5% (as opposed to top 10% in columns 1-3) or if the funds allocate at least 60% in corporate bonds (as opposed to 50% in columns 4-6), then the coefficients on top decile of fund position size are generally larger and statistically significant for both investment-grade and high-yield bonds.

Overall, the inclusion of bond-time and fund-time fixed effects (columns 4-6) allows us to dismiss any alternative explanations that are based on bond or fund omitted characteristics. However, one may wonder whether large positions in a bond issue are the least liquid in a given fund portfolio, which could explain why fund managers liquidate these positions to a lower extent independently from their propensity to internalize externalities. To evaluate the merit of this alternative explanation, we control for the decile of turnover of a given bond issue within a fund's portfolio. Consistent with the findings of Ma, Xiao, and Zeng (2022), in column 7, we indeed find that fund managers liquidate their most liquid assets first. However, this leaves the coefficient on our variable of interest unaffected suggesting that such alternative explanation does not explain our findings.

So far, we have focused on periods of large aggregate redemptions, which are those that raise most concerns for financial stability. Our findings suggest that there exist stabilizing forces within the mutual fund industry when bond mutual funds must collectively contract their balance sheets. It is however possible that during periods of extreme outflows, large mutual funds, being more reputable, experience less outflows and hence have to sell to a lower extent. If this were the case, fund size could mechanically drive the findings since large mutual funds mechanically hold a larger share of any bond issue.

To address this concern, in Table 3, we estimate a different specification, similar to the one used by Ma, Xiao, and Zeng (2022), which allows us to evaluate how funds liquidate their bond portfolios for each dollar of redemptions they experience. Specifically, we examine the sensitivity of fund *f*'s change in position in bond b to the outflows it experiences at time *t* and whether the sensitivity is reduced if fund *f* holds a large position in bond *b*, using the following specification:

$$Position\ change(f,b,t) = \alpha + \beta_1 \times Outflow_{f,t} + \beta_2 \times Outflow_{f,t} \times$$
$$Top\ decile\ of\ fund\ position\ size_{f,b,t} + \boldsymbol{\Delta_{b,t}} + \boldsymbol{\gamma_{f,t}} + \boldsymbol{\delta_f} + \boldsymbol{\theta_t} + \varepsilon_{f,b,t}. \qquad (2)$$

Besides bond and fund time-varying characteristics, represented by the matrices, $\Delta_{b,t}$ and $\gamma_{f,t}$, respectively, we include as controls fund and time fixed effects. A positive and significant coefficient on the interaction between *Outflow* and *Top decile of fund position size* would clearly indicate that for a given dollar of redemptions, fund managers sell bond issues in which they hold large positions to a lower extent.

Columns 1 to 3 provide evidence that our hypothesis continues to be supported in the whole sample and for high-yield bonds. Also, in column 4, the result is qualitatively and quantitatively invariant if we control for the liquidity decile rank of the bond within the portfolio of the fund experiencing redemptions by including an interaction between the turnover decile rank of a bond issue in the fund's portfolio and the outflows from the fund. Our results are also robust if we consider only funds that experience large fund-specific redemptions, as captured by funds with flows in the bottom quintile during a month (columns 5 to 8).[11]

Figure 1 provides a different characterization of our finding. It allows us to evaluate another alternative explanation that funds expect better performance from the securities in which they hold larger portfolio shares. In this case, funds would reduce their large positions to a lower extent when they experience financing constraints, regardless of the externalities that their trades can have on the bond prices. To differentiate between this alternative and the internalization of price externalities, we rely on the fact that depending on fund size, positions that are a fund's large portfolio shares may not necessarily represent large shares of outstanding bond issues. Specifically, for funds with small assets under management, large (portfolio share) positions are unlikely to also

[11] Since not all funds report positions monthly, for the funds that report only quarterly holdings, we consider the average monthly flows during the quarter to capture periods of large redemptions.

represent large shares of the outstanding bond issues. We thus distinguish funds depending on their TNA.

Each month, we sort funds into quintiles by TNA, and use funds in the top and bottom quintiles as our representatives of large and small funds, respectively. We then sort the positions into deciles depending on their shares within each fund's portfolio. Under the alternative explanation, both large and small funds should sell the bonds in which they have large portfolio shares to a lower extent when the industry or the individual fund experience redemptions. However, if funds' behavior is driven by their desire to avoid a negative effect on bond prices, we expect that only large funds protect their large positions. Figure 1 shows that the lower propensity to sell bonds in which the fund holds large portfolio shares during periods of turmoil is driven by large funds, that is, by funds whose large portfolio shares tend to be a large share of the outstanding bond issue and whose trades are likely to have larger price externalities.

Our results are robust to different assumptions on the extent of internalization of externalities. It is plausible that managers may internalize externalities on the valuation of the bonds of other funds in the family. These effects may be limited because even the largest families have just a few bond funds. Moreover, these funds are often specialized in different segments of the bond market and do not have much portfolio overlap. Nevertheless, in Panel A of Table 4, we test the robustness of our findings. Consistent with our earlier results, we continue to find that funds whose families hold a large share of a bond issue reduce their position in that issue to a lower extent when they experience large aggregate outflows. For example, the estimates in column (1) suggest that when the aggregate flows are in the bottom decile, funds whose family's position in a bond issue ranks in the top 10% of our sample decrease their holdings in that bond issue by 1.49% (relative to the mean position change of -5.20% in this subsample) less than in otherwise similar bond holdings in which the family has a smaller position size.

We have so far considered only fund trading when redemptions occur. In these situations, trading is unlikely to be information-driven, but rather forced by financial constraints. Externalities may therefore occur. These are precisely the periods in which we expect funds that own a large share of an issue to have particularly strong incentives to internalize the negative spillovers of their trades.

In Panel B of Table 4, we consider periods with non-negative aggregate flows into the bond mutual funds' industry. In addition, we exclude any observations of funds that experience negative flows during these periods. In this subsample, trading is more likely to be information-driven and sales are expected to cause smaller negative spillovers. We thus expect that the share of the bond issue owned by the fund has less explanatory power. This is precisely what we find. The coefficients in column 1 and 3 are smaller in magnitude and have lower statistical significance in comparison to Table 2.

3. Ownership Concentration and Bond Returns

So far, we have shown that mutual funds that own a large share of an outstanding bond issue are less inclined to sell that issue when they experience redemptions, arguably in an attempt to stabilize the bond price. This section explores whether such behavior indeed stabilizes bond prices. Under the hypothesis that bond funds internalize the price externalities of their trades, we expect that bond issues with more concentrated mutual fund ownership experience less pronounced declines in periods of distress. We should also observe that the prices of these bond issues are, ceteris paribus, less volatile.

3.1 Average Returns

Table 5 provides a first evaluation of the empirical evidence on bond returns. Each month, we sort bonds in deciles of top mutual fund ownership. We present average returns for each decile of top mutual fund ownership, distinguishing between periods of financial turmoil and normal times. In Panel A, we define periods of turmoil as months in which the average of the outflows experienced by the mutual funds holding a particular bond issue, weighted using their ownership shares, is in the top decile of the sample. In Panel B, we consider periods of large aggregate outflows, defined as months in which the aggregate flows to bond mutual funds are in the bottom decile; we also restrict the sample to bonds issues with aggregate mutual funds' ownership in the top quintile, as these issues are most likely to be affected.

For both definitions of financial turmoil, the returns of all bond portfolios appear negative and significantly lower than in normal times. Importantly, during these periods, the returns of bonds in the top decile for ownership concentration are significantly higher than the returns of bonds in the bottom decile. These differences are economically and statistically significant only in periods of financial turmoil. On average, in Panel A, where we consider bonds experiencing flow-induced fire sales, the returns of bonds in which the ownership of the top mutual fund is in the top decile outperform those in the bottom decile by an average of 0.61% per month, or 7.36% annualized. Thus, when mutual funds experience large redemptions, bonds in which the top mutual fund owns a larger share of the issue are less negatively affected.

Importantly, regardless of the definition of turmoil we use, it appears that ownership by the top mutual fund has larger impact on the returns of high-yield bonds than on those of investment-grade bonds. In Panel A, high-yield bonds that are in the top decile for the ownership of the top mutual fund outperform those in the bottom decile by 0.96%, or 11.37% per annum during periods of turmoil. This is consistent with our earlier finding that managers' propensity to internalize the externalities of their sales is more accentuated in high-yield bonds, which are relatively more illiquid and would consequently be more likely to experience large drops of prices below their fundamental value.

Notably, in both panels of Table 5, mutual funds' ownership concentration is unrelated to expected bond returns in normal times. This suggests that bond issues with higher mutual funds' ownership concentration are not more illiquid because if this were the case they would have to provide a premium to investors in the form of higher expected returns (Chen, Lesmond, and Wei, 2007).

Table 6 shows that these conclusions are robust when we control for other possible determinants of bond returns in a multivariate setting, including the bond issue liquidity, as captured by the bond issue's turnover. The two panels refer to our two different definitions of market stress. The specifications control for the overall market movements using rating matched index returns and their interaction with (logged) bond maturity, allowing long maturity (or long duration) bonds to move more with the market. In addition, we include time and issuer fixed effects, and control for other bond characteristics that may affect returns, including (logged) bond maturity, (logged) bond issue size, (logged) bond age, a dummy variable for investment-grade bonds, bond turnover, insurance ownership, and dummy variables for bonds that are upgraded or downgraded in an interval of two months from the current month. In particular, the upgrade and downgrade dummies capture that information leading to a future rating change may already be available to market participants and affect their trading. The insurance ownership variable controls for the fact that insurance companies having stable liabilities tend to create less fire sales at least in investment-grade bonds (Barbosa and Ozdagli, 2020; Coppola, 2022).

Finally, we control for bond mutual fund ownership (as a proportion of the bond's issue size), which according to Massa, Schumacher, and Wang (2021), may be lower in securities where mutual fund ownership concentration is higher. In our sample, however, higher mutual fund ownership is positively related to the proportion of the bond issue held by the top mutual fund.

We test whether in periods with more intense flow-induced fire sales (Panel A) or more intense outflows from the mutual fund industry (Panel B), which –as we would expect– depress bond returns, a larger ownership share by the top mutual fund is associated with higher bond abnormal returns. It is apparent that this is the case. The effect is again both statistically and economically significant. Based on the estimates in column 2 of Panel A, when a bond issue experiences a potential flow-induced fire sale equal to the average of the largest 10% of our sample, increasing the top owner stake from 0.004 to 0.080 (that is, from the 10^{th} to the 90^{th} percentiles) increases the bond return by about 0.23% per month (4.993 x 0.006 x (0.080 – 0.004)), or 2.73% annualized.[12]

[12] As discussed, given the small number of fund owners and the highly positive skewness of fund TNA, ownership by the top N ($N > 1$) fund owners is highly correlated with total mutual fund ownership. For example, the correlation between top 3 fund ownership and total mutual fund ownership is over 90%. To ensure the robustness of our results while avoiding the collinearlity issue, we repeat the analyses in Tables 6, Panels A and B, using ownership by top 2 funds as our measure of concentration. Table IA.2 reports the results, which are qualitatively similar to those in Table 6.

In both Panels A and B, the price effects of fund outflows are driven by the less liquid high-yield bonds (column 4), which is consistent with our earlier findings that funds internalize the negative spillovers of their trades especially for less liquid high-yield bonds. Importantly, in column 5, our findings for high-yield bonds are robust when we include the interactions of issuer and time fixed effects, which not only absorb any shocks to the issuer's fundamentals, but also control for the fact that an issuer may experience lower volatility because of its close relationships with intermediaries. Finally, we revisit the possibility that some bonds may be more fragile than others because they are owned by intermediaries with illiquid portfolios using the proxy for fragility of Jiang, Li, Sun and Wang (2022). Not only do we include this proxy for latent fragility across specifications, but we also interact it with our proxies for turmoil in columns 6 of both panels. Our results are again invariant confirming that ownership concentration limits a bond's exposure to fire sales.

3.2 Return Volatility

Our hypothesis also implies that the trading behavior of mutual funds with large stakes should reduce the flow-induced price volatility of bond issues with concentrated ownership. Figure 2 considers the volatility of bond prices. Measuring (realized) bond price volatility is challenging because the majority of bonds does not trade daily. Even when bonds are traded frequently, their transaction prices can be highly dispersed during the same trading day (O'Hara, Wang, and Zhou, 2018) and transaction costs are high (Edwards et al., 2007; Dick-Nielsen, Feldhutter, and Lando, 2012; and Bessembinder et al., 2018). For these reasons, following Alizadeh, Brandt, and Diebold (2002), among others, we use a price range measure of volatility, which is statistically efficient and robust to microstructure noise.

Specifically, we calculate the price range for each bond from the last trading day of the previous month to the last trading day of the current month and normalize the range by the price on the last trading day of the previous month. We distinguish between investment-grade bonds (Panel A) and high-yield bonds (Panel B) and present the average and median price range for different bond portfolios, sorted by deciles of the proportion of the issue held by the top mutual fund owner.

We observe that a larger stake of the top owner is associated with a monotonically decreasing pattern for our measure of bond price volatility. This supports our conjecture that a higher ownership stake gives investors incentives to internalize externalities and reduces nonfundamental volatility. Focusing on investment-grade bonds in Panel A, for example, as we move from the bottom to top deciles of top mutual fund ownership, the average (median) monthly price range decreases from 2.82% to 2.10% (2.22% to 1.42%), a twenty-five (thirty-five) percent decrease.

