Institutional Synergies and the Fragility of Loan Funds

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Abstract

There are two major institutional investors in the syndicated loan market: collateralized loan obligations (CLOs) and loan mutual funds. CLOs are closed-end funds while loan funds are open-end funds that issue claims that are redeemable on demand. In this paper, we examine whether CLOs provide arbitrage capital that contributes to the resilience of loan funds. We find that CLOs act as shock absorbers, providing liquidity through par building trades when loan funds experience large outflows. However, CLO-provided liquidity is limited to par build eligible loans, leading to potential flow-induced fire sales among par ineligible loans.

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"These [illiquid investment] funds are built on a lie, which is that you can have daily liquidity for assets that fundamentally aren't liquid." – Mark Carney, the former governor of the Bank of England

"When the stock market gets the flu, high yield catches a cold and bank loans get the sniffles …That's the cosmic order of things." – Christopher Remington, Eton Vance

1. Introduction

There are two major institutional investors in institutional loans: collateralized loan obligations (CLOs) and loan mutual funds. According to S&P, the market share of CLOs is about 65 percent while loan funds have around a 20 percent share.[1] Like banks, but unlike CLOs, loan mutual funds engage in liquidity transformation, by investing in presumably illiquid loans financed by redeemable on-demand claims on the underlying loan portfolio. Thus, over the past decade, bank loan funding has been replaced, in part, by loan mutual funds with potentially greater exposure to liquidity shocks.

The growth of open-end mutual funds investing in relatively illiquid corporate bonds and loans has raised concerns that this growth may adversely affect financial sector stability (as the first quote by Governor Carney illustrates). While arguably all open-end bond funds engage in some degree of liquidity transformation, at first glance loan funds appear to represent an extreme form of liquidity transformation. Unlike publicly traded corporate bonds, there are no reporting requirements for trades in the institutional loan market, most borrowers in the loan market are not publicly traded, and settlement times are longer for loans than for bonds. Moreover, loans are not considered to be securities and thus are exempt from Securities Act of 1933 disclosure requirements.[2] These differences suggest that the leveraged loan secondary market may be less liquid than the corporate bond market, leading to greater vulnerability to runs due to redemption-induced price declines (see Goldstein, Jiang, and Ng (2017) (hereafter GJN), and more recently Falato, Hortacsu, Li, and Shin (2021) (hereafter FHLS)).

The variability of investment flows into and out of loan funds suggests that concerns over greater vulnerability of loan funds to liquidity shocks may be justified. As shown in Figure 1, aggregate flows into and out of loan funds are substantially more volatile than the flows of corporate bond funds generally and high yield bond funds (the latter of which, like loan funds,

[1] From 2018 through January 2020 there was a net outflow from loan funds. From March 2020 through July 2022 there was a net inflow to loan funds. Analysts attribute these outflows to declines in credit risk spreads and the subsequent inflows to concerns about rising interest rates. See https://www.morningstar.com/articles/1040270/bank-loan-funds-are-back-here-are-2-to-consider

[2] For a description of Securities Act of 1933 disclosure requirements, see https://fas.org/sgp/crs/misc/IF11256.pdf

invest primarily in less than investment grade credits). However, despite a greater flow volatility, as seen in Figure 2, return volatility is significantly *lower* for loan funds than high yield bond and corporate bond funds generally.[3] While the greater return stability of loan funds in the presence of volatile investment flows suggests greater resilience of loan funds to investment outflows (as the second quote suggests), other factors such as less exposure to interest rate risk and the secured nature of bank loans may also explain the resilience.[4]

In this paper, we examine the extent to which open-end loan funds exhibit the same type of fire-sale discounts and accompanying fragility as documented for open-end corporate bond funds (see, for example, GJN (2017), FHLS (2021), and Manconi, Massa, and Yasuda (2012)).[5] The mechanism leading to fire-sale discounts is a downward sloping demand for loans arising from slow moving arbitrage capital. As Shleifer and Vishny (1997) and Coval and Stafford (2007) argue, limits to arbitrage are more likely to arise when investors hold concentrated positions in assets with limited breadth of ownership.

