

Large Funds and Corporate Bond Market Fragility

Yong Chen, Mengqiao Du, Zheng Sun*

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Abstract

The corporate bond fund industry is characterized by a high concentration of capital, with a significant portion of assets managed by large funds. We find that while trades by large funds generally stabilize the corporate bond market, they introduce fragility to the underlying bonds during periods of low market liquidity. Using a quasi-experiment that exogenously alters the size of trading funds, we show that bond return volatility decreases (increases) with trading fund size when market liquidity is high (low). Large funds are more likely to reach for yield by holding illiquid bonds. Furthermore, while large funds tend to provide liquidity during normal times, they switch to demanding liquidity during market stress. Overall, our findings highlight the important yet subtle role that large funds play in bond market fragility, akin to a “dam effect.”

JEL Classification: G10, G12, G23

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1 Introduction

How intermediaries impact financial stability is a central issue for both market participants and policymakers. Institutions such as banks and mutual funds perform essential functions in financial markets, yet history has repeatedly exposed their vulnerability. Notably, the 2008-2009 financial crisis, which saw the failure and government bailouts of several major financial institutions, underscored serious concerns about the influence of large institutions on market stability. So far, academic attention has focused on large banks and equity mutual funds.¹ However, little is known about the role of large bond funds in market stability. In this paper, we examine the impact of large corporate bond funds on the fragility of the corporate bond market.

Our study is motivated by three key observations. First, over the past three decades, bond funds have grown substantially, becoming major players in the bond market.² Second, prior research identifies mutual funds' vulnerability to investor runs due to the nexus of asset illiquidity and open-end structure (Chen, Goldstein, and Jiang (2010); Goldstein, Jiang, and Ng (2017); Zeng (2017)). This vulnerability, especially in bond funds, can amplify bond price fragility (Jiang, Li, Sun, and Wang (2022)). Third and importantly, the corporate bond fund industry exhibits a high concentration of capital. As shown in Figure 1, the ten largest funds collectively hold 36% of the total assets of corporate bond funds, compared to 22% for equity funds. Moreover, the average Herfindahl–Hirschman index, a measure of concentration, is more than four times higher among corporate bond funds than among equity funds. Thus, large funds likely play a crucial role in the bond market.

While theories have examined how investor trading impacts asset prices, the influence of large funds on bond market stability remains unclear. On the one hand, corporate bonds, traded in over-the-counter markets, are subject to search frictions (e.g., Duffie, Garleanu, and

¹See, e.g., Acharya, Pedersen, Philippon, and Richardson (2017) and Ben-David, Franzoni, Moussawi, and Sedunov (2021). Related papers are discussed in more detail below in this section.

²According to the ICI Fact Book, the total value of corporate bonds managed by mutual funds rose from \$62.9 billion in 1991 to \$2.9 trillion in 2020. These numbers indicate an average annual growth rate of 14.1%, outpacing the 11.9% growth rate of US equity mutual funds over the same period.

Pedersen (2005)). If large funds reduce search costs, they could enhance market liquidity and reduce price volatility. On the other hand, the granular view (e.g., Gabaix (2011)) suggests that large funds may execute substantial sales during periods of capital outflows, creating considerable challenges for market-making especially under market stress, which introduces fragility to the market.³ Therefore, the impact of fund size on bond market fragility is largely an empirical question.

How large funds influence financial stability has also been a point of contention among regulators and practitioners. For example, the Office of Financial Research (2013) raises concerns that “Distress at a large asset manager could amplify or transmit risks to other parts of the financial system.” Similarly, the American Economic Liberties Project (Steele (2020)) emphasizes that “The size, interconnectedness, and concentration of large fund companies do not just impact industrial companies, they also have implications for the functioning of our financial system.” However, Investment Company Institute (2014) argues that mutual funds do not pose systemic risk, citing factors such as low leverage, a stable investor base, and a robust regulatory structure. These contrasting views underscore the need for a comprehensive investigation into the effects of large funds on market stability.

Our paper provides the first systematic study on the role large corporate bond funds play in stabilizing the bond market. Our baseline analysis shows that while trades by large funds stabilize bond prices in liquid markets, they introduce price fragility in illiquid markets. Specifically, bond return volatility decreases with trading fund size (measured as the average size of bond funds trading the bond) in relatively liquid markets, when median bond illiquidity, based on the gamma measure of Bao, Pan, and Wang (2011), falls below the top-decile level. However, when median illiquidity exceeds this top-decile threshold, the return volatility of bonds traded by large funds (those in the top quintile by size) is 0.47 percentage points

³The granular theory argues that when the distribution of firm size is fat-tailed, idiosyncratic shocks to large firms can affect the aggregate economy. Similarly, trades by large institutions in illiquid markets can cause significant spikes in return volatility even without information about fundamentals. For more details, see also Gabaix, Gopikrishnan, Plerou, and Stanley (2006) and Ben-David, Franzoni, Moussawi, and Sedunov (2021), among others.

higher than that of bonds traded by small funds (those in the bottom quintile), representing 58.7% of the median bond return volatility. Similar patterns emerge when comparing normal periods with market downturns, as bond return volatility increases with trading fund size during recessions and high VIX periods.

We further establish a causal relation between trading fund size and bond price fragility by exploiting a quasi-experiment involving Bill Gross’s departure from the Pacific Investment Management Company (PIMCO) in September 2014. As co-founder and an influential bond fund manager, his departure—particularly the timing—was arguably unrelated to the underlying bond market but led to a dramatic decrease in the fund size. We find that after his departure, the return volatility of bonds traded by PIMCO increased relative to those not traded by PIMCO, suggesting that the reduced fund size weakened its stabilizing role during normal times. Furthermore, the fragility introduced by PIMCO’s trades during illiquid markets became milder after the fund size shrank. These findings reinforce our baseline results that large funds’ trades decrease bond return volatility during normal times but increase volatility during illiquid markets.

To identify the mechanisms underlying the relation between fund size and price fragility, we first examine fund holdings to understand liquidity preferences. We posit that large funds seek higher yields, often by “reaching for yield” as documented in Choi and Kronlund (2018), and tend to hold illiquid assets due to their bargaining power and lower search costs. Consistent with this idea, we find that large funds, on average, hold a larger proportion of illiquid bonds than small funds. While illiquid holdings boost returns in normal market conditions, they increase redemption risk during stress. This dynamic helps explain the differing impact of fund size on price stability across market conditions.

We also analyze bond funds’ liquidity supply and demand tendencies as a function of fund size to further understand their impact on the underlying market. Using the liquidity provision measure of Anand, Jotikasthira, and Venkataraman (2021), we find that large funds are generally more likely to conduct liquidity-supplying trades than small funds, suggesting

that their trades can enhance market liquidity and hence reduce price volatility in normal times. However, when the aggregate market liquidity is low, this relationship reverses, with large funds demanding liquidity more than small funds. This time-varying liquidity supply behavior provides additional insight into why large funds tend to stabilize prices during normal times but contribute to price instability during market stress.

Next, we find that large and small funds differ in liquidity management during redemptions. Small funds follow a pecking order of liquidation (Jiang, Li, and Wang (2021)), selling only a small proportion of illiquid bonds when experiencing capital outflows. In contrast, large funds' liquidation decisions are less influenced by bond liquidity when facing outflows. To understand the absence of a liquidity pecking order in large funds, we examine their liquidity management in normal and illiquid markets separately. Unlike small funds, which sell primarily liquid assets during outflows in both market conditions, large funds adopt a more dynamic approach: during normal times, they first sell more liquid assets, similar to small funds; however, during illiquid markets, they sell both liquid and illiquid assets, thereby maintaining their portfolios' liquidity levels. Consequently, consistent with the granular view (Gabaix (2011)), the sales of illiquid bonds by large funds during adverse conditions exacerbate market illiquidity, contributing to price instability.

Finally, we examine the implications of liquidity preference for bond fund performance. Holding illiquid bonds can enhance fund returns due to the liquidity premium, but it may also hurt performance if the prices of illiquid assets deteriorate during periods of low market liquidity. Consistent with this intuition, we find that large funds outperform small funds on average; however, they underperform small funds during illiquid market conditions. Furthermore, when performance is adjusted for an illiquidity factor, the positive relationship between fund size and performance largely disappears.

In summary, motivated by the concentration of capital in large funds, we examine the impact of fund size on bond price fragility. While large funds generally stabilize the market,

they introduce fragility during periods of stress, akin to a “dam effect.”⁴ Their liquidity management sheds light on the time-varying effects of fund size on bond price dynamics: the liquidation of illiquid bonds during market stress poses risks to stability. These findings carry important policy implications, suggesting that efforts to maintain the “financial plumbing” of the bond market during market stress should focus on large funds.

Our paper contributes to several strands of literature. First, our paper adds to existing studies on mutual fund fragility and its impact on the underlying market (Chen, Goldstein, and Jiang (2010); Goldstein, Jiang, and Ng (2017); Zeng (2017)). Recently, Falato, Goldstein, and Hortaçsu (2021a) show that asset illiquidity and vulnerability to fire sales play a key role in the large outflows of corporate bond funds during the Covid-19 crisis. Jiang, Li, Sun, and Wang (2022) find evidence of bond fund fragility spreading to underlying bonds, while Ma, Xiao, and Zeng (2022) and Jiang, Li, and Wang (2021) show how liquidation management exacerbates selling pressure during market downturns. Li, O’Hara, and Zhou (2024) examine how interactions between mutual funds and dealers contribute to bond fragility. Several papers study bond price dynamics following fund fire sales (e.g., Choi, Hoseinzade, Shin, and Tehranian (2020); Falato, Hortacsu, Li, and Shin (2021b)). Giannetti and Jotikasthira (2024) examine the effects of bond fund ownership concentration on bond price fragility. We extend this line of research by showing that the spillover of fragility from bond funds to the underlying bonds varies with fund size and market conditions.

Second, our study relates to the literature on intermediary asset pricing, which links the health of intermediaries to asset prices. He and Krishnamurthy (2013) introduce a model in which asset prices are influenced by intermediaries’ equity capital constraint. Empirically, He, Kelly, and Manela (2017) show that an intermediary factor, constructed to capture intermediaries’ equity capital ratio, helps explain the cross-section of returns across many asset classes. Relatedly, Hu, Pan, and Wang (2013) explore the connection between arbitrage capital, market-wide liquidity, and price deviations from fundamental values, while Aragon

⁴A dam can hold and regulate water flow under normal conditions but may cause flooding if it fails under extreme pressure.

and Strahan (2012) find that funding liquidity shocks to hedge funds impact the liquidity of stocks held by these funds. Our paper differs from the prior work in two main ways: while previous studies focus on intermediaries’ funding liquidity, we examine fund responses to flows—another critical aspect of financial health—and we highlight the time-varying impact of large intermediaries on asset prices.

Third, our paper is also related to the studies on how institution size affects asset prices, which has primarily focus on the equity market. For example, Kojien and Yogo (2019) find that large institutions contribute much less to stock market volatility than small institutions and households during the 2008-2009 financial crisis. In contrast, Gabaix, Gopikrishnan, Plerou, and Stanley (2006) and Ben-David, Franzoni, Moussawi, and Sedunov (2021) argue that trades by large institutions in illiquid markets generate excessive stock volatility. Different from existing papers centered on equity markets, our study provides the first analysis of how institution size affects corporate bond volatility and reveals the varying impact of large funds depending on market conditions.

Finally, our paper contributes to the literature on economies of scale in mutual funds. Prior studies find that US equity funds face decreasing returns to scale both at the fund level (e.g., Chen, Hong, Huang, and Kubik (2004); Yan (2008); Zhu (2018)) and the fund industry level (Pastor, Stambaugh, and Taylor (2015)). In contrast, we find evidence of increasing returns to scale in bond funds, mainly due to their holding of illiquid bonds. Our finding of a positive relation between bond fund size and performance is similar to Yan (2020), though we show that this size-performance relation varies with market conditions and weakens when considering the liquidity premium in performance measurement.

The paper proceeds as follows. Section 2 describes our sample of bond funds and main variables. Section 3 presents results about the impact of fund size on bond price fragility. Section 4 investigates underlying mechanisms. Section 5 examines the relation between fund size and performance. Finally, Section 6 concludes. Auxiliary tests are provided in the Internet Appendix.

2 Data and measures

In this section, we first describe our sample of corporate bond funds and their bond holdings. Next, we construct key variables related to trading fund size, corporate bond liquidity, liquidity provision of bond funds, and fund performance to be used in our empirical analyses. Finally, we present summary statistics on the characteristics of corporate bonds and bond funds in the sample. All the variables are also described in detail in Appendix I.

2.1 The sample

Our sample is obtained by merging four different databases on bond funds and corporate bonds. We start with the CRSP survivor-bias-free mutual fund database, from which we include all actively managed, open-end U.S. domestic corporate bond mutual funds in the sample based on fund objective codes.⁵ The database contains information on monthly fund returns, as well as fund characteristics such as total net assets (TNA), expense ratio, and first offer date. We aggregate all share classes of the same fund to avoid multiple counting. The bond fund sample includes 1,318 distinct funds and 171,220 fund-month observations over the period from 1991 to 2018.⁶

We then merge the CRSP mutual fund data with Morningstar’s historical bond holdings data for bond funds from 2000 to 2018 using TICKER and CUSIP as mutual fund identifiers. In particular, Morningstar provides information about the number of corporate bond shares held by bond funds at a monthly frequency. As a result, we have fund-level information on bond holdings.

Next, we merge the mutual fund holdings data with corporate bond information including maturity, the amount outstanding, credit rating, and coupon rate from Mergent’s Fixed

⁵Specifically, we include funds with the CRSP objective codes starting with “IC” or the Lipper objective codes of “HY”, “A”, “BBB”, “IID”, “SID”, or “SII”. Index funds, exchange-traded funds (ETFs), and exchange-traded notes (ETNs) are excluded from the sample.

⁶For comparison purposes, we also collect the sample of actively managed, open-end U.S. equity mutual funds from the CRSP mutual fund database and present their features in Figure 1.

Income Securities Database (FISD). These variables of bond characteristics are also at a monthly frequency, except for coupon rate which typically is fixed for each bond.

Finally, we collect corporate bond transactions and prices data from the enhanced Trade Reporting and Compliance Engine (TRACE). Following the literature, we remove canceled and corrected trades and exclude commission trades and inter-dealer trades. Using the TRACE data, we calculate dealer inventory cycles and construct bond liquidity measures. Since the TRACE data became available in 2002, our dataset spans the period from 2002 to 2018 for the analyses involving bond liquidity, and consequently the final bond fund sample includes 826 distinct funds.