Table 7 reproduces this result in a multivariate setting in which we again control for the overall market movements as well as bond characteristics, including bond turnover and the proxy for fragility of Jiang et al. (2022) capturing the relative liquidity of other bonds in the portfolio of the bond's mutual fund owners. Columns 1 to 3 confirm the univariate evidence. It is evident that ownership concentration reduces bond price volatility and that the reduction is particularly pronounced for the less liquid high-yield bonds. As we increase the top owner stake from 0.004 to 0.080 (that is, from the 10^{th} to the 90^{th} percentiles), the monthly price range decreases by 0.34% (-0.045 x (0.080 – 0.004)), on average, for all bonds, and by 0.40% (-0.052 x (0.080 – 0.004)) for high-yield bonds.

We perform two additional robustness checks concentrating on the sample of high-yield bonds, in which the mechanisms we highlight are stronger. First, in column 4, we include the interactions of issuer and time fixed effects, thus absorbing fundamental volatility. The negative and significant parameter estimate on *Top fund ownership* confirms that ownership concentration reduces non-fundamental volatility.

Second, in column 5, we control for the measure of price fragility introduced by Greenwood and Thesmar (2011), who show that stocks are exposed to non-fundamental shifts in demand if their owners face correlated shocks. The effect of this proxy on bond volatility is positive and significant as Greenwood and Thesmar (2011) find to be the case for equities. In this specification, we also control for the ownership by the largest ten families based on the total net asset under management and find that consistent with the findings of Ben David et al. (2021) for equity mutual funds, a higher ownership share by the largest ten families tends to increase price volatility. Most importantly, both controls leave unaffected the coefficients on top fund ownership, indicating that our results are robust. Our findings thus indicate that at least for corporate bonds, the positive effects of flow-induced trading on asset price volatility, which are often attributed to ownership concentration, are instead more likely to be driven by a high proportion of the security being owned by many mutual funds with correlated flows. Mutual funds that own a large proportion of an outstanding bond issue appear to internalize the externalities of their trades in corporate bonds.

4. Internalization of Externalities and the Effects of the Fed's Corporate Credit Facilities

Between the months of February and March 2020, the average bond mutual fund experienced cumulative outflows of about 10% of net asset value (Falato, Goldstein, and Hortaçsu, 2021). As mutual funds rushed to sell their more liquid positions, all bonds, including investment-grade bonds, experienced pronounced price drops (Chaderina, Muermann, and Scheuch, 2018; Ma, Xiao, and Zeng, 2022; Haddad, Moreira and Muir, 2021). On March 23, 2020, to avert a crisis in the bond market, the Fed, together with other policy interventions, announced an intent to purchase investment-grade corporate bonds with less than five-year remaining maturity, as well as U.S.-listed exchange-traded funds with focus on U.S. corporate bonds.

We exploit the announcement of the Fed's intervention in the corporate bond market through the SMCCF on March 23, 2020 to sharpen our identification. By announcing the SMCCF and the list of eligible bonds, the Fed implicitly provided a price backstop and limited the expected price externalities of distressed sales for some bonds more than for others (Haddad, Moreira, and Muir, 2021). We can thus use the exogenous variation in expected price externalities to identify how the internalization of such externalities affects bond trading.

During March 2020, we expect bond mutual funds to sell to a lower extent any bonds in which they had a large stake because due to the large outflows, all bonds were experiencing fire sales and the expected price externalities of sales were high also for investment-grade bonds. Starting from April 2020, after the Fed provided a price backstop for eligible investment-grade bonds, effectively mitigating any negative externalities of distressed sales on their price, we expect that fund managers could sell eligible investment-grade bonds without worrying much about the price impact and externalities. They could thus focus their stabilization efforts just on ineligible bonds.

To test these hypotheses, we estimate model (1) before and after the Fed's announcement over different sets of securities. Panel A of Table 8 shows that funds with large shares of a particular bond issue tend to sell that issue to a lower extent in March 2020, regardless of the issue's rating.[13] The estimates in columns 2-4 indicate that mutual funds decrease positions that are in the top decile of position size by 1.13-2.67% less than other positions in their portfolios. This effect is economically significant given the average position change of about -11.52% in this period.

Consistent with our conjecture, the funds' trading behavior changes in the six months starting after March 2020. Bond mutual funds with large shares of outstanding bond issues sell those issues that are eligible for the SMCCF to a larger extent, suggesting that they aim for a more diversified portfolio. In contrast, not only do funds continue to sell more cautiously both ineligible investment-grade and high-yield bonds in which they have large ownership shares, but the economic magnitude of the effect of having a large share on the change in a fund's position becomes noticeably larger. The estimate in column 7 is not only statistically but also economically significant: mutual funds, facing large outflows, decrease positions in SMCCF ineligible investment grade-bonds in which their ownership shares rank in the top 10% by 3.03% less than otherwise similar but smaller positions. As a benchmark for comparison, the mean position change is -6.11 percentage points in this sample. The economic effect is similar in magnitude for SMCCF ineligible high-yield bonds in column 8.

These findings fully support our interpretation of the empirical evidence. The Fed's intervention effectively eliminated the negative price spillovers of distressed sales. Consequently, bond mutual funds had no externalities to internalize in eligible bonds, and when faced with

[13] Our sample excludes fallen angels that became eligible for purchase in April 2020 to make sure that the price rebounds of high-yield bonds are not driven by the Fed's policy.

redemptions, started to sell their large positions plausibly to improve the diversifications of their portfolios.

In Panel B of Table 8, we use a difference-in-difference methodology to further examine funds' trading after the Fed's intervention and test whether the effect of a fund's large position differs in eligible and ineligible investment-grade bonds. Investment-grade bond eligibility for SMCCF depended on bond maturity. We deem unlikely that a large position should have different effects on trading for eligible and ineligible investment-grade bonds just after the Fed's intervention. Nevertheless, it would be comforting if the effect of a fund's large position became stronger as we restrict bond maturities around the eligibility cutoff, thus limiting any unobserved heterogeneity associated with maturity, which may also be correlated with a fund's position size. If our results were driven by the extent of price spillovers that was mitigated by the Fed's intervention in eligible bonds, and not by other characteristics of the bond a fund manager may care about (i.e., her beliefs on the security's future performance), we should observe that differences in trading behavior become more pronounced as we restrict the sample to bonds with more similar maturity.[14]

The coefficients on the interaction between *Top decile of fund position size x Fed eligible* are negative and significant in all subsamples, and the magnitudes largely negate the main effects of fund position size being in the top decile. Importantly, the coefficient on *Top decile of fund position size* becomes larger as we restrict the sample to bonds with maturity that is closer to the five-year eligibility cutoff, thus limiting heterogeneity in bond issues. These results support our earlier conclusions that the stabilizing trading behavior in Table 2 is driven by funds' concerns about the negative spillovers of their sales.

Table 9 provides evidence that the changes in trading patterns can help explain bond returns. In particular, we investigate how an issue's ownership structure is related the issue's return before and after the Fed's announcement, distinguishing between eligible and ineligible bonds. During March 2020, on average, bond issues experiencing flow-induced fire sales have higher returns if

[14] The interactions of bond issue and time fixed effects absorb any security level unobserved heterogeneity. Omitted factors can only pertain to characteristics of a security relative to other securities in a fund's portfolio.

their ownership is more concentrated, as captured by the share owned by the top mutual fund (column 1). The effect is statistically significant only in the subsample of investment-grade bonds with shorter maturity that will eventually become eligible for the SMCCF (column 2). The positive but statistically insignificant coefficients in columns 3 and 4 suggest that funds' stabilizing behavior becomes ineffective when redemptions are very large as during March 2020. Even then, however, funds with large positions do not appear to amplify the negative spillovers of redemptions and forced sales.

Following the announcement of the Fed, ownership structure does not appear to explain bond returns any longer for eligible bonds, that is, the bonds in which we no longer observe the stabilizing trading behavior of fund managers with a large share of the outstanding issue. On the contrary, the effect of the share owned by the top mutual fund on bond returns is larger than in the previous period for ineligible bond issues.

The estimates in column 7 indicate that when a bond issue experiences extreme flow-induced fire sales equal to the average of the largest 10% of the ineligible investment-grade bond sample, the bond's price drops by 2.43% (-4.050 x 0.006) in that particular month. However, increasing the top ownership stake from 0.004 to 0.080 (that is, the 10^{th} to the 90^{th} percentiles) almost completely eliminates the negative effect of the flow-induced fire sale, reducing the magnitude of the price drop by as much as 2.09% (45.774 x 0.006 x (0.080 – 0.004)).

Similarly in the high-yield bonds subsample in column 8, following an extreme flow-induced fire sale equal to the average of the largest 10% of the high-yield bond sample, the bond's price drops by 2.18% (-3.121 x 0.007) in that particular month; increasing the top ownership stake from 0.004 to 0.080 (that is, from the 10^{th} to the 90^{th} percentiles) reduces the magnitude of the price drop by 1.77% (38.797 x 0.007 x (0.080 – 0.004)), again almost completely offsetting the flow-induced fire sale effect.

Panel B focuses on the post-Fed-intervention sample and tests for differences in the effects of ownership concentration on the returns of eligible and ineligible investment-grade bonds subject to negative shocks, considering progressively narrower intervals around the five-year maturity cutoff. We continue to find that FIFSs result in price drops, which are mitigated by ownership concentration. However, for eligible bonds, ownership concentration does not alleviate the effect of FIFS, as the coefficients on *FIFS x Top fund ownership x Fed eligibility* is negative and negates the effect of *FIFS x Top fund ownership*.

As we move to narrower samples around the maturity eligibility cutoff and restrict the sample to bonds with similar maturity thus limiting unobserved heterogeneity, ownership concentration appears to mitigate the effects of FIFS for ineligible bonds, which could potentially drive the large parameter estimate on *FIFS x Top fund ownership* in column 1. It is thus comforting that the parameter estimate on *FIFS x Top fund ownership* increases going from columns 2 to column 3, as we narrow the maturity interval, even if it is not statistically significant in column 3 due to the smaller sample size.

Overall, not only do these findings support our conjecture that funds with large positions trade in a way that limits the negative effect of redemptions on bond returns, but they also help us to shed light on how bond funds' incentives to limit the impact of their trades helped to transmit the effects of the Fed's intervention to ineligible investment-grade and high-yield bonds. Notwithstanding its relatively small purchases of a subset of investment-grade bonds, the Fed's announcement may have succeeded in stabilizing the entire market not only thanks to the stop in redemptions and the consequent positive wealth effects, but also by increasing the efficacy of bond mutual funds' incentives to stabilize prices.

5. The Effects of Stabilizing Trading on Funds' Flows and Performance

5.1 Flows and Performance of Funds with Large Positions

This section explores whether mutual funds' internalization of negative price spillovers benefits their performance. We view negative externalities arising from distressed sales as a cost for the fund manager. Funds whose portfolios are less exposed to the negative spillovers of fire sales should have better performance, especially in periods of financial turmoil.

To evaluate whether the stabilizing trading indeed benefits mutual funds' performance, we test whether funds whose portfolio comprises a larger share of large positions perform better by estimating the following regression:

$$Alpha(f,t) = \alpha + \beta \times LARGEFRAC_{f,t} + \boldsymbol{\gamma}_{\boldsymbol{f},\boldsymbol{t}} + \varepsilon_{f,t}, \tag{3}$$

where LARGEFRAC denotes the fraction of fund *f*'s portfolio at the beginning of month *t* that consists of large positions, defined as positions that are in the top decile of the fund-bond-time sample. The vector $\gamma_{\boldsymbol{f},\boldsymbol{t}}$ includes various time-varying fund controls, such as percentage cash holding, fund TNA, fund category x month fixed effects, etc. We also include lagged flows and performance, given the well documented flow-performance relationships. Following Anand et al. (2021), we estimate $Alpha$ from the four-factor model of Chen and Qin (2017), using monthly observations over a rolling 18-month period.

Table 10 shows the results. We find that funds that have an incentive to avoid the negative price spillovers of fire sales in a larger fraction of their portfolio have better performance, especially during periods of large aggregate outflows. As in our earlier results, the effect is largely driven by high-yield bond funds, that is, by funds in which the negative price spillovers would be larger. The effects are not only statistically, but also economically significant. The estimate of β in column 4, for example, shows that increasing the fraction of large positions from 0 to 0.665 (that is, from the 10^{th} to the 90^{th} percentiles) raises the fund's alpha during periods of large aggregate outflows by 16.13 basis points (0.243 x 0.665). For funds focusing on high-yield bonds (column 6), the interdecile effects are 23.74 basis points (0.323 x 0.735). The mean alpha in our sample is just -5.28 basis points.

The conditional differences in alpha during periods of aggregate outflows translate into (smaller) differences in unconditional alpha between funds that hold relatively more large positions and other funds (columns 1-3). This is expected because the benefits of price externalities internalization are largest during periods of turmoil and may lead to costs in terms of reduced diversification when markets return to normal and funds' attempts to achieve a more diversified portfolio.

The better performance of bond funds whose portfolios comprise a larger proportion of large positions appears to stabilize the fund's assets during periods of aggregate outflows. Table 11 shows that compared to funds with a fraction of large positions in the 10^{th} percentile, those with a fraction of large positions in the 90th percentile experience flows that are 1.06 percentage points larger in the month immediately following market turmoil. Note that the average monthly flow is 0.60% in the full sample, and -0.50% in periods of large aggregate outflows. Thus, large mutual funds, being more likely to have large shares of outstanding issues, have more stable funding.