The narrow investment focus of open-end loan funds would appear to make them particularly vulnerable to fire-sale discounts from large investment outflows. However, we argue that CLOs have the ability and incentive to supply arbitrage capital during periods of large outflows from loan mutual funds, which mitigates the effect of redemptions on loan prices. As Cordell, Roberts and Schwert (2021) (hereafter CRS) explain, CLOs are closed-end funds so that capital inflows and outflows are limited. In addition, CLOs are actively managed with managers buying and selling loans during most of the life of a CLO. More importantly, CLO managers have an incentive (subject to certain limitations) to acquire loans trading at a discount from par value. Specifically, par building refers to CLOs purchasing loans at a discount but reporting the par value of these loans when performing overcollateralization tests. As discussed later, par building is subject to ratings restrictions, but is generally permitted for loans selling at prices above 85 percent

[3] The weighted average volatility in monthly returns is 0.39 percent for high yield funds versus only 0.23 percent for loan funds over the period 2010 through 2020 (the difference is statistically significant at the 1% level). One potential explanation for the lower return volatility is that loan fund managers engage in return smoothing (See Emin and James, 2022). While return smoothing may contribute to lower return volatility, as discussed later, the discrete change in return volatility around CLOs' par build eligibility threshold is difficult to explain in the context of return smoothing.
[4] Most leveraged loans have a floating rate structure tied to 90-day LIBOR or other short term interest rate indices and thus their value is less sensitive to fluctuations in the level of interest rates.
[5] A recent study by Choi, Hoseinzade, Shin, and Tehranian (2020) finds that corporate bond funds hold significant liquidity cushions that may mitigate the price impact of large redemptions. As we discuss later, the narrow focus of loan and high yield funds precludes them from holding large cushions of cash or government securities.

of the par.[6] Par building transactions loosen overcollateralization constraints, which allows CLOs to use greater leverage and thus makes purchasing loans at a discount attractive to CLOs. The incentive to purchase par eligible loans may enable CLOs to act as shock absorbers in the leveraged loan market by providing arbitrage capital to loan funds under selling pressure. As a result, loan funds may be less susceptible to redemption-induced fire-sale discounts than high yield corporate bond funds. We refer to this institutional synergy as the *Shock Absorber Hypothesis*.

Recent research by Elkamhi and Nozawa (2022) and Kundu (2023) suggests that the role of CLOs as shock absorbers in the leveraged loan market is likely limited to loans selling at modest discounts from par. As discussed later, CLO indentures contain covenants that require deeply discounted loans to be carried at their purchase price and limit the holdings of loans rated CCC+ or lower (so called par ineligible loans). These restrictions are likely to lead CLOs to avoid purchasing par ineligible loans and sell par ineligible loans during market downturns. Thus, we expect redemption-induced price declines to be significantly greater for par ineligible loans.

We begin our investigation of institutional synergies by examining the incidence of outflow-induced fire-sale discounts. We compare the incidence of fire-sale discounts in loan funds to that for high yield bond funds because both invest in less than investment grade credits but differ in terms of how they trade and active investing by CLOs in the loan market. We identify fire-sale discounts by examining the relationship between changes in prices and mutual fund investment flow pressure. Specifically, we follow Coval and Stafford (2007) and measure flow pressure as changes in holdings of a given loan or bond by funds experiencing large redemptions or investor inflows. Sales of assets by funds with large outflows are more likely to be forced sales and thus result in fire-sale discounts.

If investment in leveraged loans exposes bank loan funds to a greater fire-sale risk, we would expect a larger impact of sell flow and peer flow pressure on loan fund returns than on returns of high yield bond funds. Consistent with the findings of Coval and Stafford (2007), using holdings data we find a negative and significant impact of fire-sale pressure induced by outflows on loan prices. Consistent with FHLS (2021), at the fund level we also find a negative relationship between fire-sale pressure exerted by peer funds and fund performance. However, we find that

[6] CLOs are required to perform monthly overcollateralization (OC) tests. These tests require a CLO's loan portfolio relative to the principal value of notes outstanding to exceed a certain threshold. See Section 2 and Loumioti and Vasvari (2019) for a discussion of OC tests and their implications for loan valuation.

flow and peer flow pressures have a significantly *smaller* impact on loan prices and fund returns than on high yield bond prices and fund returns. Moreover, the difference in the impact of sales pressure on loan and bond prices (and fund returns) is economically large. For example, a one standard-deviation increase in sell pressure is associated with on average a 1.4 times greater impact on high yield bond prices than loan prices.