2.2 Construction of main variables

A. Trading fund size

We propose a measure, called trading fund size, to capture the average size of bond funds that trade a given corporate bond in each month as follows:

$$Trading\ fund\ size_{i,t} = \sum_{j=1}^J w_{i,j,t} \times TNA_{j,t}. \quad (1)$$

$TNA_{j,t}$ is the total net assets of fund j that trades bond i in month t . $w_{i,j,t}$ is the weight calculated as $\frac{|Shares\ held_{i,j,t} - Shares\ held_{i,j,t-1}|}{\sum_{j=1}^J |Shares\ held_{i,j,t} - Shares\ held_{i,j,t-1}|}$, where $Shares\ held_{i,j,t}$ is the number of shares of bond i held by fund j in month t . The change in the number of shares held reflects the fund's trading on the bond. Using bond fund holdings data, we calculate *Trading fund size* at the bond level as the weighted average of the sizes of funds trading the bond, with weights based on the volume each fund trades during the month. Note that the weight is scaled by the total shares traded by all funds, thereby controlling for the effect of bond funds' trading volume.⁷ A large value of *Trading fund size* indicates that the bond is predominantly traded

⁷As explained below, our bond-level regressions also include total trading volume as a control variable.

by large funds during the month. In our empirical analyses, we use the natural log of *Trading fund size* as an independent variable in the regressions.

As a numerical example, suppose there are two bonds, A and B, and two funds of different sizes: Fund L with a TNA of \$1 billion and Fund S with a TNA of \$10 million. For simplicity, Bonds A and B are traded solely by Funds L and S, with a total trading volume of 10,000. A dominant portion of shares (9,000) of Bond A are traded by Fund L, while Fund S handles a small portion (1,000). Conversely, for Bond B, 1,000 shares are traded by Fund L and 9,000 shares by Fund S. As a result, the trading fund size is 901 ($0.9 \times 1,000 + 0.1 \times 10$) for Bond A, whereas it is 109 ($0.1 \times 1,000 + 0.9 \times 10$) for Bond B. This example illustrates that the value of trading fund size is significantly higher only when a large portion of the bond's trading volume is from large funds. In contrast, when large funds contribute a minor share of the trading volume or small funds trade a large share, as with Bond B, the value of trading fund size is relatively low. Note that in this example, both bonds have the same total trading volume, the same number of trades by mutual funds, and the same trade size per transaction. Thus, this example clarifies that the trading fund size measure captures the influence of fund size in bond trading activity rather than the total trading volume or trade size per transaction.⁸

⁸One may argue that in scenarios where large funds trade a substantive but not overwhelming proportion of a bond, this measure may fail to distinguish the trading activities of a single large fund and a single small fund from those of several medium-sized funds. Consider, for example, two bonds, A and B, both with the same total trading volume of 10,000. Bond A is traded by a large fund with a TNA of \$1 billion and a small fund with a TNA of \$10 million, with the large fund trading a share of 60%. Consequently, the trading fund size for Bond A is calculated as $0.6 \times 1,000 + 0.4 \times 10 = 604$. On the other hand, Bond B is traded by two medium-sized funds, each with a TNA of \$604 million, and one of them trades a share of 60%. Thus, the trading fund size for Bond B is $0.6 \times 604 + 0.4 \times 604 = 604$, identical to that of Bond A. However, such a scenario seems unlikely in our sample. The histogram (Figure IA1 in the Internet Appendix), which illustrates the distribution of the weight component in Equation 1, reveals a bimodal distribution. This suggests that for many bonds, there is typically one or a few dominant funds—likely large funds—that trade a significant share. To further explore the possibility of the nonlinear effect of fund size on market stability, we replace $TNA_{j,t}$ in Equation (1) with $TNA_{j,t}^2$, which assigns a disproportionately large value if the bond is traded by large funds. Our test using this alternative measure yields similar results both qualitatively and quantitatively, as reported in Table IA1 in the Internet Appendix.

B. Corporate bond illiquidity

To quantify illiquidity of corporate bonds in our empirical analyses, we adopt four widely-used measures in the literature, namely the Amihud (2002) illiquidity measure, the gamma measure of Bao, Pan, and Wang (2011), imputed roundtrip costs (IRC) as in Dick-Nielsen, Feldhütter, and Lando (2012), and the bid-ask spread.

The Amihud measure captures average price changes relative to the trading volume of an asset. When computing the Amihud measure for corporate bonds, we remove a trade if its price change is more than 20% from the previous trade within the same day. We then calculate the per-transaction Amihud measure as the absolute value of bond return divided by trading volume. Finally, we take the average value across all trades within a given month and require at least two trades in the month to report the value.

Following Bao, Pan, and Wang (2011), we compute the gamma measure of bond illiquidity as the auto-covariance of daily price changes within each month:

$$\gamma = -Cov(p_{i,t} - p_{i,t-1}, p_{i,t+1} - p_{i,t}), \quad (2)$$

where $p_{i,t}$ is daily bond prices. The lack of liquidity in a bond gives rise to transitory price movements, leading to negatively serially correlated price changes. As the negation of the first-order auto-covariance of bond price changes, the gamma measure increases with the magnitude of the transitory component and thus captures illiquidity of the bond.

As another measure of bond illiquidity, we calculate the imputed roundtrip cost, denoted as IRC (%), using the definition in Dick-Nielsen, Feldhütter, and Lando (2012). Intuitively, we can identify roundtrip transactions as the trades in a given bond with the same trade size taking place on the same day. For each roundtrip transaction, we calculate the IRC as the difference between the largest and the smallest prices scaled by the largest price in the transaction. A daily estimate of roundtrip costs is the average of roundtrip costs on that day for different trade sizes, and we calculate monthly roundtrip costs by averaging over daily estimates.

Finally, bid-ask spread (%) is the same-bond-same-day effective bid-ask spread, which equals the difference between average buy prices and average sell prices of transactions for the same bond on the same day (Hong and Warga (2000)).

Across all four measures, the higher the value is, the more illiquid the bond is. In our empirical analyses, all measures are winsorized at the 1% and 99% levels to reduce the impact of outliers. In addition, we compute bond funds' holding illiquidity at the fund-month level by taking the holdings-weighted average of the measures for each fund's bond holdings.

C. Fund liquidity supply

Following Anand, Jotikasthira, and Venkataraman (2021), we calculate the liquidity supply measure, LS_score , to quantify a fund's capacity to supply or demand liquidity in the corporate bond market. First, using TRACE transaction data, we compute dealer inventory cycles, where a cycle starts when dealers' cumulative trade with customers (i.e., the inventory) crosses zero and ends when it crosses zero again in the opposite direction. As in Anand, Jotikasthira, and Venkataraman (2021), we use a 3-month rolling window for trade accumulation and require a minimum of \$10 million for the largest cumulative inventory (i.e., either positive or negative in par value terms) during the cycle and a cycle length of at least 5 calendar days to ensure that the inventory is material. We then classify fund trades as liquidity-supplying if the fund trades in the same direction as dealers and compute LS_score as follows:

$$LS_score_{j,t} = \frac{Liquidity\ supplied_{j,t} - Liquidity\ demanded_{j,t}}{Liquidity\ supplied_{j,t} + Liquidity\ demanded_{j,t} + Unclassified_{j,t}}. \quad (3)$$

A fund's trades are liquidity-supplying (liquidity-demanding) when the fund purchases a bond during a period when dealers face customer selling (buying). Thus, LS_score captures both liquidity-supplying and liquidity-demanding activities of a fund during each holding period.

D. Fund performance

To measure performance for corporate bond funds, we use the alpha estimated from time-series regressions over a 36-month rolling window for each fund. Following the literature (e.g., Elton, Gruber, and Blake (1995); Chen and Qin (2017); Goldstein, Jiang, and Ng (2017)), we use three sets of benchmark factors to estimate fund alpha.

First, we estimate *bond and equity market alpha* by regressing the excess returns (in excess of the one-month T-bill rate) of a given fund on the excess returns of the Vanguard total bond market index and the CRSP value-weighted stock market index, which are proxies for aggregate bond and stock market returns, respectively.

Second, we estimate *four-factor alpha* by regressing bond fund excess returns on 1) the excess return of the CRSP value-weighted stock market index, 2) the excess return of the U.S. aggregate bond market index, 3) the return spread between the high-yield bond index and the intermediate government bond index, and 4) the return spread between the GNMA mortgage-backed security index and the intermediate government bond index.

Finally, we construct tradable benchmarks using Vanguard bond market index funds, including 1) the Vanguard total bond market index fund (VBMFX), 2) the Vanguard short-term bond index fund (VBISX), 3) the Vanguard intermediate-term bond index fund (VBIIX), and 4) the Vanguard long-term bond index fund (VBLTX), in a fashion similar to the performance measure that Berk and van Binsbergen (2015) build for equity funds. We estimate *Vanguard alpha* by regressing bond fund excess returns on the excess returns of these Vanguard index funds.

2.3 Summary statistics

Panel A of Table 1 summarizes corporate bond-level variables including trading fund size, illiquidity measures, bond return, bond return volatility, credit rating, and coupon rate, among others. As discussed above, trading fund size is the trade-amount weighted average of bond fund size for each corporate bond. In our corporate bond sample, the trading fund

size is \$5,713 million on average and right-skewed with a smaller median of \$1,497 million. On average, corporate bonds realize a monthly return of 0.69%, while the weekly return volatility is about 1.33% in a month.

Panel B of the table reports variables for the corporate bond fund sample. On average, a bond fund has total net assets of \$1,230 million, an expense ratio of 0.82%, and an age of 13 years. The distribution of fund size is right-skewed with the mean larger than the median. The average value of the three alpha measures, as defined in Section 2.2, ranges from 0.43% to 2.58% per year. Consistent with Anand, Jotikasthira, and Venkataraman (2021), bond fund trades are liquidity-demanding on average, with a mean value -0.018 for *LS_score*.

Finally, Panel C contains the value-weighted average of the illiquidity measures based on the corporate bond holdings of the funds. The average bond illiquidity in bond fund holdings is 0.04% per thousand dollars based on the Amihud measure, 0.439 based on the gamma measure, 0.729% based on the roundtrip transaction cost, and 0.828% based on the bid-ask spread.

3 Do large funds introduce price fragility?

In this section, we examine the effect of trades by large funds on the corporate bond market. In particular, we are interested in evaluating whether large funds introduce fragility to the underlying bond market.

3.1 Baseline analyses

We perform baseline regressions to analyze the relationship between trades by large funds and bond fragility. In these analyses, we measure fragility with bond return volatility, an

indicator of price instability.⁹ Specifically, we run monthly panel regressions on individual bonds as follows:¹⁰

$$\begin{aligned} \text{Bond volatility}_{i,t} = & \alpha + \beta_1 \text{Trading fund size}_{i,t-1} + \beta_2 \text{Trading fund size}_{i,t-1} \times \text{Market} \\ & \text{illiquidity}_t + \text{Controls}_{i,t-1} + v_t + \varepsilon_{i,t}, \end{aligned} \tag{4}$$

where $\text{Bond volatility}_{i,t}$ is the standard deviation of corporate bond i 's weekly returns in month t .¹¹ For each bond in the month, Trading fund size is the log of the trade-amount weighted average of total net assets among bond funds that trade the bond in the month. Following Bao, Pan, and Wang (2011), $\text{Market illiquidity}_t$ is defined as the median of the gamma measure across all corporate bonds in the month.¹²

In the regressions, we control for bond return volatility from the previous month in one specification. Since large funds typically trade at higher volumes than small funds and trading volume may impact return volatility, we control for total trading volume to ensure that the tests isolate the impact of trading fund size on bond price dynamics. In addition, we include one-month lagged values of holdings-based illiquidity as measured by IRC (which Jiang, Li, Sun, and Wang (2022) show predicts bond return volatility), the IRC illiquidity measure, bond return, maturity, bond size (as measured by the amount outstanding), bond credit rating, and coupon rate as control variables.¹³ Furthermore, we consider model spec-

⁹Return volatility is a well-accepted measure of price instability in the literature (e.g., Greenwood and Thesmar (2011); Falato, Hortacsu, Li, and Shin (2021b)). Prior research also shows that return volatility is significantly related to bond returns and illiquidity in the corporate bond market; see, e.g., Bao and Pan (2013).

¹⁰Our results are robust when we perform the regression analyses at the quarterly frequency, as shown in Table IA2 in the Internet Appendix.

¹¹We use lagged trading fund size to partially address endogeneity concerns of reverse causality. Table IA3 in the Internet Appendix shows that the results are robust to contemporaneous regressions.

¹²As noted in Bao, Pan, and Wang (2011), the median value is less sensitive to highly illiquid bonds that are most severely affected by credit market turmoils, compared with the mean value of the gamma measure.

¹³Our results are robust to using alternative bond illiquidity measures, i.e., the Amihud measure, Gamma, IRC, and bid-ask spread, as control variables. In the table, we report the regressions with IRC as the control variable for bond illiquidity.

ifications with or without bond fixed effects, while controlling for time fixed effects in all specifications.¹⁴ Standard errors are clustered by bond and time.

Panel A of Table 2 presents the regression results. We find robust evidence that bond return volatility decreases with trading fund size when the market is liquid but increases with trading fund size when the market is illiquid. Specifically, when the aggregate corporate bond market is relatively liquid with the market-wide illiquidity measure lower than 0.16 (i.e., 0.015/0.095), trading fund size has a negative association with bond return volatility.¹⁵ This is consistent with the idea that large funds, generally with greater market power and lower search costs, can enhance market liquidity and reduce price variability when trading bonds. However, when the market-wide illiquidity measure is above that value, trading fund size is positively related to bond return volatility. Even in a stricter model specification that controls for lagged bond return volatility, the relation between trading fund size and bond return volatility remains economically and statistically significant at the 1% level.¹⁶

To ease the interpretation of economic significance, we consider an alternative regression specification replacing the continuous variable *Trading fund size* with its quintile rank (with the bottom quintile as the reference group) and replacing *Market illiquidity* with an indicator of whether *Market illiquidity* falls in the top decile in the sample.

Panel B of Table 2 presents the results. When the bond market is liquid, the return volatility of bonds with trading fund size in the fourth and the top quintile appears smaller,

¹⁴Ideally, our dataset would enable us to further account for firm fundamentals that influence bond trading and volatility by controlling for issuer $\times$ time fixed effects. However, we observe that the variation in trading fund size predominantly arises across issuers rather than within issuers. Specifically, the standard deviation of trading fund size within an issuer-month exhibits a mean of 5.50 and a median of 2, compared with the standard deviation of the variable within a month across all issuers presenting a mean of 258.52 and a median of 234. This small within-issuer-month variation is likely due to the fact that bonds issued by the same issuer are likely invested by the same set of mutual funds, as documented in Zhu (2021). Therefore, controlling for issuer-by-time fixed effects would result in too little variation in our explanatory variable.

¹⁵The value 0.16 for market illiquidity corresponds to a fairly illiquid market condition, since it is higher than the 75th percentile (0.137) of monthly market illiquidity as shown in Table 1.