5.2 Spillovers Effects of Funds with Large Positions

It is an empirical question whether the more stable funding of funds whose portfolios comprise a large share of large positions also helps stabilize the funding of the bond mutual fund industry and therefore contribute to financial stability. To answer this question, we adapt the methodology used by Falato, Hortaçsu, Li, and Shin (2021) to demonstrate that redemptions have negative spillovers on funds that hold the same assets. Specifically, Falato et al. (2021) show that redemptions from a fund negatively affect the performance and flows of other funds that hold similar assets.

We want to test whether redemptions from funds whose portfolios comprise a larger share of large positions have smaller negative effects than redemptions from other funds on the performance and flows of funds with overlapping portfolios. For each fund *f* in month *t*, we define two variables capturing the spillover due to redemptions experienced by the two types of peers: those with a larger portfolio share of large positions and the others. Specifically, we define:

$$Peer\ selling\ pressure\ _{f,t}^{type} = \sum_b FIFS_{b,t}^{type,-f} \times w_{f,b,t-1},$$

where *type* refers to funds with a proportion of large positions, LARGEFRAC, in the top decile of our fund-month sample (*type=HIGHLARGEFRAC*) and other funds (*type=LOWLARGEFRAC)*, respectively; $w_{f,b,t-1}$ is the portfolio weight of bond *b* in the portfolio of fund *f* in month *t*-1, and $FIFS_{b,t}^{type,-f}$ is the notional sales driven by redemptions from a given fund *type*, excluding fund *f*, in bond *b* in month *t*.[15]

[15] Put differently, we redefine $FIFS_{b,t}$ distinguishing the percentage flows in the bottom decile from peer funds that have a proportion of large positions in their portfolios in the top decile (HIGHLARGEFRAC) and other funds

We estimate the following regression:

$$Alpha(f,t) \ or \ Flow(f,t) = \alpha + \beta_1 \times Peer\ selling\ pressure\ _{f,t}^{HIGHLARGEFRAC} + \beta_2 \times Peer\ selling\ pressure\ _{f,t}^{LOWLARGEFRAC} + \boldsymbol{\gamma_{f,t}} + \boldsymbol{\delta_f} + \boldsymbol{\theta_t} + \varepsilon_{f,t}, \quad (4)$$

where $\boldsymbol{\gamma_{f,t}}$ is a vector of time-varying fund controls, including lagged flows, lagged alpha, percentage cash holding, etc., δ_f denotes fund fixed effects, and θ_t denotes month fixed effects. The existence of negative spillovers implies that β_1 and β_2 should be negative, but if funds with a larger fraction of large positions contribute to financial stability, we expect the absolute value of β_1 to be smaller than that of β_2.

Table 12 presents the results. Panel A considers a fund's alpha. Column 1 considers the spillovers created by redemptions from all peer funds and reproduces the finding of Falato et al. (2021) in our context. Redemptions from peer funds negatively affect the performance of funds with overlapping portfolios. In the rest of Table 12, we distinguish between flows from peer funds with a large proportion of the portfolio consisting of large positions and other peer funds. Redemptions from peer funds with large positions do not appear to have a significant negative effect on the focal fund's performance. Negative spillovers arise only because of redemptions from funds with a small portfolio share of large positions and are mostly concentrated in high-yield bond funds, that is, in the funds in which the negative price spillovers of sales are expected to be larger in the absence of any stabilizing behavior.

Panel B shows that similar considerations extend to fund flows. While redemptions from funds that have a large fraction of their portfolio consisting of large positions negatively affect the flows of peer funds, the estimated coefficients are about a quarter to a third of those estimated for funds with a small fraction of large positions in their portfolios (columns 2-5). This implies that redemptions from funds that are more likely to internalize the negative spillovers from their sales

(LOWLARGEFRAC). Differently from Falato et al (2021), we do not consider actual flow-induced sales, but notional sales, which would occur if a fund liquidated assets pro-rata. Only in this way, we can capture that some funds, by liquidating strategically to limit negative price spillovers, have a stabilizing effect on the market.

have less negative spillovers on other funds' flows. Also in this case, the effects are more pronounced for high-yield bond funds (column 5).

Overall, these results imply that funds with large positions in a bond issue, by trading strategically, create fewer fire sales. In doing so, not only do they experience better performance and stabilize their own assets under management, but they also limit the negative spillovers on the flows and performance of their peer funds.

6. Conclusion

The way in which fund managers liquidate their portfolios when facing redemptions is important for financial stability. Policymakers have focused on whether funds react to redemptions by first selling liquid assets, or if instead they sell their positions pro-rata, potentially leading to fire sales if many funds face redemptions at the same time. We show that mutual funds with large shares of outstanding bond issues trade strategically to minimize the negative price effects of flow-induced fire sales. In particular, these funds appear to sell their holdings of the bond issue in which they hold a large share to a lower extent when they experience redemptions, arguably because they attempt to avoid negative feedback effects on the valuation of their remaining holdings of that issue.

As a consequence of the stabilizing trading behavior of bond funds with large ownership shares, bond issues with more concentrated ownership experience higher returns during periods of market turmoil and have lower price volatility. By trading strategically, funds with large positions in a bond issue create fewer fire sales and in doing so not only do they experience better performance and stabilize their own assets under management, but they also limit the negative spillovers that redemptions from a fund have on the flows and performance of other funds with overlapping portfolios.

Our results have implications for the structure of the bond mutual fund industry. To the extent that large funds are more likely to hold large positions in outstanding bond issues, they can contribute to stabilizing the mutual fund industry. While large redemptions from a large bond fund due to an idiosyncratic shock, as in the case of PIMCO explored by Chen, Du and Sun (2022), can indeed increase volatility, we show that for a given amount of redemptions, large mutual funds that own large shares of outstanding issues may have a stabilizing effect on the asset under management of the bond mutual fund industry. Regulators should thus not merely focus on regulating large funds to improve financial stability, but also be concerned about the systemic implications of small bond funds with correlated flows.

Finally, the mechanism we document can help explain how policy interventions in a corner of the market, such as the Fed's SMCCF, can also stabilize the prices of other securities. By providing a backstop for investment-grade bonds with less than five-year maturity, the Fed enabled bond funds with large shares of outstanding bond issues to concentrate their stabilizing trading behavior on ineligible issues, helping to explain the quick price rebounds of ineligible securities.

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Appendix: Variable Definitions

Fund-level variables
Frequency: fund-month or coarser, depending on each fund's reporting frequency.
Source: Morningstar, Morningstar Direct, and CRSP, unless specified.

Variable	Definition
Alpha	The fund's monthly return minus the benchmark return. The benchmark return is calculated using the factor model of Chen and Qin (2017). The factor loadings are estimated on a rolling basis, using the most recent 18 months. 1 means 1%.
Avg. maximum rear load	Value weighted average across all share classes of the maximum charge for redeeming the mutual fund shares, as of the previous report date. 0.01 means 1%.
Broker affiliation	Dummy variable that equals one if the fund's family is affiliated with a (SEC-registered) broker-dealer bank, and zero otherwise.
Cash as % of portfolio	Holdings of cash and cash equivalents, as a percentage of TNA, as of the previous report date. 1 means 1%.
Corporate bonds as % of portfolio	Holdings of corporate bonds, as a percentage of TNA, as of the previous report date. 1 means 1%.
Flow	Sum of dollar flows across all share classes in the current reporting period, divided by the number of months in the period and presented as a fraction of TNA at the beginning of the period (i.e., on the previous report date). 0.01 means 1%.
Government bonds as % of portfolio	Holdings of (U.S. and foreign) government bonds, as a percentage of TNA, as of the previous report date. 1 means 1%.
Institutional share class fraction	Fraction of institutional share classes in the fund's TNA, as of the previous report date. 0.01 means 1%.
ln(1 + Fund age)	Natural log of 1 plus the fund's age in years, as of the previous report date.
ln(1 + Fund TNA)	Natural log of 1 plus the fund's total net assets (TNA) in dollars, as of the previous report date.
ln(1 + Family TNA)	Natural log of 1 plus the TNA in dollars of all taxable bond funds in the fund's family, as of the previous report date.
ln(1 + Portfolio avg. bond age)	Natural log of 1 plus the value weighted average bond age in years, based on the offering date of each bond from Mergent FISD and market value as of the previous report date from Morningstar. The offering dates from Mergent FISD are only available for corporate bonds.
ln(1 + Portfolio avg. bond issue size)	Natural log of 1 plus the value weighted average bond issue size in $1,000, based on the offering amount of each bond from Mergent FISD and the fund's market value as of the previous report date from Morningstar. The offering amounts from Mergent FISD are only available for corporate bonds.
Portfolio avg. coupon rate	Value weighted average coupon rate, based on the coupon rate and the market value of each bond position as of the previous report date from Morningstar. 1 means 1%.
Portfolio avg. credit rating	Value weighted average credit rating, based on the credit ratings from Moody's, S&P, and Fitch and the market value as of the previous report date from

Variable	Definition
	Morningstar. The ratings are only available for corporate bonds. If the ratings are available from all three agencies, the middle rating is used. If the ratings are available from two agencies, the worse rating is used. Rating scales are 1 for AAA (and equivalent), 2 for AA+, 3 for AA, and so on.
Portfolio effective duration	Value weighted average effective duration in years, based on the authors' calculation given bond characteristics from Morningstar and Mergent FISD and the market value as of the previous report date from Morningstar. Equity duration is assumed to be zero.
Return	Average monthly return in the current reporting period. 0.01 means 1%.
Top decile positions/ TNA (LARGEFRAC)	Value of the fund's positions that are in the top decile of position size in the sample, divided by the fund's TNA, as of the previous report date.

Position-level variables
Frequency: fund-bond-month or coarser, depending on each fund's reporting frequency.
Source: Morningstar, unless specified.

Variable	Definition
Decile of fund (family) position size, Top decile of fund (family) position size	Decile of fund (or family) position size based on the "pooled" sorting of all fund-bond-period observations. Fund position size is the fund's position in a bond divided by the bond's issue size. Family position size is the sum of positions in a bond across all taxable bond funds in the family, divided by the bond's issue size. Only corporate bonds that Mergent FISD classifies as non-puttable U.S. Corporate Debentures and U.S. Corporate Bank Notes (bond type-CDEB or USBN) are included. Decile 1 is the smallest and decile 10 is the largest. Top decile of fund (or family) position size is a dummy variable that equals one if the decile of fund (or family) position size is 10, and zero otherwise.
Position change	Change in fund position in a particular bond over the current reporting period as a fraction of beginning-of-period position (i.e., position on the previous report date). 0.01 means 1%.

Bond-level variables
Frequency: bond-month.
Source: Mergent FISD, Morningstar, and (academic) TRACE.

Variable	Definition
Bond maturity, ln(1 + Bond maturity)	Maturity in years (natural log of 1 plus maturity). For each bond, maturity is the time between a particular date and the bond's maturity date. For the position level tests, the bond maturity is as of the previous report date. For bond level tests, the bond maturity is as of the end of the previous month.
Downgrade	Dummy variable that equals one if the bond is downgraded from investment to non-investment grades within plus and minus two months from the current month, and zero otherwise.
Flow-induced fire sales (FIFS)	$FIFS(b,t)$ is the sum of notional sales driven by redemptions in bond b in month t across all funds, normalized by the bond's issue size. Only redemptions from funds experiencing flows in the bottom decile (largest outflows, pooled sort) of the sample are considered to trigger fire sales.

Variable	Definition
	$$FIFS(b,t) = \frac{\sum_f Flow(f,t) \times \mathbb{1}_{(Flow(f,t)\ in\ bottom\ decile)} \times H(f,b,t\text{-}1)}{IssueSize(b)}$$ where $Flow(f,t)$ is the percentage flows of fund f in month t, $\mathbb{1}_{(Flow(f,t)\ in\ bottom\ decile)}$ is a dummy variable that equals 1 if $Flow(f,t)$ is in the bottom decile of the sample, and zero otherwise, $H(f,b,t\text{-}1)$ is the par amount (in dollars) of bond b held by fund f at the end of month $t\text{-}1$, and $IssueSize(b)$ is the issue size (in dollars) of bond b. 0.01 means 1%. We also define $FIFS_{b,t}^{type,\,-i}$ by excluding fund i, and distinguishing the percentage flows in the bottom decile from funds that have a proportion of large positions in their portfolios, or LARGEFRAC, in the top decile (HIGHLARGEFRAC) and other funds (LOWLARGEFRAC).
Fragility, SQRT(Fragility)	Expected variance of flow-induced fund trading, calculated as in equation (8) of Greenwood and Thesmar (2011). The covariance matrix of dollar flows is calculated using percentage flows in the last 24 months, exclusive of the current month, and fund TNA at the end of the previous month. Only mutual funds with at least 6 months of past flows are included. Weights of funds' portfolios in the bond are as of the end of the previous month. Issue size is used as the scaling factor. SQRT(Fragility) is the square root of fragility. 0.01 means 1%.
Insurance ownership	Ownership in a particular bond of all life and property and casualty insurers in the NAIC Schedule database, as of the end of the previous year, computed as a fraction of the bond issue size. 0.01 means 1%.
Investment grade	Dummy variable that equals one if the bond is an investment-grade bond, and zero otherwise. An investment-grade bond is a bond whose credit rating is equivalent to BBB- or better. The credit ratings are from Moody's, S&P, and Fitch. If the ratings are available from all three agencies, the middle rating is used. If the ratings are available from two agencies, the worse rating is used.
JLSW fragility	Latent fragility measure for a particular bond, based on the Amihud ratio of all assets held by mutual funds holding the bond. JLSW fragility is available at the quarterly frequency from 2006 to 2019, and can be obtained from Yi Li's website. See Jiang, Li, Sun, and Wang (2022) for details.
Largest 10 families' ownership	Ownership in a particular bond of the largest 10 mutual fund families by TNA (sum of TNA of all taxable bond mutual funds in the family), computed as of the previous report date, as a fraction of the bond issue size. 0.01 means 1%.
ln(1 + Bond age)	Natural log of 1 plus the bond age in years. For each bond, age is the time between the offering date and a particular date. For the position level tests, the bond age is as of the previous report date. For the bond level tests, the bond age is as of the end of the previous month.
ln(1 + Bond issue size)	Natural log of 1 plus bond issue size in $1,000. For each bond, issue size is the offering amount as reported by Mergent FISD.