We next explore potential explanations for why loan mutual funds appear to be less susceptible to flow-induced fire-sale discounts and spillover effects. First, we examine the composition of loan fund assets and how it varies over time. Specifically, we examine whether loan fund resilience arises from large cash or government securities holdings serving as a buffer against adverse liquidity shocks. We find that on average cash holdings as a percentage of assets under management are similar for loan, high yield, and corporate bond funds generally. In addition, loan funds hold only 0.4 percent of their assets in government securities. Loan funds may avoid holding potentially illiquid loans by taking positions in highly rated senior tranches of CLOs. However, we find that loan funds hold, on average, only about one percent of their assets in asset backed securities. In contrast, they hold about 90 percent of their assets in either bank loans (66%) or short-term high yield floating rate notes (21%).

Another potential explanation for smaller fire-sale discounts and spillover effects for loan funds is that, despite the lack of transparency, trading by CLOs and other institutional investors in leveraged loans leads to greater liquidity and lower costs of arbitrage than in the corporate bond market. Aggregate trading statistics suggest that this may be the case. For example, according to the Loan Syndications and Trading Association (LSTA), the trading volume in the first six months of 2021 totaled $412 billion relative to approximately $1.2 trillion in institutional loans outstanding at year-end 2020. In contrast, according to the Securities Industry and Financial Markets Association (SIFMA), aggregate trading volume in corporate bonds over the same period was only $180 billion relative to approximately $10.4 trillion outstanding at year-end 2020.[7]

Unfortunately, transaction prices for loan trades are not available, so it is difficult to directly compare trading costs of bank loans to those of bonds. Thus, we construct an indirect measure of liquidity and arbitrage costs based on differences between transaction prices and net

[7] See https://www.lsta.org/news-resources/2q21-secondary-trade-data-study-executive-summary for institutional loan trading volume. For corporate bond trading volume, see https://www.sifma.org/resources/research/us-fixed-income-securities-statistics/.

asset values (NAVs) of shares of loan and high yield bond ETFs. For an ETF, trading by authorized participants (APs) is intended to align the trading price of shares in the ETF with the NAV of the shares. The average premium (or discount) in the share price relative to the NAV therefore provides a measure of the cost of arbitrage for the APs. If the cost of trading the underlying loans is significantly greater than the cost of trading high yield bonds, we expect the average premium for loan funds to be significantly greater than that for high yield ETFs. However, we find that the average premium for loan ETFs is significantly *less* than the average premium for high yield bond ETFs (and corporate bond ETFs generally). More importantly, we find that loan fund share creations/redemptions are significantly more sensitive to premiums/discounts than for high yield bond funds. The difference in the marginal effects of premiums on share redemptions is economically large, with the marginal probability of share redemption being almost 10 times larger for loan funds than for high yield bond funds. These findings suggest that the cost of arbitrage in the loan market is significantly less than that in the high yield bond market.

To explore whether par building contributes to loan mutual fund resilience, we examine the relation between investment flows into and out of loan funds and par building activity of CLOs. For this analysis, we obtain transaction prices and the volume of CLO purchases and sales of leveraged loans from CLOi. Following CRS (2021), we define par building buy transactions as loans that CLOs purchase at a discount relative to par, and CLO par building sales transactions as sales of loans at or above par value. We match CLO loan trades with CRSP mutual funds' loan holdings to identify CLO and mutual fund trades in the same loan.

To investigate synergies between CLOs' buying activity and flow-induced redemptions, we examine the relationship between par building and mutual fund flow pressure. Lower (higher) values for the pressure measure indicate loan selling (buying) by mutual funds induced by investor outflows (inflows). We also calculate separately buy and sell pressure. We find a negative and significant relationship between par building activity by CLOs and the flow-driven pressure. More importantly, we find that the relationship between CLO par building activity and mutual fund flow pressure is asymmetric. Specifically, par building purchases by CLOs are positively related to flow-induced sales by loan mutual funds. In addition, we find that par building activity is greatest when there are aggregate net outflows from loan funds.

Finally, and perhaps most interestingly, we find a significant difference in the relationship between the loan price changes and mutual fund sales pressure for par build eligible and par build ineligible loans. As shown in Figure 3, we find the impact of sales pressure is negligible for par build eligible loans. In sharp contrast, we find the impact of sales pressure on loan prices is negative and significant for par build *ineligible* loans.