¹⁶Giannetti and Jotikasthira (2024) find that bonds with concentrated ownership have lower return volatility. While *trading fund size* in our paper is positively correlated with *top fund ownership* (with a correlation coefficient of 0.20), the two measures are conceptually different. *Trading fund size* captures bond fund industry concentration, while *top fund ownership* reflects the ownership concentration of a given bond. In Table IA4 in the Internet Appendix, we show that our results are robust after including *Top fund ownership* as a control variable in the regressions.

by 0.068 and 0.031 percentage points respectively, than that of bonds with trading fund size in the bottom quintile (column (1) specification). This difference corresponds to 8.5% (0.068/0.801) and 3.9% (0.031/0.801) of the median level of bond volatility in the sample. However, when market illiquidity falls in the top decile, the volatility of bonds with trading fund size in the fourth and the top quintile becomes larger by 0.181 and 0.470 percentage points, which accounts for 22.6% (0.181/0.801) and 58.7% (0.470/0.801) of the median bond volatility in the sample, respectively. The results therefore suggest that trading fund size has an economically sizable effect on bond return volatility.

For robustness, we construct an alternative measure, called *Holding fund size*, which is the holdings-weighted average of total net assets across bond funds that hold the bond in the month. This measure captures the ownership structure of each bond by bond funds.¹⁷ As reported in Table IA5 in the Internet Appendix, the results from *Holding fund size* are consistent with the baseline results using *Trading fund size*. That is, bond return volatility decreases with holding fund size when the market is liquid but increases with holding fund size when the market is illiquid. However, since it is trades that move bond prices, we prefer to use trading fund size as the main measure in our analyses.¹⁸ In addition, as an alternative measure of bond return volatility, we use an extreme value estimate, i.e., the range of weekly bond prices in the month (e.g., Parkinson (1980)), with the results consistent with the main findings. Fund size has a negative association with bond price range during normal times and a positive association when market is illiquid (see Table IA7 in the Internet Appendix for details).

¹⁷Specifically, holding fund size is calculated as follows: $Holding\ fund\ size_{i,t} = \frac{\sum_{j=1}^J Shares\ held_{i,j,t} \times TNA_{j,t}}{\sum_{j=1}^J Shares\ held_{i,j,t}}$. In the regression analysis, we use the log form of the measure as we do with trading fund size. Statistically speaking, the measure of holding fund size may be more precise, with smaller measurement error, than trading fund size, since when constructing trading fund size, we estimate fund trades by changes of bond holdings from a quarter-end to the next quarter-end and thus ignore interim trades within the quarter (e.g., Kacperczyk, Sialm, and Zheng (2008)). Nonetheless, as discussed above, trading fund size has a more appealing economic meaning in our setting.

¹⁸As shown in Table IA6 in the Internet Appendix, our results are also robust to using the equal-weighted average of bond fund size for a bond to calculate *Trading fund size*.

In the analyses above, we use the median of the gamma measure across all corporate bonds to quantify the aggregate illiquidity in the corporate bond market. To extend our tests to general periods of market stress, we consider two measures of *down market*. The first measure indicates the recession periods based on the U.S. business cycle expansions and contractions data from the National Bureau of Economic Research (NBER). The second measure indicates whether the equity market VIX index is in the top quintile in the sample.¹⁹

Table 3 presents the results. The coefficient on *trading fund size* (the interaction term between *trading fund size* and *down market*) is negative (positive) and statistically significant at the 1% level. Thus, with both down market measures, we find that trades by large bond funds significantly increase bond return volatility during market downturns while decreasing bond return volatility during normal times.

Overall, these results suggest a significant yet subtle relation between fund size and bond price fragility: trades by large funds reduce bond return volatility during normal times but increase return volatility under adverse market conditions.

3.2 Evidence from Bill Gross leaving PIMCO

While the analyses in the previous subsection control for potential confounding factors that can impact both trading fund size and bond volatility, it is still likely that unobserved factors cause changes to both variables, making it difficult to infer a causal relation. Here, we exploit a shock to the size of PIMCO funds, due to fund manager Bill Gross’s departure, to examine the causal effect of trading fund size on bond return volatility.

PIMCO is one of the largest US investment management firms focusing on active fixed income management. Bill Gross, who co-founded the investment company in 1971 and managed its fixed income investment, announced on September 26, 2014 that he would leave the firm and join Janus Capital Group. Despite indications of his potential departure, whether

¹⁹Table IA8 in the Internet Appendix shows that the results are robust to using TED, the difference between the three-month London Inter-bank Offered Rate (LIBOR) and the three-month T-bill interest rate, as a measure of down market.

and when he would resign could not be fully anticipated by the market. Hence, the announcement still surprised the market, triggering significant fund outflows.²⁰ Within a year of his departure, the total net assets of PIMCO funds dropped by over 50%, from \$202 billion in September 2014 to \$96 billion in September 2015. Since this decrease in fund size is arguably unrelated to bond price fragility, we treat this event as a quasi-experiment to analyze changes in the return volatility of corporate bonds traded by PIMCO funds before and after his departure.²¹

We perform a panel regression using the bond-month sample from September 2013 to September 2015 (i.e., a time window of two years surrounding Bill Gross’s departure) as follows.

$$\begin{aligned}
\text{Bond volatility}_{i,t} = & \alpha + \beta_1 \text{Traded by PIMCO}_{i,t} \times \text{Post}_t \times \text{Market illiquidity}_t + \beta_2 \text{Traded} \\
& \text{by PIMCO}_{i,t} \times \text{Post}_t + \beta_3 \text{Traded by PIMCO}_{i,t} \times \text{Market illiquidity}_t \\
& + \text{Traded by PIMCO}_{i,t} + \text{Controls}_{i,t-1} + v_t + \varepsilon_{i,t},
\end{aligned} \tag{5}$$

where *Traded by PIMCO*_{*i,t*} is a dummy variable equal to one if a bond is traded by PIMCO funds in a given month, and *Post*_{*t*} indicates whether the month is after September 2014. Given the observed decrease in fund size of the PIMCO funds, we use all bonds traded by the PIMCO funds as the treatment group. As before, *Market illiquidity*_{*t*} is the median value of the gamma measure across all corporate bonds in the month. The control variables are the same as in Table 2.

Table 4 reports the regression results. Before Bill Gross’s departure, the return volatility of corporate bonds traded by PIMCO is lower than that of bonds not traded by PIMCO, when market liquidity is high. However, the PIMCO traded bonds’ volatility relative to that of non-PIMCO traded bonds becomes larger with an increase in market illiquidity. This

²⁰See “Bill Gross, King of Bonds, Abruptly Leaves Mutual Fund Giant PIMCO,” *The New York Times*, September 26, 2014. <https://archive.nytimes.com/dealbook.nytimes.com/2014/09/26/william-gross-leaves-pimco-to-join-janus/>

²¹Recently, Choi, Dasgupta, and Oh (2023a) and Zhu (2021) also use the same event as an unexpected shock to fund flows.

finding corroborates the results from our baseline analyses and confirms the effect of trading fund size on bond return volatility. After the exogenous reduction in PIMCO’s size, the return volatility of corporate bonds traded by PIMCO increases when bond market liquidity is high. However, when market liquidity is low, the return volatility of PIMCO-traded bonds decreases following the fund size reduction.

Using Bill Gross’s departure as an exogenous shock to fund size has limitations. First, large outflows after his exit may have led PIMCO to liquidate bond holdings, potentially altering bond volatility. However, this would likely increase volatility, making it harder to observe decreased volatility in illiquid markets for PIMCO-traded bonds. Second, the fund’s trading style may have changed after the manager turnover. We address this by excluding the Total Return Fund, which was managed by Gross, and reexamining the volatility of bonds traded by other PIMCO funds. Other PIMCO funds did not change managers but also experienced size reduction following his departure. As shown in Table IA9 in the Internet Appendix, our inference remains unchanged.²²

In sum, while large funds’ trades decrease bond return volatility during liquid markets, they increase bond return volatility significantly when the aggregate bond market is illiquid. Therefore, large funds may introduce fragility to the bond market, especially when the bond market experiences a liquidity crunch. We next examine the underlying mechanisms of the impact.

4 Mechanisms

In this section, we explore the economic mechanisms behind the varying impact of fund size on bond fragility across different market conditions. We begin with relating fund size to the incentive to reach for yield by holding illiquid assets. We then examine funds’ capacity

²²Moreover, excluding PIMCO funds from the baseline analysis shows that the effect of trading fund size on bond volatility is not solely driven by PIMCO’s size change. See Table IA10 in the Internet Appendix for details.

to supply liquidity in the corporate bond market. Finally, we investigate fund liquidation decisions during capital outflows.

4.1 Reaching for yield and holding illiquidity

In this subsection, we consider an economic link between reaching for yield, holding illiquidity, and fund size. Choi and Kronlund (2018) document reaching for yield, a behavior of fund managers tilting portfolio holdings toward bonds with higher yields. This behavior incentivizes funds to hold more illiquid bonds, as illiquid bonds typically offer higher yields (Chen, Lesmond, and Wei (2007)). We posit that large funds have a stronger incentive to acquire illiquid assets due to their negotiating power and lower transaction costs.

To measure reaching for yield, we follow Choi and Kronlund (2018) to calculate the value-weighted average of yield spreads across all corporate bonds held by a fund. The yield spreads are the difference between the yields of a given bond and a benchmark index. The benchmark index takes the average of the ICE BofA US Corporate Index and the ICE BofA US High Yield, obtained from the St. Louis Federal Reserve database.

We first perform a regression of *Reaching for yield* on fund size, while controlling for fund age, expense ratio, fund turnover and flow. We also include time fixed effects, investment objective fixed effects, or investment objective $\times$ time fixed effects in the regression specifications. Panel A of Table 5 contains the regression results. The coefficient on fund size is positive and statistically significant at the 1% level across all regression specifications. Thus, large funds show a stronger tendency to reach for yield.²³

Next, we examine bond funds' portfolio holdings to further understand their liquidity preference. For this purpose, we first estimate the four illiquidity measures (described in Section 2.2) at the corporate bond level and merge them with the Morningstar historical

²³This finding is also consistent with some result in Choi and Kronlund (2018). However, their paper's focus is not on large funds or how fund size is related to reaching for yield.

holdings of bond funds based on the CUSIP. We then compute holdings-based illiquidity as the value-weighted average of corporate bond illiquidity for each fund in a given month.

We regress holdings-based fund illiquidity on the one-month-lagged value of fund size, controlling for fund characteristics. We follow Pastor, Stambaugh, and Taylor (2015) and Zhu (2018) to adopt a recursive-demeaning regression. The recursive-demeaning procedure is designed to address the potential omitted variable problem that unobserved fund attributes such as fund skills could drive both fund size and holding illiquidity. Unlike a fixed-effects regression in which fund size is demeaned by the sample average, the recursive-demeaning regression demeans fund size by the average of fund size up to time $t-1$. As a result, compared to using fund fixed effects, the recursive-demeaning regression eliminates the finite-sample bias (Stambaugh (1999)). Appendix II describes the procedure in detail.

Panel B of Table 5 presents the regression results. Fund size is positively related to holdings-based illiquidity of corporate bond funds.²⁴ The coefficient is statistically significant at the 1% level across all four illiquidity measures. The finding that large funds hold more illiquid bonds is consistent with reaching for yield, as illiquid bonds tend to offer high yields. Our finding about bond funds is, however, in contrast to the prior result about equity funds, where large equity funds tend to hold relatively liquid stocks (e.g., Busse, Chordia, Jiang, and Tang (2021)). One reason for this contrast may be due to the difference in the relation between trade size and transaction costs across the two markets. While transaction costs usually increase with trade size in the stock market (Keim and Madhavan (1997)), large trades of corporate bonds often enjoy favorable prices, especially for illiquid bonds (Schultz (2001); Feldhütter (2012)).

The coefficients of holdings-based illiquidity on the control variables are also sensible. On average, young funds, funds charging large expense ratios, and funds in small fund families tend to hold more illiquid corporate bonds. Meanwhile, fund flows are negatively related

²⁴Table IA11 and Table IA12 in the Internet Appendix examine the relation of fund size to funds' asset allocation and use of leverage, respectively. Overall, from those two aspects, we do not find a clear pattern that large bond funds engage in greater risk-taking than small bond funds.

to subsequent holdings-based illiquidity, consistent with the finding of “horizontal cut” in Jiang, Li, and Wang (2021). That is, bond funds tend to sell off liquid bonds to meet investor redemptions, which increases their relative positions in illiquid bonds.

In sum, we find that large funds have a stronger tendency to reach for yield, and, on average, hold more illiquid bonds than small funds. While illiquid holdings may offer higher yields, they also expose large funds to greater liquidity risk during market stress. This, in turn, affects their liquidity trading behavior, which we will examine in the next two subsections.

4.2 Liquidity supply versus demand

In the corporate bond market, dealers have traditionally acted as liquidity providers. However, financial regulations after the global financial crisis impose higher costs for dealers to hold risky inventories on their balance sheets, weakening their capacity to provide liquidity. As a result, dealers are more inclined to match liquidity demanders with suppliers without using their own inventory (Choi, Huh, and Shin (2023b)). Hence, we hypothesize that large funds are more likely to be relationship customers that dealers ask for liquidity provision. Meanwhile, their holdings of illiquid bonds may exacerbate liquidity mismatches, potentially turning large funds into liquidity demanders during market stress.

To test this hypothesis, we examine bond funds’ tendency to supply or demand liquidity as a function of fund size in different market conditions. Anand, Jotikasthira, and Venkataraman (2021) find that bond funds are liquidity demanding on average, while a subset of liquidity-supplying funds tends to alleviate fragility risks. Hence, if large funds turn out to supply liquidity (e.g., buying illiquid bonds from a liquidity-demanding investor), their trades can enhance market liquidity and reduce price volatility. However, if large funds are liquidity demanding, their trades may introduce price fragility.

We construct the liquidity supply score following Anand, Jotikasthira, and Venkataraman (2021). Specifically, for each fund in each month, we determine liquidity supply versus

liquidity demand based on whether trades by the fund are in the same or opposite direction of dealers' inventory changes. We then aggregate the amount of liquidity supplied and demanded across all of the fund's corporate bond trades to obtain a fund-level composite score of liquidity supply. A large value of the liquidity supply score indicates a trading style that helps alleviate large dealer positions. Next, we analyze how fund size is related to bond funds' liquidity supply conditional on market illiquidity by performing the following panel regression:

$$\begin{aligned}
LS_score_{j,t} = & \alpha + \beta_1 Large\ fund_{j,t-1} + \beta_2 Large\ fund_{j,t-1} \times Market\ illiquidity_t \\
& + Controls_{j,t-1} + v_t + \varepsilon_{j,t},
\end{aligned} \tag{6}$$

where $Large\ fund_{j,t-1}$ is a dummy variable equal to one if the fund is in the top quintile of fund size in each month. $Market\ illiquidity$ is measured as either the median gamma value across all corporate bonds in the month, or an indicator of whether the median gamma value is in the top decile.