Variable	Definition
Matched index level range	Maximum minus minimum levels in the current month of Bank of America Merrill Lynch's Investment Grade Corporate Bond Index or Bank of America Merrill Lynch's High Yield Corporate Bond Index, depending on the credit rating of the matched bond, as a fraction of the index level at the end of the previous month. The matched index level range is measured over the exact same trading days used to measure the bond price range. 0.01 means 1%.
Matched index return	Current month return, calculated as the percentage change in Bank of America Merrill Lynch's Investment Grade Corporate Bond Index or Bank of America Merrill Lynch's High Yield Corporate Bond Index, depending on the credit rating of the matched bond. The matched index return is measured over the exact same trading days used to measure the bond return. 0.01 means 1%.
Mutual fund ownership	Ownership in a particular bond of all taxable bond mutual funds in the Morningstar database, as of the previous report date, computed as a fraction of the bond issue size. 0.01 means 1%.
Price range	Maximum minus minimum daily volume weighted average price (VWAP) of the bond in the current month, as a fraction of VWAP on the last day on which there were transactions in the previous month. For the price range to be measurable, the bond must trade at least once in the current month and within the last 10 days of the previous month. 0.01 means 1%.
Return	Current month return, calculated as the percentage change in VWAP of the bond from the last day on which there are transactions in the previous month to the last day on which there are transactions in the current month. Only returns calculated from VWAP that lie in the last 10 days of each month are used. 0.01 means 1%.
Top fund ownership, Top family ownership	Ownership in a particular bond of the mutual fund, or of the mutual fund family, that owns the largest amount of the bond, as of the previous report date, computed as a fraction of the bond issue size. 0.01 means 1%.
Turnover, Within-fund-period turnover decile	Monthly trading volume of all transactions reported to TRACE, averaged over the previous six months or as long as the data permit, computed as a fraction of the bond issue size. 0.01 means 1%. Within-fund-period turnover decile is the decile rank, taking on an integer value from 1 to 10 with 10 being the highest, of turnover across all corporate bond positions of a particular fund at the end of the previous report date.
Upgrade	Dummy variable that equals one if the bond is upgraded from non-investment to investment grade within plus and minus two months from the current month, and zero otherwise.

Table 1

Summary Statistics

This table presents summary statistics for fund-level (Panel A), position-level (Panel B), and bond-level (Panel C) variables. The data on fund holdings and characteristics are from Morningstar, Morningstar Direct, and CRSP. The data on bond characteristics are from Mergent FISD. The data on corporate bond transactions, which we use to calculate bond prices and returns, are from FINRA's Enhanced TRACE. The main sample covers the period from 1/2003 to 12/2019. The fund sample includes only open-ended taxable bond mutual funds that hold at least 50% of the total net assets under management (TNA) in corporate bonds. All share classes that share the same master portfolio count as one fund, and the number of unique funds is 1,016. The bond sample includes only non-puttable U.S. Corporate Debentures and U.S. Corporate Bank Notes (bond type CDEB or USBN) that are held by at least one fund on the latest report date, and the number of unique bond CUSIPs is 32,006. The position sample includes only the positions of sample funds in sample bonds. The COVID-19 sample covers the period from 3/2020 to 9/2020, with 1,159 unique funds and 10,581 unique bond CUSIPs. The sample criteria are the same as for the main sample, except without the requirement that funds must hold at least 50% of TNA in corporate bonds. In Panel A (B), the observation frequency is fund-month (fund-bond-month) or coarser in the time dimension depending on each fund's reporting frequency. In Panel C, the observation frequency is bond-month. All variables are defined in the Appendix.

Panel A: Fund-Level Variables

	Main Sample (42,251 Fund-Periods)					COVID Sample (5,711 Fund-Periods)	
Variable	Mean	Standard Deviation	PCT 10	PCT 50	PCT 90	Mean 3/20	Mean 4/20-9/20
Total net assets (TNA) ($ Mil.)	1,246	2,681	26	334	3,103	2,814	2,709
Family TNA ($ Mil.)	26,150	61,522	176	8,400	57,801	59,927	62,016
Fund age (year)	12.330	9.992	1.837	9.706	27.088	16.296	16.386
Institutional share class fraction	0.506	0.394	0.000	0.508	1.000	0.649	0.674
Avg. maximum rear load (x100)	0.375	0.638	0.000	0.013	1.747	0.145	0.071
Flow (x100)	0.603	3.362	-3.017	0.071	5.207	-4.550	0.663
Return (x100)	0.476	1.268	-1.034	0.473	1.979	-9.205	1.359
Alpha (%)	-0.053	0.807	-0.599	-0.019	0.529	-0.642	0.065
Broker affiliation	0.074	0.262	0.000	0.000	0.000	0.048	0.044
Cash as % of portfolio	6.640	9.641	0.629	4.996	15.369	8.452	9.212
Government bonds as % of portfolio	5.601	11.298	0.000	0.000	19.347	20.593	18.816
Corporate bonds as % of portfolio	77.485	18.465	50.978	84.255	95.370	43.919	45.642
Portfolio avg. bond issue size ($ Mil.)	872	307	484	855	1,265	1,166	1,184

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Table 1 *-continued*

Variable	Main Sample (42,251 Fund-Periods) Mean	Standard Deviation	PCT 10	PCT 50	PCT 90	COVID Sample (5,711 Fund-Periods) Mean 3/20	Mean 4/20-9/20
Portfolio avg. bond age (year)	2.818	1.284	1.516	2.563	4.490	3.612	3.489
Portfolio avg. coupon rate	6.568	1.925	3.966	6.569	8.910	4.523	4.587
Portfolio avg. credit rating (1 = AAA)	12.877	3.787	7.000	15.000	16.000	9.610	9.920
Portfolio Effective duration (year)	4.321	2.043	2.344	3.985	6.566	5.982	5.890
Top dec. positions/TNA (LARGEFRAC)	0.174	0.272	0.000	0.009	0.665	0.126	0.116

Panel B: Position-Level Variables

Variable	Main Sample (11,312,852 Fund-Bond-Periods) Mean	Standard Deviation	PCT 10	PCT 50	PCT 90	COVID Sample (1,161,052 Fund-Bond-Periods) Mean 3/20	Mean 4/20-9/20
Position size/Bond issue size (x100)	0.636	1.535	0.017	0.200	1.525	0.541	0.486
Family position size/Bond issue size (x100)	1.584	3.589	0.042	0.592	4.173	1.678	1.642
Position change/Beginning position (x100)	-4.611	27.927	-5.656	0.000	0.000	-9.097	-4.911
Position increase	0.063	0.243	0.000	0.000	0.000	0.065	0.070
Position decrease	0.109	0.312	0.000	0.000	1.000	0.164	0.101

Panel C: Bond-Level Variables

Variable	Main Sample (1,514,632 Bond-Months; 1,063,873 with Return/Range) Mean	Standard Deviation	PCT 10	PCT 50	PCT 90	COVID Sample (68,074 Bond-Months; 51,859 with Return/Range) Mean 3/20	Mean 4/20-9/20
Bond maturity (year)	8.699	8.301	1.498	5.916	24.287	9.377	9.645
Bond issue size ($ Mil.)	593	504	200	450	1,250	752	767

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Table 1 *-continued*

Panel C: Bond-Level Variables

	Main Sample (1,514,632 Bond-Months; 1,063,873 with Return/Range)					COVID Sample (68,074 Bond-Months; 51,859 with Return/Range)	
Variable	Mean	Standard Deviation	PCT 10	PCT 50	PCT 90	Mean 3/20	Mean 4/20-9/20
Bond maturity (year)	8.699	8.301	1.498	5.916	24.287	9.377	9.645
Bond issue size ($ Mil.)	593	504	200	450	1,250	752	767
Bond age (year)	4.466	4.144	0.550	3.274	9.621	5.272	5.191
Investment grade	0.666	0.471	0.000	1.000	1.000	0.762	0.770
Upgrade	0.021	0.142	0.000	0.000	0.000	0.017	0.029
Downgrade	0.010	0.082	0.000	0.000	0.000	0.029	0.009
Mutual fund ownership	0.100	0.097	0.007	0.068	0.244	0.107	0.107
Top fund ownership	0.035	0.037	0.004	0.022	0.080	0.035	0.034
Top family ownership	0.046	0.044	0.005	0.033	0.100	0.053	0.053
Largest 10 families' ownership	0.054	0.061	0.000	0.035	0.139	0.069	0.067
Insurance ownership	0.254	0.237	0.000	0.189	0.611	0.218	0.223
Turnover	0.062	0.060	0.003	0.043	0.160	0.044	0.040
Flow-induced fire sales (FIFS) (x100)	0.036	0.077	0.000	0.000	0.084	0.329	0.032
SQRT(Fragility) (x100)	0.121	0.130	0.015	0.073	0.297	0.102	0.149
JLSW fragility	0.041	0.022	0.020	0.035	0.068	-	-
Return (x100)	0.293	2.723	-2.036	0.231	2.766	-7.413	1.829
Return on matched IG bond index (x100)	0.269	1.421	-1.314	0.391	1.848	-7.329	1.798
Return on matched HY bond index (x100)	0.464	2.175	-1.972	0.682	2.437	-12.310	2.547
Price range (x100)	3.141	3.765	0.580	2.095	6.195	18.617	4.842
Price range of matched IG index (x100)	1.721	0.869	0.859	1.536	2.820	15.493	3.031
Price range of matched HY index (x100)	2.249	1.896	0.754	1.697	4.135	20.474	4.089

Table 2

Fund Trading during Periods of Financial Turmoil and the Fund's Share of an Outstanding Bond Issue

This table reports OLS estimates for panel regressions of fund position changes in turmoil periods on fund position size. Financial turmoil is measured using aggregate flows to all taxable bond mutual funds during a month, and the sample includes only the periods in which the aggregate flows are in the bottom decile during 1/2003 – 12/2019. The dependent variable, position change, is measured as a fraction of the position on the previous report date, and hence the sample includes only existing positions. All other variables are defined in the Appendix. All columns include fund-reporting period fixed effects. Columns (4) – (6) also include bond-period fixed effects. Standard errors, double-clustered by fund family and reporting period, are in parentheses. ∗, ∗∗, and ∗∗∗ refer to statistical significance at 10%, 5%, and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ALL	IG	HY	ALL	IG	HY	ALL
Top decile of fund position size	0.0147**	0.0071	0.0191**	0.0122**	0.0054	0.0145**	0.0148**
	(0.006)	(0.006)	(0.008)	(0.005)	(0.004)	(0.006)	(0.006)
Within-fund-period turnover decile							-0.0013**
							(0.001)
<u>Bond controls</u>							
Insurance ownership	0.0163*	0.0017	0.0261				0.0149
	(0.009)	(0.008)	(0.019)				(0.009)
Turnover	-0.1298***	-0.1224***	-0.1185***				-0.0799*
	(0.028)	(0.034)	(0.031)				(0.040)
ln(1 + Bond maturity)	0.0296***	0.0309***	0.0326***				0.0295***
	(0.005)	(0.007)	(0.005)				(0.005)
ln(1 + Bond issue size)	-0.0010	-0.0040	0.0004				-0.0008
	(0.001)	(0.002)	(0.002)				(0.001)
ln(1 + Bond age)	-0.0072***	-0.0019	-0.0102***				-0.0072***
	(0.002)	(0.002)	(0.003)				(0.002)
Investment grade	-0.0227**						-0.0229**
	(0.009)						(0.009)
Upgrade	-0.1533***		-0.1546***				-0.1534***
	(0.051)		(0.052)				(0.051)
Downgrade	-0.2359***	-0.2295***					-0.2357***
	(0.056)	(0.055)					(0.056)

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Table 2 *-continued*

	(1) ALL	(2) IG	(3) HY	(4) ALL	(5) IG	(6) HY	(7) ALL
Fund x Period fixed effects	YES	YES	YES	YES	YES	YES	YES
Bond x Period fixed effects	NO	NO	NO	YES	YES	YES	NO
Observations	717,870	250,676	467,194	717,870	250,676	467,194	717,870
R-squared	0.099	0.136	0.107	0.360	0.425	0.354	0.099

Table 3

Fund's Share of an Outstanding Bond Issue and the Sensitivity of Fund Trading to Outflows