We conduct several tests to examine whether the difference in price impact is due to CLO par building activity or other factors. CLO managers are unlikely to engage in par building by purchasing loans at or close to the par build eligibility thresholds since loans close to the threshold expose the manager to the risk of losing par in the event of small decrease in loan performance. The first test involves searching over loan prices for a structural break in par building activity. Specifically, drawing on the literature of structural breaks (Card, Mas, and Rothstein, 2008 and Hansen, 2000), we identify a significant discontinuity in par building activity at 87.5 percent of par value. Next, we test whether there is a significant difference in the price impact of loan fund selling pressure around the threshold of 87.5. Consistent with the *Shock Absorption Hypothesis*, we find the impact of sell pressure is significantly greater for loans below the 87.5 threshold than above. Finally, we perform a placebo test by comparing the impact of sales pressure on loans and high yield bonds prices. As shown in Figure 4, we find sales pressure has a significantly greater impact on high yield bond prices than loan prices, but only for loans priced above 87.5. For prices below 87.5, we find no difference in the impact of sales pressure on loan prices than bond prices.

To examine whether the greater sensitivity of loan prices to sell pressure is due to fire-sale discounts or fundamentals, we perform two tests. First, we examine cumulative average abnormal returns (CAARs) around flow-pressure months and compare the pattern of abnormal returns for par eligible and par ineligible loans. Consistent with fire-sale discounts, we find for par ineligible loans a U-shaped pattern of returns around the sell-pressure month, and no evidence of negative abnormal returns for par eligible loans around the sell-pressure month. Second, for firms with both loans and CDS trading, we examine whether flow pressure is related to CDS spreads. By including firm and year fixed effects, we can compare the impact of flow pressure on loan prices and CDS spreads for the same firm controlling for time-invariant factors. In contrast to loan returns, we find no significant relationship between fund investment flows and CDS spreads.

To our knowledge, our study is the first to examine the institutional synergies and the flow of arbitrage capital in the loan market. Specifically, we provide novel evidence of synergies among institutional investors in the loan market and find that fire-sale discounts among loan mutual funds vary with the availability of arbitrage capital from outside the mutual fund sector. Our research also contributes to the literature on how stable funding insulates certain institutions from temporary dislocations in securities prices. For example, Chodorow-Reich, Ghent, and Haddad (2020) provide evidence that the stable long-term liabilities of insurance companies act as asset insulators, allowing insurers to ride out transitory bond price declines. O'Hara, Rapp, and Zhou (2022) find that insurers acted as "buyers of last resort" in the corporate bond market during the COVID-19 pandemic. We provide evidence that the asset insulation of the stable funding of CLOs generates synergies that reduces the vulnerability of mutual funds to fire-sale discounts.[8] More broadly, our research suggests that the vulnerability of institutions to transitory pricing distortions depends on not just their own funding sources but the funding of other institutions investing in similar assets. Finally, our analysis suggests that for large adverse economic shocks that lead to loan prices decreasing below the par eligibility threshold, arbitrage capital from CLOs will not be available. In this respect, our finding of fire-sale discounts among par ineligible loans is consistent with those of Elkamhi and Nozawa (2022) who find evidence of fire sales among recently downgraded par ineligible loans.

The rest of the paper is organized into seven sections. In section 2, we provide institutional background on trading of syndicated loans and institutional holdings. Section 3 provides a description of our data sources, variable construction, and summary statistics concerning the funds in our sample. In section 4, we examine the relationship between contemporaneous loan and bond returns and fund outflows. In section 5, we examine the price impact of redemption induced outflows. In section 6, we compare the costs of arbitrage in the syndicated loan and high yield bond markets. In section 7, we examine the relationship between CLO par building transactions and mutual fund flow pressure. We also examine whether the impact of sell pressure on loan prices varies around the par build price threshold. Section 8 provides concluding comments.

2. Institutional Background on Loan Trading and CLO Par Building Activity

Concern with the potentially greater fragility of loan funds stems in part from differences in the way loans and bonds trade. Unlike corporate bonds, traders in the loan market cannot generally observe dealer quotes in a centralized location or on a computer screen. Instead, as

[8] Insurance companies are unlikely to act as shock absorbers in the loan market. According to the National Association of Insurance Commissioners, at year-end 2020, insurance companies held about one percent of their investment portfolios in leveraged loans, which amounts to less than three percent of the leveraged loans outstanding (Wong and Carelus, 2021).

described in Taylor and Sansone (2007), indicative quotes are obtained from originating banks. More recently, indicative quotes from broker-dealers are assembled and distributed by loan pricing services such as LSTA and IHS Markit (Markit). Nevertheless, loan trading lacks the transparency the Financial Industry Regulatory Authority (FINRA) Trade Reporting and Compliance Engine (TRACE) provides for bond trading.