Table 6 shows a significantly positive relation between the large fund indicator and the liquidity supply score, indicating that large funds are more likely to supply liquidity than small funds in general. However, the coefficient on the interaction between the large fund indicator and aggregate market illiquidity appears negative, which suggests a mitigating effect of an illiquid market on large funds' capacity to supply liquidity. In fact, when the market-wide illiquidity is severely high (e.g., above the top decile level), large funds switch to demanding liquidity more than small funds.

Therefore, our empirical results reveal a time-varying role of large bond funds in supplying or demanding liquidity under different market conditions. This dynamic helps explain why large funds stabilize the market during normal times but contribute to market instability during periods of stress.

4.3 Liquidation decisions

In this subsection, we examine how fund size relates to liquidation decisions when facing outflows. Jiang, Li, and Wang (2021) show that bond funds follow a “pecking order” when selling assets, prioritizing the sale of relatively liquid bonds to reduce transaction costs. Further, Jiang, Li, Sun, and Wang (2022) find that outflows-induced fund selling generates excessive volatility in the bond market. Therefore, studying fund liquidation decisions can provide additional insights about the impact of fund size on the bond market.

Given that large funds tend to hold more illiquid bonds, we conjecture that their liquidation decisions may differ from those of small funds. To test this, we analyze the liquidity pecking order for large and small funds separately. In our analysis, large and small funds are defined based on whether they fall into the top quintile of fund size each month. We then run the following regression at the bond-fund-month level for the sub-samples of large and small funds:

$$\begin{aligned} \text{Percentage of bonds sold}_{i,j,t} = & \alpha + \beta_1 \text{Outflow}_{j,t} + \beta_2 \text{Outflow}_{j,t} \times \text{Bond illiquidity}_{i,t} \\ & + \beta_3 \text{Bond illiquidity}_{i,t} + \text{Controls}_{i,j,t-1} + v_t + u_j + \varepsilon_{i,j,t}, \end{aligned} \quad (7)$$

where *Percentage of bonds sold*_{*i,j,t*} is the shares of a bond sold by a fund in a certain month scaled by the number of shares held at the end of last month, and *Outflow*_{*j,t*} equals the absolute value of net fund flows if it is below zero, and zero otherwise. Control variables include fund expense ratio, fund turnover ratio, fund age, abnormal bond returns in the current and previous months, months to maturity, bond size, credit rating, and coupon rate. The regressions also control for fund and time fixed effects. Standard errors are clustered by fund and time.

Panel A of Table 7 presents the regression results. As expected, outflow is positively associated with the percentage of bonds sold, suggesting that bond funds sell more bonds when encountering larger outflows. For small funds, we observe the liquidity pecking order in that these funds sell a smaller fraction of illiquid bonds when they have outflows, with

the coefficient both economically sizable and statistically significant across all four illiquidity measures. This liquidity pecking order is consistent with findings in Jiang, Li, and Wang (2021). For large funds, however, such a pattern is absent according to three out of the four illiquidity measures. In addition, the coefficient on bond illiquidity is insignificant for large funds in three of the four illiquidity measures, and the economic significance is smaller than that for small funds. These findings indicate that, when encountering outflows, the liquidation decisions of large funds are not as influenced by bond illiquidity as those of small funds.

Panel B of Table 7 further examines fund liquidation decisions during normal times and illiquid markets separately. Specifically, we include a triple interaction term between outflow, bond illiquidity, and the illiquid market indicator in the regression, where the illiquid market indicator equals one when the aggregate market illiquidity falls in the top quintile and zero otherwise. We find that while small funds sell more liquid assets when facing outflows in both market conditions, large funds follow a more dynamic strategy of liquidity management. During normal times, based on the negative coefficient estimates of the interaction term between *Outflow* and bond illiquidity measures, large funds also first sell relatively liquid assets to meet investor redemptions, similar to small funds. When the market is illiquid, however, adding up the coefficient estimates of all interaction terms including *Illiquid market* (i.e., $\text{Outflow} \times \text{Illiquidity} \times \text{Illiquid market}$, $\text{Outflow} \times \text{Illiquid market}$, and $\text{Illiquidity} \times \text{Illiquid market}$) yields a positive or a null effect of bond illiquidity on large funds' liquidity decisions. The results indicate that during illiquid markets, large funds sell both liquid and illiquid assets, thereby preserving the overall liquidity of their portfolios. Consequently, consistent with the granular view (Gabaix (2011)), sales of illiquid bonds by large funds during illiquid markets deteriorate the market liquidity, bringing about a destabilization effect.²⁵

To summarize, our analysis of liquidation decisions in large and small funds provides further insights into the time-varying effect of fund size on bond price dynamics. Large

²⁵We also check whether redemption decisions of bond fund investors are different between large funds and small funds in stressed times. As reported in Table IA13 in the Internet Appendix, we find no evidence that investor flows of large funds differ from those of small funds during illiquid markets.

funds' liquidation of illiquid bonds during market stress can pose risks of destabilizing the corporate bond market, carrying important policy implications.

5 Economies of scale

After examining how fund size impacts bond return volatility, a natural question arises: why has the bond fund industry become so concentrated? One possibility is economies to scale. If large funds outperform small funds, they may attract more capital due to investors' return-chasing behavior (e.g., Chevalier and Ellison (1997), Chen and Qin (2017) and Goldstein, Jiang, and Ng (2017)), leading to even greater fund size and capital concentration. While much attention has been given to the fund size-performance relation in equity funds, less is known about this relation among corporate bond funds. In this section, we examine the relation between bond fund size and performance.

5.1 Fund size, performance, and flows

To examine the relation between bond fund size and performance, we follow Pastor, Staambaugh, and Taylor (2015) and Zhu (2018) to apply the recursive-demeaning regression. In the regression, we include one-month-lagged value of fund age, expense ratio, turnover, fund flows, and family size to control for confounding factors that affect both fund size and performance. Standard errors are clustered by fund and time.

Panel A of Table 8 presents the regression results. As can be seen, bond fund size positively affects fund performance. The effect is statistically significant at the 1% or 5% level, across the fund alpha measures. The economic magnitude is also large. For example, in Column (1), when fund alpha is calculated based on bond and equity market returns as the benchmark factors, a 1% increase in funds' total net assets would increase the fund alpha by 0.039%, which amounts to 4.0% ($0.039/0.973$) of the average alpha in the sample (as shown Table 1). The results are robust if we use different measures of fund alphas including the four-factor

alpha with excess returns of the equity market, the bond market, the high-yield bond index, and the mortgage-backed security index as factors and the alpha based on the Vanguard bond index fund returns.²⁶

In addition to fund performance, we also examine the effect of fund size on fund flows. For the same reason discussed for fund performance, it is preferable to use the recursive demeaning regressions to estimate the effect of fund size on fund flows, as unobserved fund skills can influence fund flows and size simultaneously. In addition, given that fund flow is calculated as a percentage of lagged fund size, instrumenting the fund size with its backward-demeaned measure helps mitigate the endogeneity concern from the negative correlation between fund flow and lagged fund size. We use fund size in the previous month, six months ago, or one year ago to examine the effect of fund size on fund flows. Given that fund flow is negatively correlated with fund size in the previous month by construction, we include lagged fund size by longer time periods to reduce the mechanical negative correlation. We also control for fund performance, fund age, expense ratio, turnover, and family size in the regression. Standard errors are clustered by fund and time.

As shown in Panel B of Table 8, bond fund size has a positive effect on fund flows. The effect is statistically significant at least at the 1% level. Economically, a 1% increase in fund size in the previous month (one year ago) would raise fund flows by 1.581% (1.420%), which is economically meaningful compared to the mean (0.646%) and the standard deviation (6.076%) of fund flows in the entire sample. We also confirm the return-chasing behavior of bond fund investors, that is, fund flows are positively related to previous fund performance.

Taken together, our analyses about fund size, performance and flows provide an explanation for the high capital concentration in the bond fund industry. Large funds tend to outperform small funds and attract greater investor flows, leading to the accumulation of capital in these funds and the increasing concentration of capital.

²⁶While we use gross alpha (before deducting expenses) to measure fund performance, the inference remains unchanged if we use net alpha as the performance measure (see Table IA14 in the Internet Appendix for details).

5.2 Illiquid holdings and fund performance

So far, we have shown that large funds tend to hold illiquid bonds and that bond funds exhibit economies of scale. Are these two phenomena connected? If the positive relation between fund size and performance is largely driven by the illiquidity premium through holding illiquid bonds, this effect should be diminished once an illiquidity factor is included in the model. To test this conjecture, we estimate fund alphas by augmenting each of the three benchmark models with an illiquidity factor. The illiquidity factor is constructed based on the long-short portfolio returns of corporate bonds in the top and bottom quintiles sorted by the gamma measure. Using these new alpha estimates, we reexamine the relation between fund size and performance.

As shown in Panel A of Table 9, the size-performance relation is no longer significant for two of the three-factor models. For example, in column (1) including the bond and equity factors, the coefficient on fund size drops from 0.039 (statistically significant at the 1% level) without the illiquidity factor previously to 0.005 (statistically insignificant) with the illiquidity factor. In fact, even with the only model that still shows a statistically significant relation between fund size and performance, the coefficient on fund size becomes smaller after the model controls for the illiquidity factor.

Next, we examine how the fund size-performance relation varies with market condition.²⁷ Specifically, we perform the recursive-demeaning regression for the subperiods of high and low market illiquidity separately. Market illiquidity is measured by the median bond illiquidity based on the gamma measure across all corporate bonds in each month. Market illiquidity is considered high in a month when the value of the median gamma measure is in the top decile level.

²⁷It is well documented in the mutual fund literature that fund performance varies with market conditions (e.g., Ferson and Schadt (1996)). For studies on the performance of bond funds, see, e.g., Elton, Gruber, and Blake (1995), Chen, Ferson, and Peters (2010), Choi and Kronlund (2018), and Hong, Pan, and Tian (2023). However, the time variation in the fund size-performance relation, as shown in our study, has received little attention in prior research.

Panel B of Table 9 reports the results. When the market condition is normal with the aggregate illiquidity below the top decile, the coefficient of fund performance on fund size is positive and statistically significant across all the three alpha measures. The magnitude of the coefficient estimates is similar to the finding about the unconditional fund size-performance relation presented in Table 8. However, the sign of the coefficient on fund size becomes negative when the market is highly illiquid, suggesting that large funds perform worse during market stress. The coefficient is statistically significant and has a larger magnitude than the coefficient during normal times based on two of the three alpha measures.

The contrasting size-performance relations across different market conditions align with our earlier finding that large funds outperform small funds in normal times due to an illiquidity premium, but underperform during illiquid markets. In normal times, large funds' superior performance attracts capital inflows, enabling them to supply liquidity. However, during market stress, their performance deteriorates more than that of small funds, leading them to liquidate illiquid bonds to meet investor redemptions, which exacerbates price volatility in the underlying bonds.

Overall, our results provide a coherent narrative on how large funds influence price fragility in the corporate bond market. The holdings and liquidation of illiquid bonds give rise to an important yet subtle role of large funds in impacting bond price dynamics—they stabilize bond prices in normal times but destabilize the market during market stress.

6 Conclusion

The corporate bond fund industry is highly concentrated, with a significant portion of assets managed by large funds. Motivated by this observation, we examine how large funds impact bond price fragility. We find that while large funds' trading reduces bond return volatility under normal conditions, their sales of illiquid bonds significantly destabilize bond prices

during market stress, akin to a “dam effect.” Using a quasi-experiment that exogenously changes fund size, we confirm the varying effect of fund size on bond return volatility.

To understand the mechanisms behind this time-varying effect, we show that large funds hold more illiquid bonds, which generates an illiquidity premium during normal times but poor performance during illiquid markets. In addition, large funds tend to supply liquidity during normal times, but they switch to demanding liquidity in adverse market conditions.

To our knowledge, this paper is the first to examine the impact of large funds on bond market fragility. Through a comprehensive analysis of fund holdings, liquidity management, and economies of scale, we uncover an important yet subtle effect of fund size on bond price fragility. Our findings have significant implications for both corporate bond market participants and financial policymakers.

Appendix

I Variable description

This table contains a description of all variables used in our empirical analyses. Data sources are as follows:

1. CRSP: CRSP Survivor-Bias-Free Mutual Fund Database
2. FISD: Mergent's Fixed Income Securities Database
3. MS: Morningstar historical holdings
4. TRACE: Trade Reporting and Compliance Engine
5. FED: St. Louis Federal Reserve
6. MC: Manually constructed

Variable name	Description	Data source
Amihud	The monthly Amihud illiquidity measure for a bond in % per thousand dollars for a corporate bond fund. We first remove a trade if its price change is more than 20% from the previous trade within the same day and compute per transaction the Amihud measure as the absolute value of return divided by the trading volume. We then average across all trades of a bond within a month. We require at least 2 trades per month to report the measure. The variable is winsorized at the top and bottom 1% level.	TRACE, MC
Amihud_fund	The holdings-weighted average of the monthly Amihud illiquidity measure across all corporate bonds held by the fund.	TRACE, MS, MC
Bond and equity market alpha	Alpha from the 36-month rolling-window time-series regressions of bond fund returns on the Vanguard Total Bond Market Index returns and the CRSP value-weighted market returns.	CRSP, MC
Bond price range	The range of bond price in a month.	TRACE, MC

Variable name	Description	Data source
Bond return	Average weekly bond returns in a month.	TRACE, MC
Bond return volatility	Standard deviation of weekly bond returns over the month in percentage.	TRACE, MC
Bond amount outstanding	Amount outstanding of the bond, measured in \$billion.	FISD
Coupon rate	Coupon rate of fixed rate bonds, in percent.	FISD
Expense ratio	Mutual funds' expense ratio in percentage.	CRSP
Four-factor alpha	Alpha from the 36-month rolling-window time-series regressions of bond fund returns on 1) the excess return on the CRSP value-weighted stock index, 2) the excess return on the U.S. aggregate bond index, 3) the return spread between the high-yield bond index and the intermediate government bond index, and 4) the return spread between the GNMA mortgage-backed security index and the intermediate government bond index.	CRSP, MC
Fund age	The number of years since the inception of the fund.	CRSP, MC
Fund flows	Fund flows are calculated as: $FundFlow_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1} \times (1 + R_{i,t})}{TNA_{i,t-1}},$ where $TNA_{i,t}$ is total net assets, and $R_{i,t}$ is monthly fund return.	CRSP
Gamma	The illiquidity measure calculated using the following equation, as proposed in Bao, Pan, and Wang (2011): $\gamma = -Cov(p_t - p_{t-1}, p_{t+1} - p_t),$ where p_t is daily bond price in a certain month. The variable is winsorized at the top and bottom 1% level.	TRACE, MC
Gamma_fund	The holdings-weighted average of the gamma measure for a bond fund.	TRACE, MS, MC