This table reports OLS estimates for panel regressions of fund position changes in turmoil periods on fund outflows and the interaction of fund outflows with position size. In columns (1) – (4), financial turmoil is measured using aggregate flows to all taxable bond mutual funds during a month, and the sample includes only the periods in which the aggregate flows are in the bottom decile during 1/2003 – 12/2019. In columns (5) – (8), financial turmoil is measured using individual fund flows. The dependent variable is the position change as a fraction of the position on the previous report date, and hence the sample includes only existing positions. All other variables are defined in the Appendix. All columns include bond controls (as in Table 2), (time-varying) fund controls including portfolio time-varying characteristics (% cash, % government bonds, % corporate bonds, average coupon rate, average credit rating, effective duration, natural log of 1 + average bond issue size, and natural log of 1 + average bond age) as well as fund time-varying characteristic (age, size, family size, institutional share class fraction, and average maximum rear load), and fund and reporting period fixed effects. Standard errors, clustered by fund family, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

	Stress = Periods with Aggregate Flows in Bottom Decile (≤ -0.854%, average = -1.388%)				Stress = Fund-Periods with Individual Flows in Bottom Quintile (≤ -1.620%, average = -3.482%)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ALL	IG	HY	ALL	ALL	IG	HY	ALL
Outflow	-0.7207***	-0.7671***	-0.7203***	-0.6602***	-1.3758***	-1.8070***	-1.2464***	-1.2981***
	(0.089)	(0.063)	(0.107)	(0.085)	(0.117)	(0.151)	(0.143)	(0.113)
Outflow x Top decile of fund position size	0.2029***	0.1157	0.2040**	0.1979***	0.1591**	0.1786*	0.1695**	0.1566**
	(0.069)	(0.073)	(0.084)	(0.068)	(0.063)	(0.092)	(0.078)	(0.062)
Outflow				-0.0112				-0.0144**
x Within-fund-period turnover decile				(0.010)				(0.007)
Bond controls	YES	YES	YES	YES	YES	YES	YES	YES
(Time-varying) fund controls	YES	YES	YES	YES	YES	YES	YES	YES
Fund fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Period fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	703,288	248,382	454,906	703,288	1,281,393	320,821	960,572	1,281,393
R-squared	0.064	0.090	0.065	0.064	0.065	0.096	0.062	0.065

Table 4

Fund's Share of an Outstanding Bond Issue and Fund Trading during Periods of Financial Turmoil – Robustness Checks

This table presents two robustness checks for the relationships between fund position changes during turmoil periods and position size. The dependent variable is the position change as a fraction of the position on the previous report date, and therefore the samples in both panels include only existing positions. In Panel A, fund position changes are regressed on family position size, instead of fund position size. Financial turmoil is measured using aggregate flows to all taxable bond mutual funds during a month, and the sample includes only the periods in which the aggregate flows are in the bottom decile during 1/2003 – 12/2019. In Panel B, the turmoil sample is replaced with the non-turmoil sample, which includes only the fund-period observations for which both the individual fund flows and the aggregate flows to all taxable bond mutual funds are positive. All columns in both panels include bond controls (as in Table 2) and fund-reporting period fixed effects. All other variables are defined in the Appendix. Standard errors, two-way clustered by fund family and reporting period, are in parentheses. $*$, $**$, and $***$ refer to statistical significance at 10%, 5%, and 1% levels.

Panel A: Replacing Fund Position Size with Family Position Size

	(1)	(2)	(3)
	ALL	IG	HY
Top decile of family position size	0.0149**	0.0063	0.0251***
	(0.005)	(0.005)	(0.006)
Bond controls	YES	YES	YES
Fund x Period fixed effects	YES	YES	YES
Observations	717,870	250,676	467,194
R-squared	0.099	0.136	0.107

Panel B: Replacing Turmoil Periods with Non-Turmoil Periods

	(1)	(2)	(3)
	ALL	IG	HY
Top decile of fund position size	0.0051*	0.0003	0.0071**
	(0.003)	(0.006)	(0.003)
Bond controls	YES	YES	YES
Fund x Period fixed effects	YES	YES	YES
Observations	2,130,590	699,072	1,430,011
R-squared	0.100	0.131	0.101

Table 5

Bond Returns and Ownership Concentration

This table reports average bond returns in turmoil and non-turmoil periods for bond portfolios in different deciles of ownership by the top fund. For each bond-month observation, return is calculated as the percentage change in the volume-weighted average price (VWAP) of the bond from the last day on which there are transactions in the previous month to the last day on which there are transactions in the current month. Only returns calculated from VWAP that lie in the last 10 days of each month are used. In Panel A, the sample includes all bond-month observations, and the turmoil indicator equals 1 if flow-induced fire sales (FIFS) are in the top decile based on the pooled sorting of the sample. In Panel B, the sample includes only bond-month observations for which mutual fund ownership is in the top quintile based on monthly sorting, and the turmoil indicator equals 1 to capture months in which aggregate flows to all taxable bond mutual funds are in the bottom decile during 1/2003 – 12/2019. Deciles of top fund ownership are calculated by (independently) sorting bonds by the top one fund ownership during each month. All variables are defined in the Appendix. All columns include fund-reporting period fixed effects. Tests of differences are conducted using standard errors clustered by month. ∗, ∗∗, and ∗∗∗ refer to statistical significance at 10%, 5%, and 1% levels.

Panel A: Turmoil = Flow-Induced Fire Sales in the Top Decile

	Decile of Top Fund Ownership										
Turmoil	1 (Lowest)	2	3	4	5	6	7	8	9	10 (Highest)	10 - 1
All bonds											
1	-0.927%	-0.529%	-0.470%	-0.393%	-0.389%	-0.397%	-0.392%	-0.385%	-0.364%	-0.314%	0.613%***
0	0.127%	0.118%	0.123%	0.132%	0.135%	0.135%	0.147%	0.152%	0.126%	0.130%	0.002%
1-0											0.611%***
Investment-grade bonds											
1	-0.290%	-0.104%	-0.092%	-0.081%	-0.064%	-0.066%	-0.050%	-0.043%	-0.042%	-0.027%	0.262%***
0	0.032%	0.050%	0.050%	0.050%	0.057%	0.049%	0.059%	0.051%	0.050%	0.052%	0.020%
1-0											0.242%***
High-yield bonds											
1	-1.485%	-1.062%	-0.807%	-0.729%	-0.772%	-0.702%	-0.713%	-0.714%	-0.607%	-0.537%	0.948%***
0	0.311%	0.308%	0.285%	0.284%	0.312%	0.318%	0.335%	0.331%	0.334%	0.320%	0.009%
1-0											0.939%***

Table 5 *-continued*

Panel B: Turmoil = Aggregate Flows to All Taxable Bond Funds in the Bottom Decile

	Decile of Top Fund Ownership										
Turmoil	1 (Lowest)	2	3	4	5	6	7	8	9	10 (Highest)	10 - 1
All bonds											
1	-2.329%	-2.233%	-2.142%	-2.200%	-2.125%	-2.197%	-2.132%	-1.986%	-1.999%	-1.936%	0.392%***
0	0.204%	0.218%	0.185%	0.201%	0.202%	0.188%	0.195%	0.176%	0.198%	0.181%	-0.023%
1-0											0.416%***
Investment-grade bonds											
1	-0.865%	-0.818%	-0.773%	-0.592%	-0.614%	-0.855%	-0.893%	-0.848%	-0.607%	-0.568%	0.297%***
0	0.091%	0.094%	0.079%	0.082%	0.080%	0.080%	0.079%	0.087%	0.092%	0.092%	0.001%
1-0											0.296%***
High-yield bonds											
1	-2.619%	-2.541%	-2.493%	-2.570%	-2.626%	-2.634%	-2.612%	-2.375%	-2.458%	-2.199%	0.421%***
0	0.241%	0.240%	0.212%	0.233%	0.235%	0.230%	0.230%	0.227%	0.233%	0.214%	-0.027%
1-0											0.448%***

Table 6

The Cross-Section of Bond Returns and Ownership Concentration during Financial Turmoil

This table reports OLS estimates for panel regressions of bond returns on proxies for market turmoil, top fund ownership, and their interaction. For each bond-month observation, the dependent variable, bond return, is calculated as the percentage change in VWAP of the bond from the last day on which there are transactions in the previous month to the last day on which there are transactions in the current month. Only returns calculated from VWAP in the last 10 days of each month are used. In Panel A, the degree of turmoil is captured by FIFS. In Panel B, the degree of turmoil is captured by an indicator variable that equals one for calendar months in which aggregate flows to all taxable bond mutual funds are in the bottom decile during 1/2003 – 12/2019. All variables are defined in the Appendix. All columns in both panels include market and bond controls as listed in Panel A. All columns in both panels, except column (5), also include month and issuer fixed effects. Column (5) in both panels includes issuer-month fixed effects. Standard errors, clustered by month, are in parentheses. $*$, $**$, and $***$ refer to statistical significance at 10%, 5%, and 1% levels.

Panel A: Turmoil Captured by Flow-Induced Fire Sales

	(1) ALL	(2) ALL	(3) IG	(4) HY	(5) HY	(6) HY
Flow induced fire sales (FIFS)	-1.3602***	-1.5375***	-0.6889	-1.5363***	-1.0894***	-0.6406
	(0.241)	(0.378)	(0.429)	(0.307)	(0.238)	(0.594)
Top fund ownership		-0.0019	-0.0020	-0.0022	-0.0037	-0.0023
		(0.003)	(0.002)	(0.004)	(0.003)	(0.004)
FIFS x Top fund ownership		4.9934*	3.3443	6.3758**	4.6054*	6.1247**
		(2.763)	(2.418)	(2.625)	(2.351)	(2.529)
FIFS x JLSW fragility						-21.5246*
						(11.620)
<u>Market controls</u>						
Matched index return	-0.1865***	-0.1864***	-0.4068***	0.1843***	0.0601	0.1873***
	(0.058)	(0.058)	(0.074)	(0.038)	(0.055)	(0.039)
Matched index return	0.3721***	0.3721***	0.5045***	0.1412***	0.1874***	0.1400***
x ln(1 + Bond maturity)	(0.046)	(0.046)	(0.044)	(0.028)	(0.036)	(0.028)

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Table 6 *-continued*

	(1)	(2)	(3)	(4)	(5)	(6)
	ALL	ALL	IG	HY	HY	HY
<u>Bond controls</u>						
Mutual fund ownership	-0.0004	0.0000	0.0016	-0.0027	0.0026**	-0.0027
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Insurance ownership	0.0002	0.0002	0.0001	-0.0010	0.0020***	-0.0011
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Turnover	0.0029*	0.0029*	0.0016	0.0031	0.0034*	0.0031
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
JLSW fragility	-0.0075	-0.0075	0.0017	-0.0186*	-0.0055	-0.0125
	(0.011)	(0.011)	(0.016)	(0.010)	(0.007)	(0.010)
ln(1 + Bond maturity)	0.0006	0.0006	0.0005	0.0009**	0.0005	0.0009**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1 + Bond issue size)	-0.0002*	-0.0002*	-0.0002*	-0.0002	-0.0004**	-0.0002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1 + Bond age)	-0.0005***	-0.0005***	-0.0005***	-0.0003	-0.0004*	-0.0003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Investment grade	-0.0021***	-0.0021***				
	(0.001)	(0.001)				
Upgrade	0.0006**	0.0006**	0.0007***	0.0010	0.0007	0.0010
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Downgrade	-0.0071***	-0.0071***	-0.0144***	0.0043*	0.0007	0.0043*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Issuer fixed effects	YES	YES	YES	YES	NO	YES
Month fixed effects	YES	YES	YES	YES	NO	YES
Issuer x Month fixed effects	NO	NO	NO	NO	YES	NO
Observations	917,167	917,167	646,365	270,802	189,995	270,802
R-squared	0.351	0.351	0.430	0.309	0.778	0.309

Table 6 *–continued*

Panel B: Turmoil Defined as Periods with Aggregate Flows to All Taxable Bond Funds Being in the Bottom Decile

	(1) ALL	(2) ALL	(3) IG	(4) HY	(5) HY	(6) HY
Top fund ownership		0.0011	0.0027	-0.0033	-0.0039	-0.0027
		(0.003)	(0.004)	(0.002)	(0.003)	(0.002)
Aggregate flow D1 (AFD1)		0.0246*	0.0131	0.0313***	0.0413**	0.0260***
x Top fund ownership		(0.014)	(0.023)	(0.011)	(0.017)	(0.009)
AFD1 x Mutual fund ownership	-0.0152**	-0.0193**	-0.0146	-0.0360***	-0.0222***	-0.0319***
	(0.007)	(0.009)	(0.011)	(0.010)	(0.008)	(0.009)
AFD1 x JLSW fragility						-0.1217**
						(0.058)
Market controls	YES	YES	YES	YES	YES	YES
Bond controls	YES	YES	YES	YES	YES	YES
Issuer fixed effects	YES	YES	YES	YES	NO	YES
Month fixed effects	YES	YES	YES	YES	NO	YES
Issuer x Month fixed effects	NO	NO	NO	NO	YES	NO
Observations	917,167	917,167	646,365	270,802	189,995	270,802
R-squared	0.350	0.350	0.430	0.309	0.778	0.309

Table 7

Bond Price Volatility and Ownership Concentration

This table reports OLS estimates for panel regressions of bond price volatility, measured using the bond price range, on the bond's top fund ownership. For each bond-month observation, the dependent variable, bond price volatility, is calculated as the maximum minus minimum VWAP of the bond in the current month, as a fraction of VWAP on the last day on which there were transactions in the previous month. For the price range to be measurable, the bond must trade at least once in the current month and in the last 10 days of the previous month. All other variables are defined in the Appendix. All columns, except column (4), include month and issuer fixed effects. Column (4) includes issuer-month fixed effects. Standard errors, clustered by month, are in parentheses. $*$, $**$, and $***$ refer to statistical significance at 10%, 5%, and 1% levels.

	(1)	(2)	(3)	(4)	(5)
	ALL	IG	HY	HY	HY
Top fund ownership	-0.0453***	-0.0151***	-0.0523***	-0.0311***	-0.0560***
	(0.003)	(0.002)	(0.004)	(0.008)	(0.005)
SQRT(Fragility)					0.0166***
					(0.002)
Largest 10 families' ownership					0.0143***
					(0.002)
<u>Market controls</u>					
Matched index level range	0.0258	-0.2159**	0.3644***	0.2076***	0.3623***
	(0.042)	(0.097)	(0.061)	(0.061)	(0.061)
Matched index level range	0.2276***	0.4024***	0.0640**	0.0966***	0.0648***
x ln(1 + Bond maturity)	(0.037)	(0.044)	(0.025)	(0.035)	(0.025)
<u>Bond controls</u>					
Mutual fund ownership	0.0387***	0.0161***	0.0450***	0.0009	0.0388***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)
Insurance ownership	-0.0050***	-0.0029***	-0.0093***	0.0024***	-0.0095***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Turnover	0.0066***	-0.0046**	0.0137***	-0.0073***	0.0141***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
JLSW fragility	0.1925***	0.0858***	0.2472***	0.1057***	0.2502***
	(0.013)	(0.008)	(0.014)	(0.008)	(0.014)
ln(1 + Bond maturity)	0.0096***	0.0077***	0.0130***	0.0133***	0.0132***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(1 + Bond issue size)	-0.0012***	-0.0025***	0.0023***	-0.0006***	0.0019***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1 + Bond age)	0.0027***	0.0020***	0.0051***	0.0020***	0.0049***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

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Table 7 –*continued*

	(1) ALL	(2) IG	(3) HY	(4) HY	(5) HY
Investment grade	-0.0036***				
	(0.001)				
Upgrade	-0.0021***	-0.0014***	-0.0038***	0.0001	-0.0039***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Downgrade	0.0176***	0.0232***	0.0114***	0.0012	0.0113***
	(0.003)	(0.004)	(0.004)	(0.002)	(0.004)
Issuer fixed effects	YES	YES	YES	NO	YES
Month fixed effects	YES	YES	YES	NO	YES
Issuer x Month fixed effects	NO	NO	NO	YES	NO
Observations	915,627	645,648	269,979	189,521	269,958
R-squared	0.592	0.651	0.542	0.869	0.543

Table 8

Fund Trading and Share of an Outstanding Bond Issue during the COVID-19 Pandemic

Panel A reports OLS estimates for panel regressions of fund position changes on fund position size in the period when the COVID-19 shock hit markets in March 2020 (columns (1) – (4)) and in the subsequent period when the Fed intervened (columns (5) – (9)). The sample includes only fund-period observations for which the flows are in the bottom quintile, based on pooled sorting across all fund-period observations during 9/2019 – 9/2020. The COVID-19 shock period in columns (1) – (4) is 3/2020, and the samples include only fund-period observations with report date 3/31/2020. The Fed's intervention period in columns (5) – (9) spans 4 – 9/2020, and the samples include only fund-period observations that are associated with report dates during the Fed's intervention period. In both periods, different subsets of corporate bonds are considered as indicated on top of each column. Bonds are Fed eligible if they meet the criteria for purchases by the Fed under the Secondary Market Corporate Credit Facility (SMCCF). Panel B reports OLS estimates for panel regressions of fund position changes on fund position size and its interaction with Fed eligibility during the period when the Fed intervened. The samples include both Fed eligible and ineligible investment-grade corporate bonds, but with progressively narrower maturity bands around the five-year maturity cutoff for Fed eligibility, as indicated on top of each column. In both panels, the dependent variable is position change as a fraction of the position on the previous report date, and hence the observations include only existing positions. All other variables are defined in the Appendix. All columns in both panels include fund-reporting period fixed effects. Standard errors in parentheses are clustered by fund family in columns (1) – (4) of Panel A (which have no time dimension) and double-clustered by fund family and reporting period in columns (5) – (9) of Panel A and all columns of Panel B. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

Panel A: Different Subsamples of Corporate Bonds

	3/2020				4/2020 - 9/2020			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY
Top decile of fund position size	0.0175	0.0113**	0.0267*	0.0256**	0.0203*	-0.0138*	0.0303***	0.0306**
	(0.014)	(0.005)	(0.014)	(0.012)	(0.008)	(0.005)	(0.005)	(0.011)
Bond controls								
Insurance ownership	0.0078	-0.0243***	0.0948***	-0.0325	-0.0370**	-0.0047	0.0231	0.0178
	(0.008)	(0.006)	(0.034)	(0.048)	(0.013)	(0.006)	(0.031)	(0.050)
Turnover	-0.0814***	0.0503***	-0.1383***	0.0342	0.0813	-0.0123	0.1363*	-0.0286
	(0.028)	(0.014)	(0.037)	(0.061)	(0.050)	(0.015)	(0.063)	(0.044)

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Table 8 *-continued*

	3/2020				4/2020 - 9/2020			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY
ln(1 + Bond maturity)	0.0269***	-0.0001	0.0833***	0.0724***	0.0369***	-0.0024	0.1169***	0.0554**
	(0.006)	(0.002)	(0.024)	(0.013)	(0.008)	(0.003)	(0.013)	(0.015)
ln(1 + Bond issue size)	-0.0252***	-0.0076***	-0.0148*	-0.0179***	-0.0190***	-0.0046	-0.0065	-0.0124*
	(0.004)	(0.002)	(0.008)	(0.006)	(0.004)	(0.003)	(0.006)	(0.005)
ln(1 + Bond age)	-0.0008	0.0084***	-0.0135	-0.0151**	0.0142**	-0.0026	0.0136**	-0.0169
	(0.003)	(0.002)	(0.009)	(0.006)	(0.005)	(0.002)	(0.005)	(0.009)
Investment grade	-0.0054				-0.0176			
	(0.015)				(0.015)			
Upgrade	-0.0811*			-0.0777	-0.0596			-0.0318
	(0.042)			(0.081)	(0.041)			(0.032)
Downgrade	-0.2367***	-0.0115	-0.1624		-0.1426**	-0.0817**	-0.1186	
	(0.081)	(0.020)	(0.104)		(0.047)	(0.030)	(0.069)	
Fund x Period fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	101,553	25,454	59,161	16,938	91,743	20,737	47,391	23,615
R-squared	0.116	0.044	0.216	0.167	0.119	0.210	0.228	0.181

Table 8 *-continued*

Panel B: Differences in Trading in Fed Eligible and Ineligible Corporate Bonds

	(1) IG	(2) IG (2-8 years)	(3) IG (4-6 years)
Top decile of fund position size	0.0297***	0.0511***	0.0653***
	(0.007)	(0.009)	(0.015)
Fed eligible	0.2685***	0.2846***	0.3087***
	(0.026)	(0.034)	(0.041)
Top decile of fund position size x Fed eligible	-0.0391*	-0.0702***	-0.0732***
	(0.016)	(0.008)	(0.012)
<u>Bond controls</u>			
Insurance ownership	0.0020	-0.0793**	-0.1303**
	(0.020)	(0.028)	(0.042)
Turnover	0.1184*	0.0085	0.0936
	(0.056)	(0.031)	(0.066)
ln(1 + Bond maturity)	0.1216***	0.3640***	1.2135***
	(0.014)	(0.057)	(0.190)
ln(1 + Bond issue size)	-0.0084	-0.0135	-0.0137
	(0.005)	(0.007)	(0.009)
ln(1 + Bond age)	0.0132**	0.0310***	0.0445***
	(0.004)	(0.007)	(0.007)
Downgrade	-0.1194*	-0.0661	-0.0620
	(0.052)	(0.058)	(0.087)
Fund x Period fixed effects	YES	YES	YES
Observations	68,128	24,201	9,217
R-squared	0.199	0.283	0.309

Table 9

Bond Returns and Ownership Concentration during the COVID-19 Pandemic

Panel A reports OLS estimates for panel regressions of bond returns on flow-induced fire sales, top fund ownership, and their interaction in the period when the COVID-19 shock hit markets in March 2020 (columns (1) – (4)) and in the subsequent period when the Fed intervened (columns (5) – (9)). The sample includes 3,933 investment-grade eligible bonds, 6,070 investment-grade ineligible bonds, and 4,734 high-yield bonds. Eligible fallen angels, that is, 696 bonds that were downgraded from investment grade to below investment grade after March 2020, are excluded from the sample. The COVID-19 shock period in columns (1) – (4) is 3/2020, and the Fed's intervention period in columns (5) – (9) spans 4 – 9/2020. In both cases, different subsets of corporate bonds as indicated on top of each column. All columns include issuer-month fixed effects. Panel B reports OLS estimates for panel regressions of bond returns on flow-induced fire sales, top fund ownership, Fed eligibility, and their interactions during the Fed's intervention period. The samples include both Fed eligible and ineligible investment-grade corporate bonds, but with progressively narrower maturity bands around the five-year maturity cutoff for Fed eligibility, as indicated on top of each column. All columns include issuer and month fixed effects. In both panels, for each bond-month observation, the dependent variable, bond return, is calculated as the percentage change in VWAP of the bond from the last day on which there are transactions in the previous month to the last day on which there are transactions in the current month. Only returns calculated from VWAP that lie in the last 10 days of each month are used. All variables are defined in the Appendix. White's heteroskedasticity robust standard errors are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

Panel A: Different Subsamples of Corporate Bonds

	3/2020				4/2020 - 9/2020			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY
Flow induced fire sales (FIFS)	-0.5063	-2.3354***	-1.4868**	-1.9030	-3.2329***	1.1557	-4.0501***	-3.1205**
	(0.381)	(0.545)	(0.604)	(1.230)	(0.545)	(0.800)	(0.992)	(1.353)
Top fund ownership	0.0999**	0.0614	0.0766	0.0226	-0.0233***	0.0091*	-0.0265**	-0.0041
	(0.050)	(0.059)	(0.084)	(0.089)	(0.007)	(0.005)	(0.011)	(0.020)
FIFS x Top fund ownership	26.4526*	30.0190*	22.0757	29.1863	28.0563***	-17.0839**	45.7744**	38.7971*
	(14.696)	(17.392)	(25.092)	(27.150)	(8.233)	(8.318)	(17.779)	(20.481)
<u>Market controls</u>								
Matched index return	0.3890***	0.2549*	0.2175**	-0.0480	-0.8442***	-0.0220	-1.4041***	-0.3295
	(0.056)	(0.131)	(0.096)	(0.357)	(0.049)	(0.062)	(0.068)	(0.208)
Matched index return x ln(1 + Bond maturity)	-0.0907***	-0.0156	-0.0231	-0.0172	0.4497***	0.2934***	0.5695***	0.1897***
	(0.017)	(0.090)	(0.029)	(0.123)	(0.006)	(0.010)	(0.014)	(0.031)

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Table 9 *-continued*

	3/2020				4/2020 - 9/2020			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY	ALL	Fed Eligible	Fed Ineligible IG	Fed Ineligible HY
Bond controls								
Mutual fund ownership	-0.0083	0.0007	-0.0134	0.0007	0.0048*	-0.0065***	0.0013	0.0009
	(0.006)	(0.010)	(0.010)	(0.016)	(0.002)	(0.002)	(0.004)	(0.008)
Insurance ownership	-0.0065***	0.0176***	0.0035	0.0007	0.0051***	-0.0044***	0.0008	0.0095
	(0.002)	(0.004)	(0.003)	(0.012)	(0.001)	(0.001)	(0.002)	(0.006)
Turnover	0.0170***	0.0016	0.0120*	-0.0081	-0.0147**	-0.0055	0.0011	-0.0323**
	(0.005)	(0.010)	(0.007)	(0.012)	(0.006)	(0.009)	(0.007)	(0.016)
ln(1 + Bond maturity)	-0.0218***	-0.0260***	-0.0082***	-0.0124	-0.0036***	0.0038***	-0.0091***	0.0003
	(0.001)	(0.007)	(0.002)	(0.015)	(0.000)	(0.000)	(0.000)	(0.001)
ln(1 + Bond issue size)	0.0024***	0.0059***	0.0013*	0.0019	-0.0005**	-0.0010***	-0.0007**	-0.0013
	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)
ln(1 + Bond age)	0.0020***	-0.0002	-0.0001	-0.0015	-0.0012***	-0.0003	-0.0002	-0.0001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Investment grade	-0.0045				0.0011			
	(0.003)				(0.002)			
Upgrade	0.0050**	0.0035	0.0035	-0.0054	0.0015***	0.0029***	0.0028***	0.0053
	(0.002)	(0.004)	(0.002)	(0.006)	(0.001)	(0.001)	(0.001)	(0.008)
Downgrade	0.0066	0.0117*	-0.0091***	-0.0150	-0.0034	0.0004	-0.0248	0.0016
	(0.009)	(0.007)	(0.003)	(0.040)	(0.002)	(0.001)	(0.021)	(0.005)
Issuer x Month fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	6,653	2,541	3,372	740	41,668	15,464	21,307	4,897
R-squared	0.704	0.784	0.659	0.718	0.739	0.775	0.802	0.781