Variable name	Description	Data source
Holding fund size	Log of the holdings-weighted average of total net assets among bond funds that hold the bond in the month	TRACE, MS, MC
Holdings-based illiquidity measure	Bond-level holdings-based illiquidity measure calculated as in Jiang, Li, Sun, and Wang (2022).	TRACE, MS, MC
IRC	Imputed Round-trip Costs (IRC) in percentage per month, calculated following Dick-Nielsen, Feldhütter, and Lando (2012)). The variable is winsorized at the top and bottom 1% level.	TRACE, MC
IRC_fund	The holdings-weighted average of monthly imputed round-trip costs (IRC) across corporate bonds held by the fund.	TRACE, MS, MC
Log fund age	Log of fund age.	CRSP, MC
Log fund size	Log of total net assets.	CRSP, MC
LS_score	Following Anand, Jotikasthira, and Venkataraman (2021), we aggregate the amount of liquidity supplied and demanded across all corporate bond transactions and obtain a fund's composite trading style. A large values of LS_score indicates a trading style that helps alleviate large dealer positions.	MS, TRACE
Market illiquidity	The median of the gamma measure across all corporate bonds in a certain month.	TRACE, MC
Maturity	Number of months until bond maturity, measured at the beginning of the month, winsorized at the top and bottom 1% level.	FISD, MC
Percentage of bonds sold	The shares of a bond sold by a fund in a certain month scaled by the number of shares held at the end of last month.	MS, MC
Post	Dummy variable indicates whether the month is after September 2014.	MS, MC

Variable name	Description	Data source
Reaching for yield	The value-weighted average of yield spreads across all corporate bonds held by a fund, calculated following Choi and Kronlund (2018). The yield spreads are measured as the difference in yield between a bond and a benchmark index. The benchmark index is the average of the ICE BofA US Corporate Index and the ICE BofA US High Yield Index.	TRACE, MS, FED, MC
Rating	The average rating from Moody's, S&P, and Fitch, ranging from 1 to 24, with 1 representing the highest rating (AAA) and 24 representing the lowest rating (D).	FISD, MC
Spread	The same-bond-same-day effective bid-ask spread in percentage for a corporate bond fund. Following Hong and Warga (2000), we calculate the average buy prices minus the average sell prices of all transactions on the same day and same bond and then take the average for each bond for all days within a month. The variable is winsorized at the top and bottom 1% level.	TRACE, MC
Spread_fund	The holdings-weighted average of the same-bond-same-day effective bid-ask spread for a corporate bond fund.	TRACE, MS, MC
Traded by PIMCO	Dummy variable equal to one if a bond is traded by PIMCO funds in the month.	CRSP, MS, MC
Trading fund size	The trade-amount weighted average of total net assets of bond funds that trade a certain corporate bond in a certain month. The measure is in million dollars or its log value.	CRSP, MS, MC
Total net assets	Total net assets of a fund in million dollars.	CRSP
Turnover ratio	Fund turnover ratio in percentage.	CRSP
Vanguard funds alpha	Alpha from 36-month rolling-window time-series regressions of bond fund returns on returns of 1) the Vanguard Total Bond Market Index Fund (VBMFX), 2) the Vanguard Short-Term Bond Index Fund (VBISX), 3) the Vanguard Intermediate-Term Bond Index Fund (VBIIX), and 4) the Vanguard Long-Term Bond Index Fund (VBLTX).	CRSP, MC

II Recursive demeaning regression

We implement recursive demeaning regressions following Pastor, Stambaugh, and Taylor (2015) and Zhu (2018). The recursive-demeaning procedure is designed to address the potential omitted variable problem that unobserved fund attributes can drive both fund size and holding illiquidity. For example, if funds with better skills (which are unobserved) in managing liquidity choose to hold more illiquid assets and if funds with better such skills attract more capital, then the coefficient estimate of holding illiquidity on fund size will be biased. A natural remedy to reduce the bias is to include fund fixed effects in the regression to control for time-invariant fund skills. However, fund fixed effects generate a finite-sample bias (Stambaugh (1999)), as fund size positively correlates with the error term. Unlike a fixed-effects regression in which fund size is demeaned by the sample average, the recursive-demeaning regression demeans fund size by the average of fund size up to time $t-1$. This procedure eliminates the finite-sample bias, since the backward-demeaned fund size does not correlate with the error term.

To estimate β_1 in the following regression of fund performance (fund flows or fund holding illiquidity) on fund size:

$$Fund\ Performance_{i,t} = \alpha + \beta_1 \times Fund\ Size_{i,t-1} + \beta \times Controls_{i,t-1} + \varepsilon,$$

we substitute the variables with the forward demeaned measures and cancel out the intercept as below:

$$\overline{Fund\ Performance}_{i,t} = \beta_1 \times \overline{Fund\ Size}_{i,t-1} + \beta \times \overline{Controls}_{i,t-1} + \bar{\varepsilon}, \quad (8)$$

where $\overline{X}_{i,t-1}$ is defined as

$$\overline{X}_{i,t-1} = X_{i,t-1} - \frac{1}{T_i - t + 1} \sum_{k=t}^{T_i} X_{i,k-1}.$$

We then estimate Equation (8) with the instrumental variable approach. More specifically, we instrument $\overline{Fund\ Size}_{i,t-1}$ by $\underline{Fund\ Size}_{i,t-1}$, where

$$\underline{Fund\ Size}_{i,t-1} = Fund\ Size_{i,t-1} - \frac{1}{t-1} \sum_{k=1}^{t-1} Fund\ Size_{i,k-1}$$

Following Zhu (2018), we include intercept and $\underline{FundSize}_{i,t-1}$ in the first-stage regressions.

The relevance condition holds because $\underline{FundSize}_{i,t-1}$ and $\overline{FundSize}_{i,t-1}$ clearly correlates. The exclusion condition, $E[\overline{\varepsilon}_{i,t}|\underline{FundSize}_{i,t-1}] = 0$, holds because backward-looking information in fund size is unlikely to be useful to predict the forward-looking information in $\overline{\varepsilon}_{i,t}$.

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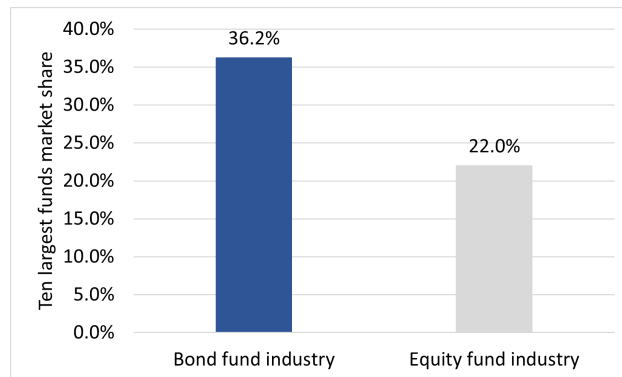
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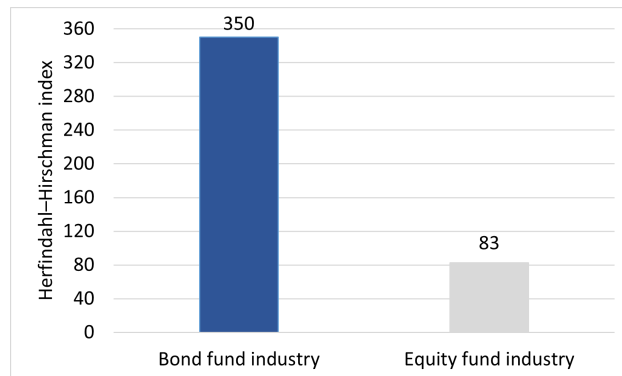
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Figure 1: Capital concentration and average fund size

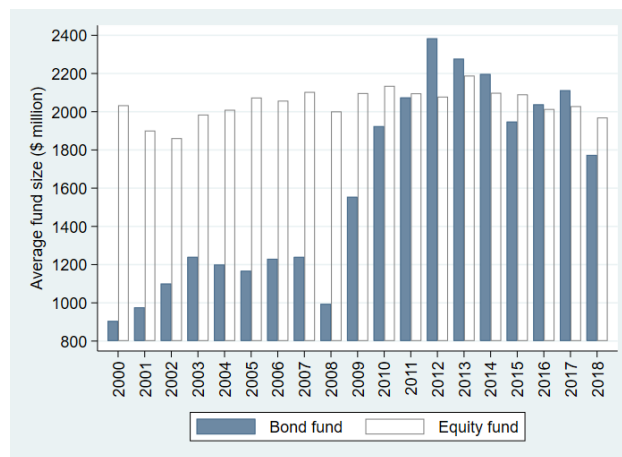
This figure plots the average fund size and capital concentration in the corporate bond fund industry. For comparison purposes, we also plot the values for the equity mutual fund industry. Panel A presents the average market share of the top 10 largest funds. Panel B presents the Herfindahl–Hirschman index. Panel C presents the average fund size over the period from 2000 to 2018. The fund size is inflation adjusted to 2018 dollars.



Panel A: Market share of top 10 largest funds



Panel B: Herfindahl-Hirschman Index



Panel C: Average fund size

Table 1: Summary statistics

This table presents summary statistics of corporate bond characteristics, bond fund characteristics and performance, and holding illiquidity of bond funds. Panel A summarizes bond-level variables for corporate bonds held by bond funds in the sample. Panel B summarizes fund-level variables for corporate bond funds (excluding index funds, ETFs, and ETNs). Fund alphas are annualized and are presented in percentage. Panel C summarized holding illiquidity, measured as the value-weighted average of illiquidity across corporate bonds held by each fund. Corporate bond-level illiquidity is measured based on four alternative measures: the Amihud measure, gamma, round-trip transaction cost, and bid-ask spread.

Variable	Obs	Mean	Std. Dev.	P10	P25	P50	P75	P90
Panel A: Corporate bonds								
Trading fund size (\$million)	201922	5713.07	16357.11	132.80	481.80	1496.90	4795.20	11866.24
Trading fund size (log)	201922	7.252	1.772	4.889	6.178	7.311	8.475	9.381
Bond return volatility (%/week)	201922	1.325	1.690	0.207	0.410	0.801	1.529	2.815
Market illiquidity	201922	0.120	0.174	0.023	0.042	0.066	0.137	0.260
Total trading volume (\$million/month)	201922	72.529	322.726	5.225	14.195	35.156	77.862	152.789
Holdings-based illiquidity	201922	0.760	0.217	0.501	0.617	0.742	0.886	1.033
Bond return (%/month)	201922	0.694	3.364	-2.080	-0.366	0.451	1.662	3.637
Maturity	201922	87.748	78.455	21	42	68	99	194
Bond amount outstanding (\$billion)	201922	0.705	0.584	0.225	0.3	0.5	0.85	1.5
Rating	201922	11.195	4.041	6	8	11	14	16.333
Coupon rate	201922	6.568	2.169	3.7	5.2	6.625	7.875	9.375
Amihud (%)	191498	0.047	0.070	0.001	0.005	0.023	0.057	0.114
Gamma	94126	0.503	3.730	-0.011	0.009	0.061	0.249	0.775
IRC (%)	201922	0.825	0.812	0.123	0.239	0.545	1.142	1.922
Spread (%)	189487	1.005	1.016	0.209	0.351	0.660	1.286	2.226

Table 1: Summary statistics, continued

Variable	Obs	Mean	Std. Dev.	P10	P25	P50	P75	P90
Panel B: Corporate bond funds								
Total net assets (\$million)	171220	1230.47	6282.39	30.64	74.70	240.10	819.00	2307.05
Fund age (year)	171220	13.133	10.737	2.333	5.083	10.750	18.500	26.667
Expense ratio (% p.a.)	148209	0.822	0.361	0.439	0.569	0.765	1	1.296
Fund flow (%/month)	169914	0.646	6.076	-3.267	-1.311	-0.046	1.599	4.776
Fund turnover ratio (p.a.)	147513	1.409	1.753	0.280	0.467	0.810	1.660	3.290
Bond and equity market alpha (% p.a.)	116694	0.973	4.533	-1.166	-0.101	0.618	1.612	3.784
Four-factor alpha (% p.a.)	116694	0.432	3.721	-1.071	-0.210	0.386	1.059	2.021
Vanguard funds alpha (% p.a.)	106730	2.578	5.279	-0.221	0.419	1.289	3.506	7.598
Reaching for yield	32075	-0.196	2.283	-3.077	-1.665	-0.255	1.667	2.754
LS_score	34970	-0.018	0.144	-0.169	-0.073	-0.007	0.038	0.121
Panel C: Holding illiquidity of bond funds								
Amihud_fund (%)	58778	0.040	0.023	0.018	0.026	0.035	0.049	0.068
Gamma_fund	61683	0.439	1.347	0.028	0.070	0.163	0.354	0.828
IRC_fund (%)	58777	0.729	0.290	0.386	0.532	0.703	0.888	1.079
Spread_fund (%)	58780	0.828	0.448	0.372	0.541	0.743	1.003	1.359

Table 2: Trading fund size and bond return volatility

This table contains the regression of bond return volatility on trading fund size. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. In Panel A, *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond in the month. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. In Panel B, *Trading fund size* is ranked into quintiles, with the bottom quintile used as the reference group in the regression. *Illiquid market* is a dummy variable indicating whether market illiquidity is in the top decile. All control variables are lagged by one month. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Continuous measures of trading fund size and market illiquidity			
Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Trading fund size _{<i>i,t-1</i>}	-0.015*** (-4.46)	-0.015*** (-4.81)	-0.010*** (-4.17)
Trading fund size _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	0.095*** (3.58)	0.086*** (3.58)	0.047*** (2.65)
Bond return volatility _{<i>i,t-1</i>}			0.452*** (31.75)
Total trading volume _{<i>i,t-1</i>}	0.134*** (5.45)	0.082*** (6.50)	0.063*** (5.96)
Holdings-based illiquidity _{<i>i,t-1</i>}	0.702*** (10.57)	0.291*** (3.94)	0.372*** (8.43)
IRC _{<i>i,t-1</i>}	0.373*** (18.57)	0.206*** (15.74)	0.192*** (17.11)
Bond return _{<i>i,t-1</i>}	-0.046*** (-3.74)	-0.046*** (-4.75)	-0.050*** (-6.83)
Maturity _{<i>i,t-1</i>}	0.003*** (23.23)	-0.006*** (-2.67)	0.002*** (14.18)
Bond amount outstanding _{<i>i,t-1</i>}	-0.016 (-0.91)	0.163* (1.85)	-0.008 (-0.69)
Rating _{<i>i,t-1</i>}	0.122*** (16.18)	0.161*** (12.50)	0.065*** (16.27)
Coupon rate _{<i>i</i>}	-0.015** (-2.26)		-0.005 (-1.16)
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	201922	200875	201922
Adjusted <i>R</i> ²	0.365	0.483	0.500