Table 9 *-continued*

Panel B: Differences in the Effect of Top Fund Ownership on Fed Eligible and Ineligible Corporate Bonds

	(1) IG	(2) IG (2-8 years)	(3) IG (4-6 years)
Flow induced fire sales (FIFS)	-8.6446***	-3.3581**	-4.0070*
	(1.155)	(1.585)	(2.175)
Top fund ownership	-0.0369***	-0.0103	-0.0367
	(0.011)	(0.013)	(0.026)
FIFS x Top fund ownership	69.2419***	43.0872*	48.5979
	(21.097)	(24.963)	(30.901)
Fed eligible	-0.0054***	-0.0017***	-0.0012
	(0.000)	(0.001)	(0.001)
FIFS x Fed eligible	10.3702***	4.3325**	3.4945
	(1.317)	(1.886)	(2.815)
Top fund ownership x Fed eligible	0.0206**	0.0159	0.0435*
	(0.010)	(0.013)	(0.025)
FIFS x Top fund ownership x Fed eligible	-84.5732***	-46.2491*	-48.5599
	(22.749)	(24.920)	(37.978)
Market controls	YES	YES	YES
Bond controls	YES	YES	YES
Issuer fixed effects	YES	YES	YES
Month fixed effects	YES	YES	YES
Observations	36,771	15,649	5,267
R-squared	0.559	0.527	0.565

Table 10

Fund Performance and the Portfolio Fraction of Large Positions

This table reports OLS estimates for panel regressions of a fund's alpha (in percent) on its fraction of positions, in market value terms, that are in the top decile of position size, divided by the fund's TNA (LARGEFRAC). For each fund *f* in month *t*, the dependent variable, alpha, is the fund's monthly return minus the benchmark return, estimated from the following equation:

$$R_{f,t} \text{ - } \textit{Risk free rate}_t = \alpha + [\, \beta_{f,STK} STK_t \; + \; \beta_{f,BOND} BOND_t \; + \; \beta_{f,DEF} DEF_t \; + \; \beta_{f,OPTION} OPTION_t \,] + \varepsilon_{f,t} \; ,$$

where $R_{f,t}$ is the fund's monthly return, *STK* is the excess return on the CRSP value-weighted stock index, *BOND* is the excess return on the U.S. aggregate bond index, *DEF* is the return spread between the high-yield bond index and the intermediate government bond index, and *OPTION* is the return spread between the GNMA mortgage-backed security index and the intermediate government bond index. All bond indices are from Bank of America Merrill Lynch and are downloaded from DataStream. The parameters, $\beta_{f,STK}$, $\beta_{f,BOND}$, $\beta_{f,DEF}$, and $\beta_{f,OPTION}$ are estimated on a rolling basis. For alpha in month *t*, the estimation period is from months *t*-18 to *t*-1. All of the independent variables, including LARGEFRAC, are as of the end of month *t*-1. Columns (1) – (3) are for the full sample period. The subsample in columns (4) – (6) includes only months in which aggregate flows to all taxable bond mutual funds are in the bottom decile during 1/2003 – 12/2019. The subsample in columns (7) – (9) includes only fund-month observations in which individual fund flows are in the bottom quintile, based on pooled sorting across all fund-month observations. All variables are defined in the Appendix. All columns include Morningstar's fund category-month fixed effects, and fund controls, including lagged flows, lagged alpha, broker affiliation dummy, portfolio time-varying characteristics (% cash, % government bonds, % corporate bonds, average coupon rate, average credit rating, effective duration, natural log of 1 + average bond issue size, and natural log of 1 + average bond age), and fund time-varying characteristic (age, size, family size, institutional share class fraction, and average maximum rear load). Standard errors, clustered by fund, are in parentheses. ∗, ∗∗, and ∗∗∗ refer to statistical significance at 10%, 5%, and 1% levels.

	Full Sample Period			Bottom Decile of Aggregate Flows			Bottom Quintile of Individual Flows		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		IG	HY		IG	HY		IG	HY
	ALL	Focused	Focused	ALL	Focused	Focused	ALL	Focused	Focused
Top decile positions/TNA	0.0747***	0.0709*	0.1064**	0.2425*	0.1829	0.3230**	0.0428	-0.0829	0.0678
(LARGEFRAC)	(0.026)	(0.037)	(0.053)	(0.138)	(0.225)	(0.156)	(0.081)	(0.232)	(0.088)
Fund controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fund category x Month fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	53,045	16,640	36,405	4,954	1,524	3,430	10,835	2,542	8,293
R-squared	0.500	0.580	0.494	0.514	0.684	0.473	0.429	0.578	0.430

Table 11

Fund Flows the Portfolio Fraction of Large Positions Following Financial Turmoil

This table reports OLS estimates for panel regressions of fund flows on the lagged fraction of a fund's positions, in market value terms, that are in top decile of position size (LARGEFRAC) and the interactions of lagged LARGEFRAC and dummies for periods following financial turmoil. For each fund-month observation, the dependent variable, Flow, is computed at month *t*, while all of the independent variables, including LARGEFRAC, are as of the end of month *t*-1 or prior. In columns (1) – (3), the turmoil indicator equals one if the aggregate flows to all taxable bond mutual funds in that month are in the bottom decile during 1/2003 – 12/2019. In columns (4) – (6), the turmoil indicator equals one if in that month, the individual fund experiences flows in the bottom quintile, based on pooled sorting across all fund-month observations. All other variables are defined in the Appendix. All columns include Morningstar's fund category-month fixed effects, and fund controls, including lagged flows, lagged alpha, broker affiliation dummy, portfolio time-varying characteristics (% cash, % government bonds, % corporate bonds, average coupon rate, average credit rating, effective duration, natural log of 1 + average bond issue size, and natural log of 1 + average bond age), and fund time-varying characteristic (age, size, family size, institutional share class fraction, and average maximum rear load). Standard errors, clustered by fund, are in parentheses. ∗, ∗∗, and ∗∗∗ refer to statistical significance at 10%, 5%, and 1% levels.

	Turmoil = Bottom Decile of Aggregate Flows			Turmoil = Bottom Quintile of Individual Flows		
	(1)	(2)	(3)	(4)	(5)	(6)
	ALL	IG Focused	HY Focused	ALL	IG Focused	HY Focused
LARGEFRAC(t - 1)	0.0012	-0.0178	0.0033	0.0024	-0.0130	0.0039
	(0.007)	(0.018)	(0.008)	(0.007)	(0.019)	(0.008)
LARGEFRAC(t - 2)	0.0031	0.0240	0.0022	0.0020	0.0238	-0.0003
	(0.009)	(0.023)	(0.010)	(0.009)	(0.024)	(0.010)
LARGEFRAC(t - 3)	-0.0068	-0.0127	-0.0072	-0.0075	-0.0155	-0.0066
	(0.006)	(0.015)	(0.007)	(0.006)	(0.016)	(0.007)
LARGEFRAC(t - 1) x Turmoil(t - 1)	0.0160***	0.0280**	0.0109*	-0.0032	0.0206	-0.0052
	(0.006)	(0.014)	(0.006)	(0.006)	(0.015)	(0.007)
LARGEFRAC(t - 2) x Turmoil(t - 2)	-0.0008	-0.0123	0.0027	0.0044	-0.0108	0.0075
	(0.006)	(0.011)	(0.007)	(0.005)	(0.014)	(0.005)
LARGEFRAC(t - 3) x Turmoil(t - 3)	0.0017	0.0048	0.0003	0.0051	-0.0021	0.0036
	(0.005)	(0.009)	(0.006)	(0.004)	(0.018)	(0.004)
Fund controls	YES	YES	YES	YES	YES	YES
Fund category x Month fixed effects	YES	YES	YES	YES	YES	YES
Observations	52,570	16,496	36,074	52,570	16,496	36,074
R-squared	0.338	0.341	0.353	0.352	0.353	0.367

Table 12

Spillovers of Flow-Induced Fire Sales on Performance and Flows of Peer Funds

This table reports OLS estimates for panel regressions of fund alpha (in percent) (Panel A) and fund flows (Panel B) on total peer selling pressure and the separate selling pressures from two types of peers, those with LARGEFRAC in and not in the top decile in each month, as denoted by HIGHLARGEFRAC and LOWLARGEFRAC. For each fund-month observation, the dependent variables, Alpha and Flow, are computed at month *t*, as described in Tables 10-11. Peer selling pressure is calculated as the position-weighted average of FIFS from a given type of peers in a given bond, where the position weight is as of month *t*-1 but the peer flows that drive FIFS are as of month *t*. All other independent variables are as of the end of month *t*-1 or prior, and are defined in the Appendix. Following Falato et al. (2021), all columns include fund and month fixed effects. Columns (3) – (5) also include fund controls, including lagged flows, lagged alpha, portfolio time-varying characteristics (% cash, % government bonds, % corporate bonds, average coupon rate, average credit rating, effective duration, natural log of 1 + average bond issue size, and natural log of 1 + average bond age), and fund time-varying characteristic (age, size, family size, institutional share class fraction, and average maximum rear load). Standard errors, clustered by fund, are in parentheses. ∗, ∗∗, and ∗∗∗ refer to statistical significance at 10%, 5%, and 1% levels.

Panel A: Spillover Effects on Peer Performance

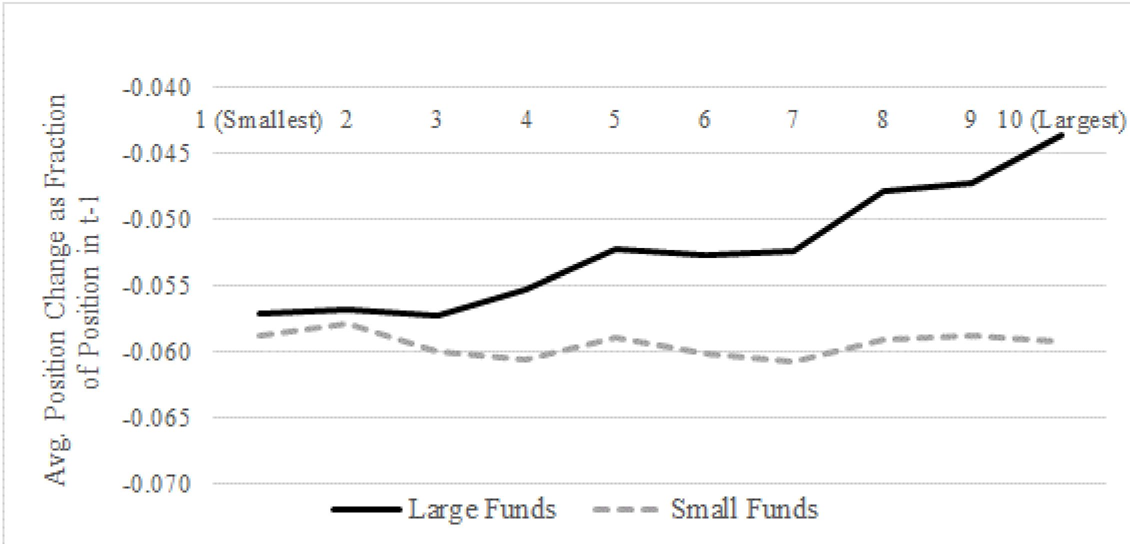
	(1) ALL	(2) ALL	(3) ALL	(4) IG Focused	(5) HY Focused
Peer selling pressure (x100)	-0.6418*** (0.180)				
HIGHLARGEFRAC peer selling pressure (x100)		-0.2689 (0.193)	-0.5358** (0.226)	-0.3849 (0.453)	-0.1531 (0.326)
LOWLARGEFRAC peer selling pressure (x100)		-1.3673*** (0.266)	-1.3072*** (0.236)	0.6774 (0.649)	-1.3997*** (0.369)
(Time varying) fund controls	NO	NO	YES	YES	YES
Fund fixed effects	YES	YES	YES	YES	YES
Month fixed effects	YES	YES	YES	YES	YES
Observations	53,045	53,045	53,045	16,640	36,405
R-squared	0.289	0.290	0.346	0.426	0.323

Table 12 *-continued*

Panel B: Spillover Effects on Peer Flows

	(1) ALL	(2) ALL	(3) ALL	(4) IG Focused	(5) HY Focused
Peer selling pressure (x100)	-0.0999***				
	(0.006)				
HIGHLARGEFRAC peer selling pressure (x100)		-0.0575***	-0.0588***	-0.0498***	-0.0430***
		(0.008)	(0.007)	(0.019)	(0.011)
LOWLARGEFRAC peer selling pressure (x100)		-0.1876***	-0.1641***	-0.1041***	-0.1860***
		(0.016)	(0.014)	(0.033)	(0.019)
(Time varying) fund controls	NO	NO	YES	YES	YES
Fund fixed effects	YES	YES	YES	YES	YES
Month fixed effects	YES	YES	YES	YES	YES
Observations	53,045	53,045	53,045	16,640	36,405
R-squared	0.159	0.163	0.299	0.306	0.303