Table 2: Trading fund size and bond return volatility, continued

Panel B: Discrete measures of trading fund size and market illiquidity			
Dependent variable:	Bond return volatility $_{i,t}$		
	(1)	(2)	(3)
Trading fund size quintile $2_{i,t-1}$	-0.019 (-1.33)	0.003 (0.27)	-0.017 (-1.63)
Trading fund size quintile $3_{i,t-1}$	-0.053*** (-3.42)	-0.033*** (-2.63)	-0.036*** (-3.23)
Trading fund size quintile $4_{i,t-1}$	-0.068*** (-4.00)	-0.048*** (-3.60)	-0.051*** (-4.13)
Trading fund size top quintile $_{i,t-1}$	-0.031* (-1.73)	-0.034** (-2.37)	-0.025** (-2.02)
Trading fund size quintile $2_{i,t-1} \times$ Illiquid market $_t$	0.047 (0.62)	0.018 (0.25)	-0.031 (-0.58)
Trading fund size quintile $3_{i,t-1} \times$ Illiquid market $_t$	0.171 (1.47)	0.183* (1.87)	0.068 (0.73)
Trading fund size quintile $4_{i,t-1} \times$ Illiquid market $_t$	0.181* (1.97)	0.131 (1.56)	0.063 (0.84)
Trading fund size top quintile $_{i,t-1} \times$ Illiquid market $_t$	0.470*** (3.11)	0.387*** (3.01)	0.240** (2.16)
Bond return volatility $_{i,t-1}$			0.452*** (31.65)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	201922	200875	201922
Adjusted R^2	0.366	0.483	0.500

Table 3: Trading fund size and bond return volatility during down markets

This table contains the regression of bond return volatility on trading fund size. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond in a month. In Columns (1) and (2), *Down market* indicates the recession periods based on the US Business Cycle Expansions and Contractions data from the National Bureau of Economic Research (NBER). In Columns (3) and (4), *Down market* indicates whether the VIX is in the top quintile in the sample period. All control variables are lagged by one month. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. * * *, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}			
	(1)	(2)	(3)	(4)
	NBER recession		VIX top quintile	
Down market:				
Trading fund size _{<i>i,t-1</i>}	-0.010*** (-3.25)	-0.009*** (-3.46)	-0.012*** (-3.36)	-0.011*** (-3.98)
Trading fund size _{<i>i,t-1</i>} × Down market _{<i>t</i>}	0.079*** (3.71)	0.054*** (2.62)	0.038*** (3.13)	0.033*** (3.09)
Total trading volume	0.134*** (5.42)	0.082*** (6.46)	0.171*** (5.13)	0.096*** (4.26)
Holdings-based illiquidity _{<i>i,t-1</i>}	0.694*** (10.47)	0.287*** (3.87)	0.698*** (10.45)	0.284*** (3.82)
IRC _{<i>i,t-1</i>}	0.373*** (18.58)	0.206*** (15.75)	0.373*** (18.39)	0.205*** (15.52)
Bond return _{<i>i,t-1</i>}	-0.046*** (-3.73)	-0.046*** (-4.74)	-0.045*** (-3.56)	-0.045*** (-4.58)
Maturity _{<i>i,t-1</i>}	0.003*** (23.42)	-0.006*** (-2.69)	0.003*** (22.78)	-0.006** (-2.20)
Bond amount outstanding _{<i>i,t-1</i>}	-0.015 (-0.89)	0.164* (1.86)	-0.018 (-1.05)	0.169* (1.82)
Rating _{<i>i,t-1</i>}	0.122*** (16.20)	0.161*** (12.49)	0.121*** (15.95)	0.161*** (12.14)
Coupon rate _{<i>i</i>}	-0.016** (-2.27)		-0.016** (-2.38)	
Controls	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Bond fixed effects	No	Yes	No	Yes
Observations	201922	200875	197390	196338
Adjusted <i>R</i> ²	0.365	0.483	0.365	0.482

Table 4: Trading fund size and bond return volatility: Evidence from Bill Gross leaving PIMCO

This table contains the regression of bond return volatility on the triple-interaction term between *Traded by PIMCO*, *Post*, and *Market illiquidity* around September 2014 when Bill Gross left PIMCO. *Traded by PIMCO* is a dummy variable equal to one if a bond is traded by PIMCO funds in a given month. *Post* indicates whether the month is after September 2014. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. Control variables are the same as those in Table 2. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Traded by PIMCO _{<i>i,t</i>} × Post _{<i>t</i>} × Market illiquidity _{<i>t</i>}	-13.502*** (-5.08)	-15.766*** (-4.18)	-13.233*** (-3.13)
Traded by PIMCO _{<i>i,t</i>} × Post _{<i>t</i>}	0.517*** (3.25)	0.620*** (3.54)	0.543*** (2.95)
Traded by PIMCO _{<i>i,t</i>} × Market illiquidity _{<i>t</i>}	10.418*** (7.69)	9.007*** (5.91)	9.876*** (5.34)
Traded by PIMCO _{<i>i,t</i>}	-0.483*** (-7.05)	-0.327*** (-4.63)	-0.449*** (-5.96)
Bond return volatility _{<i>i,t-1</i>}			0.462*** (15.68)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	56359	56138	56359
Adjusted <i>R</i> ²	0.280	0.479	0.427

Table 5: Fund size, reaching for yield, and holding illiquidity

This table contains the regression of reaching for yield (holding illiquidity) on one-month-lagged fund size in Panel A (Panel B). In Panel A, *Reaching for yield* is measured for a given fund as the value-weighted average of the yield difference between each bond held by the fund and the benchmark index following Choi and Kronlund (2018). In Panel B, the dependent variable is fund-level *holding illiquidity*. We first compute bond-level illiquidity with the Amihud measure, gamma, round-trip transaction cost, and bid-ask spread. *Holding illiquidity* is then calculated as the value-weighted average of illiquidity across corporate bonds held by the fund. The variables are recursive-demeaned: all dependent variables and independent variables are forward-demeaned, and log fund size is instrumented by its backward-demeaned counterpart. Standard errors are clustered by fund and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Fund size and reaching for yield				
Dependent variable:	Reaching for yield _{<i>j,t</i>}			
	(1)	(2)	(3)	
Log fund size _{<i>j,t-1</i>}	0.237*** (3.54)	0.179*** (3.28)	0.176*** (3.18)	
Log fund age _{<i>j,t-1</i>}	-0.342*** (-3.54)	-0.316*** (-3.98)	-0.316*** (-4.00)	
Expense ratio _{<i>j,t-1</i>}	3.437*** (10.27)	2.083*** (6.59)	2.072*** (6.54)	
Turnover ratio _{<i>j,t-1</i>}	-0.125** (-2.53)	-0.017 (-0.32)	-0.013 (-0.24)	
Fund flow _{<i>j,t-1</i>}	-0.014** (-2.46)	-0.009* (-1.96)	-0.009** (-2.01)	
Time fixed effects	Yes	Yes	No	
Investment objective fixed effects	No	Yes	No	
Investment objective × Time fixed effects	No	No	Yes	
Observations	32075	32075	32075	
Panel B: Fund size and holding illiquidity				
Dependent variable:	Average illiquidity of bonds held by fund _{<i>j,t</i>}			
	(1) Amihud	(2) Gamma	(3) IRC	(4) Spread
Illiquidity measures:				
Log fund size _{<i>j,t-1</i>}	0.026*** (4.09)	0.552*** (3.23)	0.617*** (4.15)	0.433*** (5.18)
Log fund age _{<i>j,t-1</i>}	-0.024*** (-4.75)	-0.684*** (-4.78)	-0.553*** (-4.81)	-0.381*** (-6.14)
Expense ratio _{<i>j,t-1</i>}	0.062*** (3.58)	1.993*** (4.66)	1.526*** (3.91)	1.131*** (4.98)
Turnover ratio _{<i>j,t-1</i>}	-0.001 (-0.82)	-0.010 (-0.60)	-0.010 (-0.44)	-0.011 (-0.67)
Fund flow _{<i>j,t-1</i>}	-0.019** (-2.41)	-0.404** (-2.06)	-0.324* (-1.78)	-0.161* (-1.70)
Observations	36306	36195	36306	36309

Table 6: Fund size and liquidity supply

This table contains the regressions of bond fund's liquidity supply, measured by LS_score , on the variables of *Large fund*, market illiquidity, and other bond characteristics. *Large fund* is a dummy variable equal to one if the fund size is in the top quintile in a given month. Market illiquidity is the median of the gamma measure across all corporate bonds in the month in Columns (1) and (2), or a dummy variable indicating whether market illiquidity is in the top decile in Columns (3) and (4). All control variables are lagged by one month. Standard errors are clustered by fund and time. t -statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	$LS_score_{j,t}$			
	(1)	(2)	(3)	(4)
Market illiquidity measure:	Gamma		Gamma top decile	
Large fund $_{j,t-1}$	0.014*** (3.30)	0.013*** (3.18)	0.012*** (3.30)	0.012*** (3.14)
Large fund $_{j,t-1} \times$ Market illiquidity $_t$	-0.029*** (-2.74)	-0.030*** (-2.80)	-0.022*** (-3.55)	-0.022*** (-3.54)
IRC_Fund $_{j,t-1}$	-0.005 (-0.80)	-0.008 (-1.33)	-0.005 (-0.81)	-0.008 (-1.33)
Log fund age $_{j,t-1}$	-0.004** (-2.26)	-0.004** (-2.15)	-0.004** (-2.26)	-0.004** (-2.16)
Expense ratio $_{j,t-1}$	0.360 (0.75)	-0.034 (-0.06)	0.345 (0.72)	-0.046 (-0.08)
Turnover ratio $_{j,t-1}$	-0.006*** (-5.08)	-0.005*** (-4.62)	-0.006*** (-5.07)	-0.005*** (-4.61)
Fund flow $_{j,t-1}$	0.123*** (6.05)	0.124*** (6.06)	0.123*** (6.03)	0.124*** (6.04)
Time fixed effects	Yes	Yes	Yes	Yes
Category fixed effects	No	Yes	No	Yes
Observations	34970	34970	34970	34970
Adjusted R^2	0.042	0.042	0.042	0.042

Table 7: Fund size and bond liquidation

This table contains the regression of the percentage of bonds sold on outflow, bond illiquidity, and their interaction terms in the subsamples of large funds and small funds. Large versus small fund is defined by whether the fund size is in the top quintile in a given month. Percentage of bonds sold is the the shares of a bond sold by a fund in the month scaled by the number of shares held at the end of last month. Corporate bond illiquidity measures include the Amihud measure, gamma, round trip transaction cost, and the bid-ask spread. Outflow equals the absolute value of net fund flow if the net flow is below zero, and zero otherwise. Control variables include fund expense ratio, fund turnover ratio, log fund age, abnormal bond returns in the current and previous month, months to maturity, bond size, credit rating, and coupon rate. Panel B further includes a triple interaction term between outflow, bond illiquidity, and a dummy variable Illiquid market that is equal to one if the aggregate market illiquidity falls in the top quintile and zero otherwise. Standard errors are clustered by fund and time. t -statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Bond liquidation								
Dependent variable:		Percentage sold $_{i,j,t}$						
Illiquidity measure:	Amihud		Gamma		IRC		Spread	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fund size	Small	Large	Small	Large	Small	Large	Small:	Large
Outflow $_{j,t} \times$ Illiquidity $_{i,t}$	-1.114*** (-6.12)	-0.294 (-0.63)	-0.101*** (-5.60)	-0.078 (-1.56)	-0.105*** (-5.90)	-0.068* (-1.75)	-0.129*** (-7.81)	-0.059 (-1.23)
Outflow $_{j,t}$	0.757*** (17.33)	0.756*** (9.47)	0.818*** (18.38)	0.809*** (9.81)	0.791*** (16.47)	0.783*** (9.59)	0.828*** (16.98)	0.799*** (8.42)
Illiquidity $_{i,t}$	-0.020*** (-3.43)	0.005 (0.64)	0.001 (1.23)	0.003*** (3.19)	-0.003*** (-5.72)	-0.001 (-0.96)	-0.003*** (-5.73)	-0.000 (-0.25)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1773344	1076160	923412	546069	1710623	1046456	1762462	1069724
Adjusted R^2	0.059	0.051	0.060	0.054	0.058	0.051	0.058	0.051

Table 7: Bond fund size and bond liquidation, continued

Panel B: Bond liquidation conditional on market illiquidity									
Dependent variable:		Percentage sold _{<i>i,j,t</i>}							
Illiquidity measure:		Amihud		Gamma		IRC		Spread	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fund size		Small	Large	Small	Large	Small	Large	Small:	Large
Outflow _{<i>j,t</i>} × Illiquidity _{<i>i,t</i>}		-1.058*** (-4.67)	-0.583 (-1.25)	-0.087*** (-3.64)	-0.141*** (-2.87)	-0.098*** (-4.97)	-0.096*** (-3.21)	-0.127*** (-6.59)	-0.111*** (-3.41)
Outflow _{<i>j,t</i>} × Illiquidity _{<i>i,t</i>} × Illiquid market _{<i>t</i>}		0.503 (1.51)	1.302* (1.72)	0.066** (2.02)	0.186** (2.43)	0.058** (1.97)	0.148* (1.96)	0.079*** (2.85)	0.176** (2.35)
Outflow _{<i>j,t</i>} × Illiquid market _{<i>t</i>}		-0.382*** (-4.14)	-0.191 (-0.77)	-0.459*** (-5.15)	-0.262 (-1.06)	-0.408*** (-4.59)	-0.213 (-0.89)	-0.413*** (-4.22)	-0.330 (-1.36)
Illiquidity _{<i>i,t</i>} × Illiquid market _{<i>t</i>}		0.014 (1.49)	0.030** (2.04)	0.002*** (2.74)	0.005*** (3.23)	0.001 (0.90)	0.001 (0.68)	0.003*** (2.83)	0.001 (0.98)
Outflow _{<i>j,t</i>}		0.801*** (16.47)	0.781*** (8.65)	0.854*** (17.99)	0.835*** (9.42)	0.832*** (15.83)	0.810*** (9.03)	0.865*** (16.34)	0.850*** (8.43)
Illiquidity _{<i>i,t</i>}		-0.021*** (-2.89)	0.000 (0.04)	0.000 (0.71)	0.001 (1.26)	-0.003*** (-4.76)	-0.001 (-0.87)	-0.004*** (-4.98)	-0.000 (-0.35)
Control		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		1773344	1076160	923412	546069	1710623	1046456	1762462	1069724
Adjusted <i>R</i> ²		0.059	0.051	0.060	0.054	0.058	0.051	0.059	0.051

Table 8: Fund size, performance, and flows

This table contains the regression of fund performance (fund flows) on fund size in Panel A (Panel B). Log fund size is the log form of fund total net assets. In Panel A, the dependent variable is fund performance measured by gross alpha that is net alpha plus expense ratio. In Panel B, the dependent variable is fund flows calculated as the percentage change in fund size after adjusting for the change in fund size attributed to fund returns. The variables are recursive-demeaned: all dependent variables and independent variables are forward-demeaned, and all fund size variables are instrumented by their backward-demeaned counterparts. Standard errors are clustered by fund and time. t -statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Fund size and performance			
Dependent variable:	(1)	(2)	(3)
Gross alpha _{j,t}	Bond and equity market alpha	Four-factor alpha	Vanguard funds alpha
Log fund size _{$j,t-1$}	0.039*** (6.28)	0.014*** (4.02)	0.042*** (5.14)
Log fund age _{$j,t-1$}	-0.038*** (-6.71)	-0.015*** (-5.07)	-0.025*** (-3.48)
Expense ratio _{$j,t-1$}	0.049*** (4.54)	0.014*** (2.94)	0.046*** (3.31)
Turnover ratio _{$j,t-1$}	0.038 (1.11)	0.031 (1.61)	0.062* (1.81)
Fund flow _{$j,t-1$}	-0.002 (-0.24)	0.016*** (3.31)	-0.005 (-0.40)
Observations	115777	115777	105852
Panel B: Fund size and fund flows			
Fund size lagged by k months:	(1) $k = 1$	(2) $k = 6$	(3) $k = 12$
Log fund size _{$j,t-k$}	1.581*** (4.61)	1.590*** (4.98)	1.420*** (4.32)
Fund alpha _{$j,t-1$}	0.042** (1.99)	0.051** (2.13)	0.060** (2.28)
Log fund age _{$j,t-1$}	-2.459*** (-8.23)	-2.508*** (-7.98)	-2.493*** (-7.38)
Expense ratio _{$j,t-1$}	1.125** (2.03)	1.114** (2.15)	0.766 (1.55)
Turnover ratio _{$j,t-1$}	0.034 (0.77)	0.043 (0.88)	0.045 (0.88)
Observations	114977	114640	114376

Table 9: Illiquidity and the fund size-performance relation

This table contains the regression of fund performance on fund size with performance measured by gross alphas from factor models augmented with a bond illiquidity factor (Panel A) or during liquid versus illiquid markets (Panel B). Log fund size is the log form of fund total net assets. Fund gross alpha is fund net alpha plus expense ratio. In Panel A, alphas are estimated from the factor models including a bond illiquidity factor. In Panel B, market illiquidity is measured by the median of the gamma measure across all corporate bonds in a given month and is considered high if it is in the top decile. The variables are recursive-demeaned: all dependent variables and independent variables are forward-demeaned, and all fund size variables are instrumented by their backward-demeaned counterparts. Standard errors are clustered by fund and time. t -statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

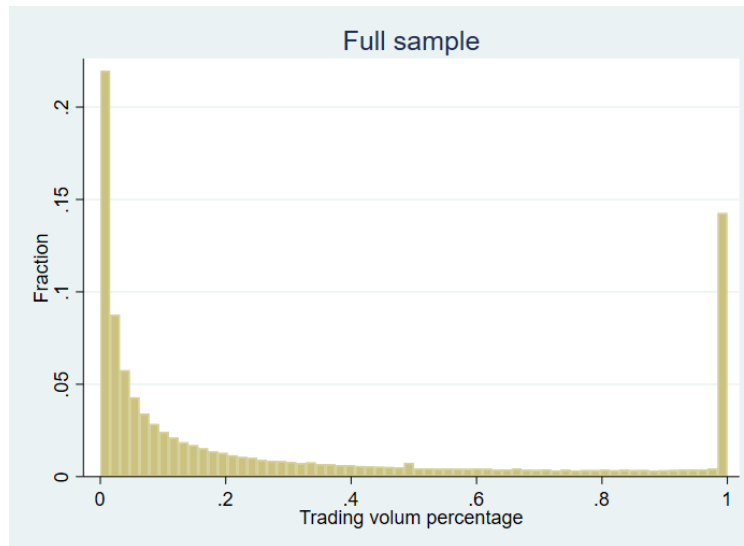
Panel A: Bond fund size and performance adjusted for illiquidity factor						
Dependent variable:	(1)		(2)		(3)	
Gross alpha _{j,t}	Bond and equity market + illiq. alpha		Four-factor + illiq. alpha		Vanguard funds + illiq. alpha	
Log fund size _{$j,t-1$}	0.005		0.005		0.032***	
	(0.66)		(0.88)		(3.66)	
Log fund age _{$j,t-1$}	-0.013**		-0.008**		-0.029***	
	(-2.34)		(-2.21)		(-3.00)	
Expense ratio _{$j,t-1$}	0.009		0.002		0.042**	
	(0.84)		(0.21)		(2.51)	
Turnover ratio _{$j,t-1$}	0.001		0.000		0.000	
	(1.50)		(1.26)		(0.48)	
Fund flow _{$j,t-1$}	0.035***		0.021***		0.026**	
	(4.37)		(3.93)		(2.15)	
Observations	76124		76124		76124	
Panel B: Bond fund size and performance conditional on market illiquidity						
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Gross alpha _{j,t}	Bond and equity market alpha		Four-factor alpha		Vanguard funds alpha	
Market illiquidity	Low	High	Low	High	Low	High
Log fund size _{$j,t-1$}	0.040***	-0.080**	0.011**	-0.014	0.045***	-0.141**
	(4.82)	(-2.03)	(2.45)	(-0.64)	(4.86)	(-2.10)
Log fund age _{$j,t-1$}	-0.046***	0.076**	-0.014***	0.009	-0.040***	0.151**
	(-7.23)	(2.01)	(-4.41)	(0.41)	(-4.95)	(2.38)
Expense ratio _{$j,t-1$}	0.066***	-0.131**	0.014**	-0.026	0.067***	-0.242**
	(4.64)	(-2.26)	(2.10)	(-0.91)	(4.08)	(-2.40)
Turnover ratio _{$j,t-1$}	0.009	0.132	0.014	0.035	0.039	0.178
	(0.25)	(0.52)	(0.98)	(0.61)	(1.08)	(0.40)
Fund flow _{$j,t-1$}	-0.012	0.064*	0.013**	0.037	-0.010	0.064
	(-0.92)	(1.82)	(1.99)	(1.44)	(-0.72)	(1.21)
Observations	78535	8560	78535	8560	78535	8560

Internet Appendix for
Large Funds and Corporate Bond Market Fragility

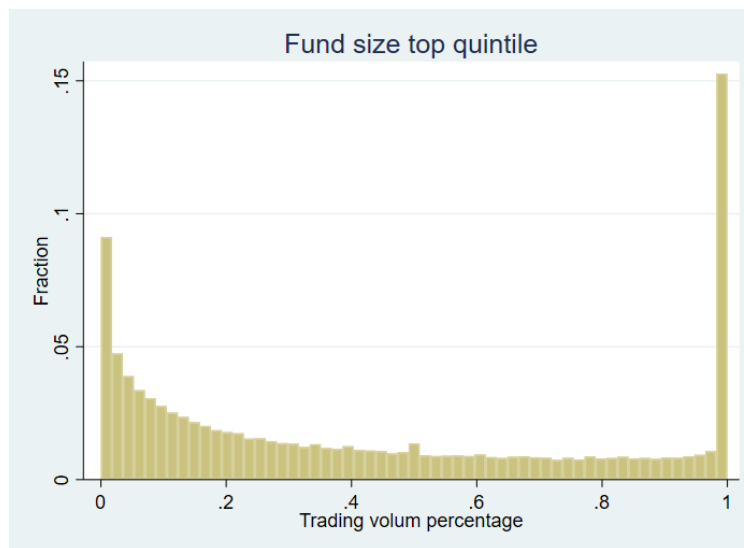
November 9, 2024

Figure IA1: Distribution of trading volume weight within a bond

This figure plots the distribution of the weight component in Equation (1). Panel A presents the distribution in the full sample, and Panel B presents the distribution in the sample of large funds in the top quintile.



Panel A: Full sample



Panel B: Large funds

Table IA1: Trading fund size squared and bond return volatility

This table contains the regression of bond return volatility on trading fund size squared. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. *Trading fund size* is the log of the trade-amount-weighted average total net assets squared of funds that trade a bond in the month. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. The independent variables and the dependent variable are measured for the same month (with no lead-lag relation) in the regressions. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Trading fund size squared _{<i>i,t</i>}	-0.009*** (-5.02)	-0.008*** (-5.03)	-0.006*** (-4.66)
Trading fund size squared _{<i>i,t</i>} × Market illiquidity _{<i>t</i>}	0.047*** (3.56)	0.043*** (3.62)	0.024*** (2.63)
Bond return volatility _{<i>i,t-1</i>}			0.452*** (31.68)
Total trading volume	0.134*** (5.43)	0.082*** (6.49)	0.063*** (6.00)
Bond return	-0.046*** (-3.74)	-0.046*** (-4.75)	-0.050*** (-6.82)
Maturity	0.003*** (23.26)	-0.006*** (-2.67)	0.002*** (14.20)
Bond size	-0.014 (-0.83)	0.162* (1.84)	-0.007 (-0.61)
Rating	0.122*** (16.18)	0.162*** (12.50)	0.066*** (16.28)
Coupon rate	-0.016** (-2.28)		-0.005 (-1.18)
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	202090	201044	202090
Adjusted <i>R</i> ²	0.365	0.483	0.500

Table IA2: Trading fund size and bond return volatility at the quarterly frequency

This table contains the regression of bond return volatility on trading fund size at the quarterly frequency. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given quarter. *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond in the quarter. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the quarter. All control variables are lagged by one quarter. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Trading fund size _{<i>i,t-1</i>}	-0.010*	-0.022***	-0.007*
	(-1.82)	(-3.78)	(-1.77)
Trading fund size _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	0.173***	0.207***	0.087**
	(3.58)	(4.32)	(2.55)
Bond return volatility _{<i>i,t-1</i>}			0.593***
			(22.94)
Holdings-based illiquidity _{<i>i,t-1</i>}	0.878***	0.393***	0.326***
	(11.96)	(4.34)	(3.26)
Total trading volume _{<i>i,t-1</i>}	0.268**	0.098	0.058
	(2.53)	(1.24)	(1.00)
IRC _{<i>i,t-1</i>}	0.388***	0.206***	0.142***
	(23.27)	(13.79)	(8.46)
Bond return _{<i>i,t-1</i>}	-4.223***	-4.763***	-5.811***
	(-7.54)	(-9.97)	(-5.04)
Maturity _{<i>i,t-1</i>}	0.003***	-0.001	0.001***
	(23.37)	(-0.29)	(7.04)
Bond amount outstanding _{<i>i,t-1</i>}	-0.145***	0.137	-0.046**
	(-5.59)	(1.14)	(-2.13)
Rating _{<i>i,t-1</i>}	0.141***	0.176***	0.055***
	(32.57)	(15.19)	(9.93)
Coupon rate _{<i>i</i>}	0.001		0.011*
	(0.18)		(1.94)
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	36274	33230	36274
Adjusted <i>R</i> ²	0.423	0.571	0.623

Table IA3: Trading fund size and bond return volatility: Contemporaneous regressions

This table contains the regression of bond return volatility on trading fund size. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond in the month. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. The independent variables and the dependent variable are measured for the same month (with no lead-lag relation) in the regressions. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Trading fund size _{<i>i,t</i>}	-0.016*** (-4.38)	-0.015*** (-4.35)	-0.007** (-2.36)
Trading fund size _{<i>i,t</i>} × Market illiquidity _{<i>t</i>}	0.112*** (4.99)	0.107*** (5.07)	0.049** (2.37)
Bond return volatility _{<i>i,t-1</i>}			0.438*** (28.09)
Total trading volume	0.164*** (2.76)	0.108** (2.35)	0.116** (2.48)
Bond return	0.010 (0.77)	0.007 (0.67)	-0.009 (-0.97)
Maturity	0.003*** (22.13)	-0.002 (-0.71)	0.002*** (13.43)
Bond size	-0.047** (-2.53)	0.061 (0.74)	-0.003 (-0.25)
Rating	0.122*** (16.01)	0.176*** (13.09)	0.070*** (16.64)
Coupon rate	-0.020*** (-2.98)		-0.010** (-2.46)
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	220621	219097	200268
Adjusted <i>R</i> ²	0.365	0.476	0.492

Table IA4: Trading fund size and bond return volatility controlling for top fund ownership

This table contains the regression of bond return volatility on trading fund size, controlling for *Top fund ownership*, constructed following Giannetti and Jotikasthira (2024). The dependent variable is the standard deviation of corporate bonds' weekly returns within a given quarter. *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond in the month. *Top fund ownership* is the ownership of the mutual fund that owns the largest amount of the bond as a fraction of the bond amount outstanding. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. All control variables are lagged by one quarter. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Trading fund size _{<i>i,t-1</i>}	-0.012*** (-3.79)	-0.014*** (-4.49)	-0.009*** (-3.70)
Trading fund size _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	0.072*** (3.06)	0.072*** (3.38)	0.042** (2.23)
Top fund ownership _{<i>i,t-1</i>}	-1.673*** (-4.50)	-1.801*** (-3.91)	-0.916*** (-3.44)
Top fund ownership _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	7.053** (2.41)	6.268* (1.77)	3.739* (1.70)
Bond return volatility _{<i>i,t-1</i>}			0.459*** (21.39)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	200620	199601	200620
Adjusted <i>R</i> ²	0.369	0.485	0.500

Table IA5: Holding fund size and bond return volatility

This table contains the regression of bond return volatility on holding fund size. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. *Holding fund size* is the log of the holdings-weighted average total net assets of funds that hold a bond in the month. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. All control variables are lagged by one month. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Holding fund size _{<i>i,t-1</i>}	-0.086*** (-12.34)	-0.053*** (-7.18)	-0.047*** (-12.66)
Holding fund size _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	0.211*** (5.23)	0.218*** (4.53)	0.122*** (6.07)
Bond return volatility _{<i>i,t-1</i>}			0.460*** (41.79)
Total trading volume _{<i>i,t-1</i>}	0.111*** (6.54)	0.059*** (5.25)	0.041** (2.41)
Holdings-based illiquidity _{<i>i,t-1</i>}	0.661*** (12.43)	0.218*** (3.71)	0.361*** (10.51)
IRC _{<i>i,t-1</i>}	0.385*** (20.32)	0.193*** (17.54)	0.196*** (19.34)
Bond return _{<i>i,t-1</i>}	-3.545*** (-3.35)	-3.920*** (-4.68)	-4.283*** (-7.01)
Maturity _{<i>i,t-1</i>}	0.003*** (26.90)	-0.003 (-1.40)	0.002*** (16.90)
Bond amount outstanding _{<i>i,t-1</i>}	-0.051*** (-3.08)	0.082 (0.94)	-0.023* (-1.95)
Rating _{<i>i,t-1</i>}	0.127*** (18.35)	0.161*** (13.79)	0.068*** (17.92)
Coupon rate _{<i>i</i>}	-0.013* (-1.91)		-0.005 (-1.26)
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	397492	396893	397492
Adjusted <i>R</i> ²	0.376	0.501	0.509