Panel A: Periods with Aggregate Fund Flows in Bottom Decile



Panel B: Fund-Periods with Individual Fund Flows in Bottom Quintile

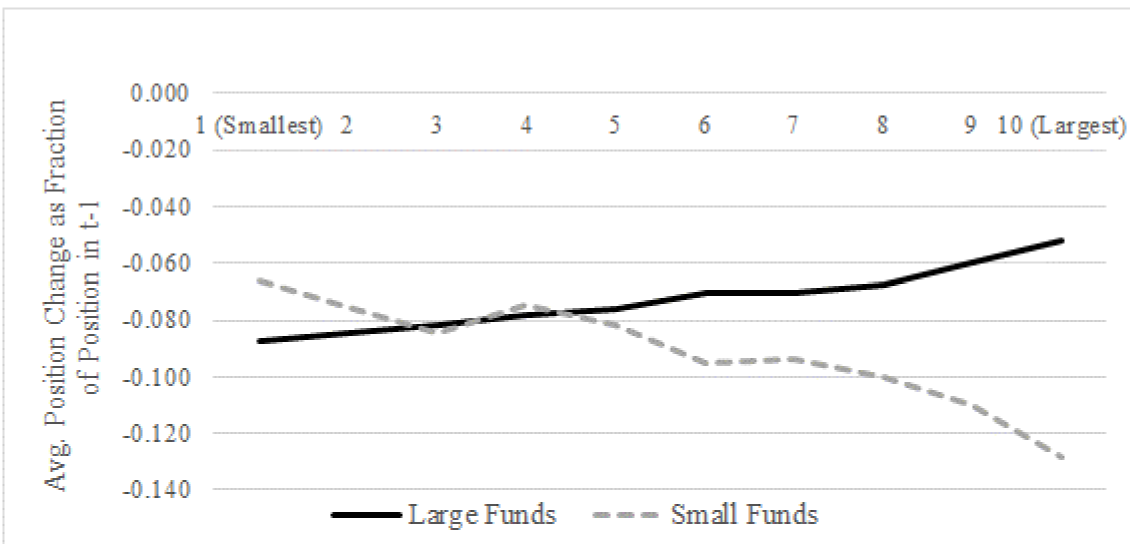
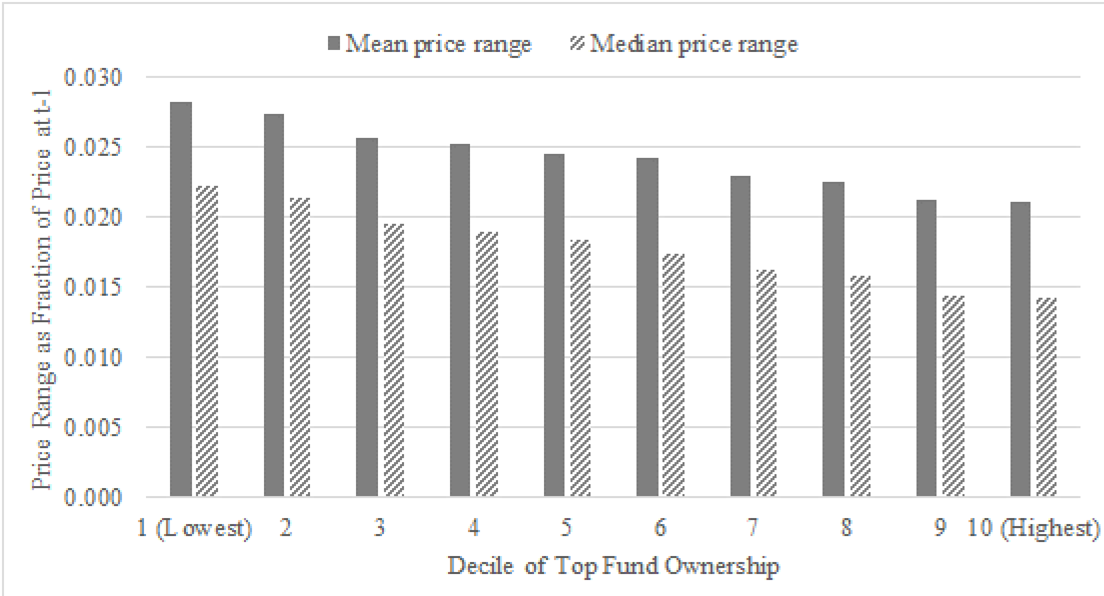


Figure 1. Fund position changes in turmoil periods by deciles of portfolio share. This figure presents average fund position changes, as a fraction of the bond's position on the previous report date. The portfolio share ranking is computed by sorting all corporate bond positions within a fund portfolio at *t*-1 into deciles. Panel A includes only position changes (inclusive of zeros) during the periods in which the aggregate flows to all taxable bond mutual funds are in the bottom decile during 2003 – 2019. Panel B includes only position changes (inclusive of zeros) associated with fund-period observations for which the individual fund flows are in the bottom quintile, based on pooled sorting across all fund-period observations. Solid black lines represent position changes for large funds, defined as funds whose TNA is in the top quintile on each report date. Dashed gray lines represent position changes for small funds, defined as funds whose TNA is in the bottom quintile on each report date. Detailed variable definitions are in the Appendix.

Panel A: Investment-Grade Bonds



Panel B: High-Yield Bonds

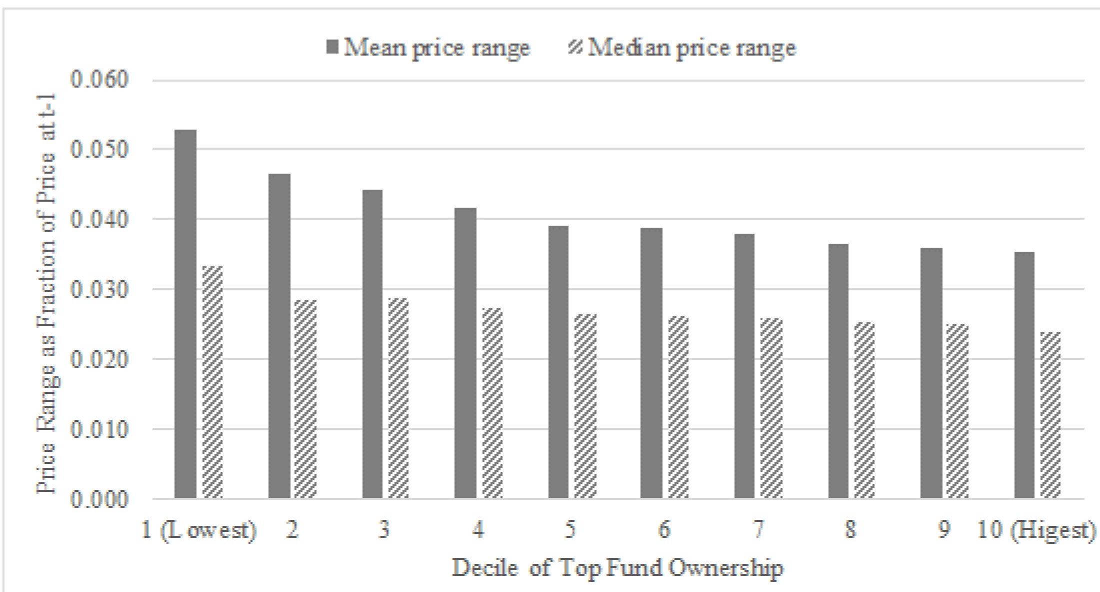


Figure 2. Bond price volatility by decile of top fund ownership. This figure presents the bond price volatility, measured as the average monthly bond price range, divided by the price at the end of previous month, by deciles of the top fund ownership. In each month, corporate bonds with available price range data are sorted into deciles by top fund ownership, with decile 1 (10) being the lowest (highest). Panel A includes only investment-grade corporate bonds. Panel B includes only high-yield corporate bonds. Solid gray bars represent the means. Patterned gray bars represent the medians. Detailed variable definitions are in the Appendix.

Internet Appendix for
Bond Price Fragility and the Structure of the Mutual Fund Industry

Table IA.1

Robustness Results for Table 2

Fund Trading during Periods of Financial Turmoil and the Fund's Share of an Outstanding Bond Issue

This table reports OLS estimates for panel regressions of fund position changes in turmoil periods on fund position size. Financial turmoil is measured using aggregate flows to all taxable bond mutual funds during a month. The samples in columns (1) – (3) differ from the samples in Table 2 in that they include only the periods in which the aggregate flows are in the bottom 5% during 1/2003 – 12/2019. The samples in columns (4) – (6) differ from the samples in Table 2 in that they include only positions of funds that allocate at least 60% of their portfolios in corporate bonds. The dependent variable, position change, is measured as a fraction of the position on the previous report date, and hence the samples include only existing positions. All other variables are defined in the Appendix of the main paper. All columns include fund-reporting period and bond-reporting period fixed effects. Standard errors, double-clustered by fund family and reporting period, are in parentheses. $*$, $**$, and $***$ refer to statistical significance at 10%, 5%, and 1% levels.

	Aggregate Flows in Bottom 5%. Allocation to Corporate Bonds ≥ 50%			Aggregate Flows in Bottom 10%. Allocation to Corporate Bonds ≥ 60%		
	(1)	(2)	(3)	(4)	(5)	(6)
	ALL	IG	HY	ALL	IG	HY
Top decile of fund position size	0.0150**	0.0077*	0.0180**	0.0137**	0.0089**	0.0145**
	(0.006)	(0.004)	(0.007)	(0.006)	(0.004)	(0.007)
Fund x Period fixed effects	YES	YES	YES	YES	YES	YES
Bond x Period fixed effects	YES	YES	YES	YES	YES	YES
Observations	476,649	173,499	303,150	573,773	157,044	416,729
R-squared	0.350	0.415	0.348	0.357	0.437	0.352

Table IA.2

Robustness Results for Table 6

The Cross-Section of Bond Returns and Ownership Concentration during Financial Turmoil

This table reports OLS estimates for panel regressions of bond returns on proxies for market turmoil, ownership of the top 2 funds, and their interaction. For each bond-month observation, the dependent variable, bond return, is calculated as the percentage change in VWAP of the bond from the last day on which there are transactions in the previous month to the last day on which there are transactions in the current month. Only returns calculated from VWAP in the last 10 days of each month are used. In Panel A, the degree of turmoil is captured by FIFS. In Panel B, the degree of turmoil is captured by an indicator variable that equals one for calendar months in which aggregate flows to all taxable bond mutual funds are in the bottom decile during 1/2003 – 12/2019. All variables are defined in the Appendix of the main paper. All columns in both panels include market and bond controls as listed in Table 6, Panel A. All columns in both panels, except column (5), also include month and issuer fixed effects. Column (5) in both panels includes issuer-month fixed effects. Standard errors, clustered by month, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

Panel A: Turmoil Captured by Flow-Induced Fire Sales

	(1)	(2)	(3)	(4)	(5)	(6)
	ALL	ALL	IG	HY	HY	HY
Flow induced fire sales (FIFS)	-1.3602***	-1.5733***	-0.6198	-1.5595***	-1.1021***	-0.6701
	(0.241)	(0.426)	(0.481)	(0.334)	(0.250)	(0.619)
Top 2 fund ownership		-0.0017	-0.0023	-0.0010	-0.0074***	-0.0009
		(0.003)	(0.002)	(0.004)	(0.003)	(0.004)
FIFS x Top 2 fund ownership		4.3530	3.2904	5.7415***	3.0827*	4.2600**
		(2.695)	(2.698)	(2.039)	(1.745)	(1.965)
FIFS x JLSW fragility						-21.4517*
						(11.604)
Market controls	YES	YES	YES	YES	YES	YES
Bond controls	YES	YES	YES	YES	YES	YES
Issuer fixed effects	YES	YES	YES	YES	YES	YES
Month fixed effects	YES	YES	YES	YES	YES	YES
Issuer x Month fixed effects	NO	NO	NO	NO	YES	NO
Observations	917,167	917,167	646,365	270,802	189,995	270,802
R-squared	0.351	0.351	0.430	0.309	0.778	0.309

Table IA.2 *–continued*

Panel B: Turmoil Defined as Periods with Aggregate Flows to All Taxable Bond Funds Being in the Bottom Decile

	(1)	(2)	(3)	(4)	(5)	(6)
	ALL	ALL	IG	HY	HY	HY
Top 2 fund ownership		0.0009	0.0033	-0.0036	-0.0071**	-0.0030
		(0.003)	(0.004)	(0.002)	(0.003)	(0.002)
Aggregate flow D1 (AFD1)		0.0247*	0.0089	0.0305***	0.0372**	0.0254***
x Top 2 fund ownership		(0.014)	(0.021)	(0.011)	(0.016)	(0.009)
AFD1 x Mutual fund ownership	-0.0152**	-0.0214**	-0.0048	-0.0402***	-0.0266**	-0.0354***
	(0.007)	(0.011)	(0.013)	(0.011)	(0.010)	(0.010)
AFD1 x JLSW fragility						-0.1215**
						(0.058)
Market controls	YES	YES	YES	YES	YES	YES
Bond controls	YES	YES	YES	YES	YES	YES
Issuer fixed effects	YES	YES	YES	YES	YES	YES
Month fixed effects	YES	YES	YES	YES	YES	YES
Issuer x Month fixed effects	NO	NO	NO	NO	YES	NO
Observations	917,167	917,167	646,365	270,802	189,995	270,802
R-squared	0.350	0.350	0.430	0.309	0.778	0.309