Table IA6: Trading fund size (equally-weighted) and bond return volatility

This table contains the regression of bond return volatility on trading fund size. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. *Avg. trading fund size* is the log of the average total net assets of funds that trade a bond in a month. *Market illiquidity* is the median of the gamma measure across all corporate bonds in a certain month. All control variables are lagged by one month. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Avg. trading fund size _{<i>i,t-1</i>}	-0.011*** (-2.91)	-0.013*** (-3.95)	-0.006** (-2.45)
Avg. trading fund size _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	0.096*** (3.46)	0.083*** (3.31)	0.043** (2.10)
Bond return volatility _{<i>i,t-1</i>}			0.452*** (31.76)
Total trading volume _{<i>i,t-1</i>}	0.134*** (5.48)	0.082*** (6.52)	0.062*** (5.88)
Holdings-based illiquidity _{<i>i,t-1</i>}	0.700*** (10.53)	0.290*** (3.93)	0.370*** (8.37)
IRC _{<i>i,t-1</i>}	0.374*** (18.57)	0.206*** (15.74)	0.192*** (17.12)
Bond return _{<i>i,t-1</i>}	-0.046*** (-3.74)	-0.046*** (-4.75)	-0.050*** (-6.83)
Maturity _{<i>i,t-1</i>}	0.003*** (23.26)	-0.006*** (-2.66)	0.002*** (14.17)
Bond amount outstanding _{<i>i,t-1</i>}	-0.018 (-1.06)	0.163* (1.85)	-0.010 (-0.84)
Rating _{<i>i,t-1</i>}	0.121*** (16.18)	0.161*** (12.50)	0.065*** (16.26)
Coupon rate _{<i>i</i>}	-0.015** (-2.23)		-0.005 (-1.13)
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	201923	200875	201922
Adjusted <i>R</i> ²	0.365	0.483	0.500

Table IA7: Trading fund size and bond price range

This table contains the regression of bond price range on trading fund size. The dependent variable is the range of bond price within a given month. *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond in the month. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. All control variables are lagged by one month. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Continuous measures of trading fund size and market illiquidity			
Dependent variable:	Bond price range _{<i>i,t</i>}		
	(1)	(2)	(3)
Trading fund size _{<i>i,t-1</i>}	-0.060*** (-3.62)	-0.032*** (-3.35)	-0.039*** (-3.42)
Trading fund size _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	0.502*** (3.33)	0.372*** (4.50)	0.320*** (3.26)
Bond price range _{<i>i,t-1</i>}			0.363*** (40.88)
Total trading volume _{<i>i,t-1</i>}	0.529*** (21.09)	0.256*** (16.58)	0.268*** (15.53)
Holdings-based illiquidity _{<i>i,t-1</i>}	3.675*** (22.33)	1.984*** (11.39)	2.417*** (17.65)
IRC _{<i>i,t-1</i>}	1.303*** (34.18)	0.499*** (21.29)	0.699*** (24.96)
Bond return _{<i>i,t-1</i>}	-0.052** (-2.30)	-0.052*** (-3.02)	-0.047*** (-3.69)
Maturity _{<i>i,t-1</i>}	0.006*** (14.43)	0.017** (2.55)	0.004*** (11.76)
Bond amount outstanding _{<i>i,t-1</i>}	0.972*** (13.18)	1.797*** (7.94)	0.735*** (14.12)
Rating _{<i>i,t-1</i>}	0.183*** (14.91)	0.232*** (10.89)	0.125*** (13.34)
Coupon rate _{<i>i</i>}	0.138*** (6.86)		0.079*** (5.51)
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	206045	204989	206045
Adjusted <i>R</i> ²	0.341	0.466	0.426

Table IA8: Trading fund size and bond return volatility during down markets: Robustness check with TED

This table contains the regression of bond return volatility on trading fund size. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond in a month. *Down market* indicates whether the variable TED falls in the top quintile. All control variables are lagged by one month. TED is the difference between the three-month London Interbank Offered Rate (LIBOR) and the three-month T-bill rate. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}	
	(1)	(2)
Trading fund size _{<i>i,t-1</i>}	-0.009*** (-2.90)	-0.008*** (-2.97)
Trading fund size _{<i>i,t-1</i>} × Down market _{<i>t</i>}	0.027** (2.41)	0.016* (1.80)
Total trading volume	0.134*** (5.43)	0.082*** (6.48)
Holdings-based illiquidity _{<i>i,t-1</i>}	0.703*** (10.63)	0.294*** (4.00)
IRC _{<i>i,t-1</i>}	0.374*** (18.55)	0.206*** (15.73)
Bond return _{<i>i,t-1</i>}	-4.630*** (-3.73)	-4.553*** (-4.74)
Maturity _{<i>i,t-1</i>}	0.003*** (23.28)	-0.006*** (-2.67)
Bond amount outstanding _{<i>i,t-1</i>}	-0.016 (-0.91)	0.163* (1.86)
Rating _{<i>i,t-1</i>}	0.122*** (16.20)	0.162*** (12.49)
Coupon rate _{<i>i</i>}	-0.015** (-2.26)	
Controls	Yes	Yes
Time fixed effects	Yes	Yes
Bond fixed effects	No	Yes
Observations	201922	200875
Adjusted <i>R</i> ²	0.365	0.483

Table IA9: Bond return volatility of bonds traded by other PIMCO funds after Bill Gross left PIMCO

This table contains the regressions of bond return volatility on the triple-interaction term between *Traded by PIMCO*, *Post*, and *Market illiquidity* around September 2014 when Bill Gross left PIMCO. $\Delta ownership$ by PIMCO is the change in the ownership (holding value divided by the amount outstanding of the bond in percentage) of a bond by PIMCO funds other than the Total Return fund managed by Bill Gross. *Post* indicates whether the month is after September 2014. *Market illiquidity* is the median of the gamma measure across all corporate bonds in the month. Control variables are the same as those in Table 2. Standard errors are clustered by fund. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Traded by PIMCO _{<i>i,t</i>} × Post _{<i>t</i>} × Market illiquidity _{<i>t</i>}	-13.045*** (-3.14)	-18.029*** (-4.42)	-12.395** (-2.31)
Traded by PIMCO _{<i>i,t</i>} × Post _{<i>t</i>}	0.492** (2.51)	0.791*** (3.49)	0.518** (2.27)
Traded by PIMCO _{<i>i,t</i>} × Market illiquidity _{<i>t</i>}	10.647*** (2.87)	13.001*** (3.29)	8.892* (2.00)
Traded by PIMCO _{<i>i,t</i>}	-0.398** (-2.25)	-0.507** (-2.42)	-0.334* (-1.75)
Bond return volatility _{<i>i,t-1</i>}			0.462*** (15.66)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	55883	55666	55883
Adjusted <i>R</i> ²	0.280	0.479	0.427

Table IA10: Trading fund size and bond return volatility: Excluding PIMCO

This table contains the regression of bond return volatility on trading fund size. The dependent variable is the standard deviation of corporate bonds' weekly returns within a given month. *Trading fund size* is the log of the trade-amount-weighted average total net assets of funds that trade a bond excluding PIMCO funds. All control variables are lagged by one month. Standard errors are clustered by bond and time. *t*-statistics are provided in parentheses. * * *, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Bond return volatility _{<i>i,t</i>}		
	(1)	(2)	(3)
Trading fund size excl. PIMCO _{<i>i,t-1</i>}	-0.017*** (-4.52)	-0.016*** (-4.74)	-0.011*** (-4.26)
Trading fund size excl. PIMCO _{<i>i,t-1</i>} × Market illiquidity _{<i>t</i>}	0.110*** (3.92)	0.101*** (4.07)	0.059*** (2.82)
Bond return volatility _{<i>i,t-1</i>}			0.452*** (31.52)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Bond fixed effects	No	Yes	No
Observations	200723	199687	200723
Adjusted <i>R</i> ²	0.365	0.483	0.500

Table IA11: Fund size and capital allocation across asset classes

This table contains the regression of capital allocation across different asset classes on fund size. The dependent variable is the percentage of holdings in cash, government bonds, municipal bonds, corporate bonds, mortgages, or equity. The variables are recursive-demeaned: all dependent variables and independent variables are forward-demeaned, and all fund size variables are instrumented by their backward-demeaned counterparts. Standard errors are clustered by fund and time. t -statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Holding percentage:	<u>Cash_{<i>j,t</i>}</u>	<u>Government_{<i>j,t</i>}</u>	<u>Municipal_{<i>j,t</i>}</u>	<u>Corporate_{<i>j,t</i>}</u>	<u>Mortgage_{<i>j,t</i>}</u>	<u>Equity_{<i>j,t</i>}</u>
Log fund size _{<i>j,t-1</i>}	0.001 (0.17)	-0.010 (-0.76)	-0.001 (-0.15)	-0.017 (-0.96)	0.060*** (3.97)	0.006 (1.29)
Log fund age _{<i>j,t-1</i>}	-0.004 (-0.86)	-0.006 (-0.78)	-0.000 (-0.12)	0.007 (0.64)	-0.028*** (-3.08)	-0.002 (-1.04)
Expense ratio _{<i>j,t-1</i>}	-0.362 (-0.25)	-0.724 (-0.25)	0.939 (1.08)	-0.984 (-0.25)	9.802** (2.39)	1.857* (1.74)
Turnover ratio _{<i>j,t-1</i>}	0.006** (2.52)	0.002 (0.72)	0.002 (1.48)	-0.017*** (-5.16)	0.006 (1.50)	0.000 (0.80)
Fund flow _{<i>j,t-1</i>}	0.022* (1.87)	0.099*** (5.08)	0.002 (0.71)	-0.068*** (-3.44)	-0.069*** (-3.38)	-0.003 (-0.82)
Observations	36334	36334	36334	36334	36334	36334

Table IA12: Fund size and the use of leverage

This table contains the regression of usage of leverage on fund size. The dependent variable is either *leverage use* or *leverage percentage*. *Leverage use* is a dummy variable equal to one if the total market value of the fund's holdings is larger than the fund's total net assets. *Leverage percentage* is calculated as the difference between the total market value of the fund's holdings and the fund's total net assets scaled by total net assets for funds that use leverage. Standard errors are clustered by fund and time. *t*-statistics are provided in parentheses. * * *, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	(1) Leverage use _{<i>j,t</i>}	(2) Leverage use _{<i>j,t</i>}	(3) Leverage percentage _{<i>j,t</i>}	(4) Leverage percentage _{<i>j,t</i>}
Log TNA _{<i>j,t-1</i>}	-0.010 (-0.72)	-0.043** (-2.60)	-0.012** (-2.06)	-0.029*** (-3.37)
Fund alpha _{<i>j,t-1</i>}	-0.239 (-0.68)	0.458** (2.21)	0.025 (0.09)	-0.021 (-0.14)
Expense ratio _{<i>j,t-1</i>}	0.007 (0.13)	-0.124 (-1.34)	0.094*** (3.82)	-0.015 (-0.31)
Turnover Ratio _{<i>j,t-1</i>}	0.081*** (5.59)	0.027** (2.25)	0.004 (0.87)	0.012*** (3.40)
Log fund age _{<i>j,t-1</i>}	0.028 (1.25)	0.023 (0.51)	0.011 (0.91)	0.099*** (3.98)
Time fixed effects	Yes	Yes	Yes	Yes
Bond fixed effects	No	Yes	No	Yes
Observations	32084	32063	5780	5731

Table IA13: Fund size and flows during down markets

This table contains the regression of fund flow on the interaction term of a large fund indicator and a down market indicator. In Columns (1) and (2), *Down market* indicates whether market illiquidity falls in the top quintile. In Columns (3) and (4), *Down market* indicates the recession periods based on the US Business Cycle Expansions and Contractions data from the National Bureau of Economic Research (NBER). In Columns (5) and (6), *Down market* indicates whether the VIX is above the top quintile. All control variables are lagged by one month. Standard errors are clustered by fund and time. *t*-statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	Fund flow _{<i>i,t</i>}					
	(1)	(2)	(3)	(4)	(5)	(6)
Down market:	Illiquid market		NBER recession		VIX top quintile	
Large fund _{<i>i,t-1</i>} × Down market _{<i>i,t</i>}	0.333 (1.32)	0.332 (1.32)	0.216 (0.79)	0.214 (0.78)	-0.183 (-0.87)	-0.185 (-0.88)
Large fund _{<i>i,t-1</i>}	0.275*** (2.88)	0.274*** (2.88)	0.288*** (3.08)	0.287*** (3.08)	0.325*** (3.43)	0.325*** (3.44)
Performance rank _{<i>i,t-1</i>}	1.062*** (7.09)	1.064*** (7.08)	1.061*** (7.08)	1.063*** (7.07)	1.058*** (7.06)	1.059*** (7.06)
Expense ratio _{<i>i,t-1</i>}	-0.168 (-1.07)	-0.195 (-1.16)	-0.168 (-1.07)	-0.195 (-1.16)	-0.167 (-1.06)	-0.194 (-1.15)
Turnover ratio _{<i>i,t-1</i>}	0.079** (2.06)	0.080** (2.07)	0.080** (2.06)	0.080** (2.08)	0.080** (2.08)	0.081** (2.09)
Log fund age _{<i>i,t-1</i>}	-0.739*** (-11.42)	-0.743*** (-11.44)	-0.739*** (-11.43)	-0.744*** (-11.45)	-0.739*** (-11.42)	-0.744*** (-11.44)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bond category fixed effects	No	Yes	No	Yes	No	Yes
Observations	60262	60262	60262	60262	60262	60262
Adjusted <i>R</i> ²	0.039	0.039	0.039	0.039	0.039	0.039

Table IA14: Fund size and performance: Robustness check with net alphas

This table contains the regression of fund performance on fund size. Log fund size is the log form of fund total net assets. The variables are recursive-demeaned: all dependent variables and independent variables are forward-demeaned: all fund size variables are instrumented by their backward-demeaned counterparts. The dependent variable is fund performance measured by net alpha calculated based on net fund returns. Control variables include lagged values of fund age, expense ratio, turnover ratio, and fund flows. Standard errors are clustered by fund and time. t -statistics are provided in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	(1)	(2)	(3)
Net alphas $_{j,t}$	Bond and equity market alpha	Four-factor alpha	Vanguard funds alpha
Log fund size $_{j,t-1}$	0.042*** (5.91)	0.014*** (3.88)	0.045*** (4.78)
Log fund age $_{j,t-1}$	-0.025*** (-6.25)	-0.011*** (-5.01)	-0.015*** (-2.90)
Expense ratio $_{j,t-1}$	0.029*** (2.91)	0.001 (0.29)	0.029** (2.25)
Turnover ratio $_{j,t-1}$	0.048 (1.35)	0.035* (1.76)	0.062* (1.76)
Fund flow $_{j,t-1}$	0.004 (0.44)	0.018*** (4.00)	-0.001 (-0.10)
Observations	115779	115779	105854