Loan trading differs from bond trading along two additional dimensions. First, because loans are not securities, loan sales contracts require more extensive documentation and take longer to settle. Most par or near par trades (typically at a price of 90% or more) use LSTA or Loan Market Association (LMA) documentation forms and settlement procedures. LSTA settlement procedures allow seven days to settle in contrast to the two-day settlement for most corporate bonds. In addition, because loans are not securities and most borrowers are not publicly held, loan transactions are not governed by securities laws and borrowers are not subject to the same disclosure requirements as firms registered with the U.S. Securities and Exchange Commission (SEC). Finally, loan contracts are often bespoke with borrower specific covenants.[9] Given the potential information asymmetry between the original lender and the purchaser of the loan in the secondary market, LSTA and LMA loan trade documents contain so called "Big Boy" language concerning non-reliance and lack of liability if one party possesses material information unknown to the other.[10]

A second way in which loan trading differs from bond trading is that loan sales can be structured as either an assignment or a participation. Assignment sales are more common and are true sales in the sense that the assignee obtains an ownership interest in the loan or in the part assigned. In a participation, on the other hand, the original lender maintains ownership over the loan and the participant has only a contractual right against the leading participant, not a credit relationship with the borrower (see Taylor and Sansone, 2017). As a result, with loan participations, the buyer generally has no right to enforce compliance with the terms of the credit agreement against the borrower, and the buyer is subject to the credit risk of both the borrower and

[9] For evidence of heterogeneity among syndicated loan contracts see Ivashina and Vallee (2022).

[10] Trades in the United States are conducted using LSTA documentation while trades in the UK and Europe are conducted using LMA. Settlement typically occurs within seven days (as opposed to two days for corporate bonds in the United States). For differences between LMA and LSTA trading, see https://www.cadwalader.com/uploads/media/CWT_-_LMA_vs_LSTA_loan_trading_2015-12_(3).pdf

the seller. Loan mutual funds acquire loans under both assignment and participations although participations are typically used when acquiring relatively small (under $5 million) interests.

The prospectuses for the loan funds in our sample warn investors that illiquidity and valuation risk is a principal risk associated with investing in loan funds. For example, the Shareholder Report for Fidelity Floating Rate High Income Fund states:

> *Floating rate loans generally are subject to restrictions on resale. Floating rate loans sometimes trade infrequently in the secondary market. As a result, valuing a floating rate loan can be more difficult, and buying and selling a floating rate loan at an acceptable price can be more difficult or delayed, including extended trade settlement periods.*

While the lack of transparency and complexity of trading loans may impede the movement of arbitrage capital in a way that makes loans more susceptible to fire-sale discounts than bonds, CLOs' purchase and sale activity may serve to mitigate those impediments. As we mentioned earlier, CLOs are closed-end funds and are therefore not subject to redemption-induced sales pressure. Moreover, CLO managers may have an incentive to acquire loans at a discount from par, creating a supply of arbitrage capital for loans under flow-induced sales pressure from mutual funds.

The incentive to acquire loans at a discount from par arises from the way CLO covenant compliance is determined. As Kundu (2022) explains, CLOs are subject to coverage and quality covenants that are intended to limit CLO leverage and to ensure adequate interest coverage on the CLO's debt tranches. The overcollateralization covenant (OC) is designed to limit leverage while interest diversion covenants (ID) are designed to ensure adequate coverage of the CLO's interest obligations. A breach of either of these covenants leads to a diversion of cash flows away from the equity tranche (as well as payment of management fees) and is therefore costly to the CLO manager.

When calculating covenant compliance, most loans are valued at *par* and not marked to market. The exceptions to par value accounting are so called "discount obligations", loans that have been downgraded to CCC+ or below and loans that are in default. Discount obligations are loans that are purchased at below 80 (or 85) percent of par. Discount obligations are carried at the purchase price (if rated above CCC+) but cease to be considered as discount obligations if their market value rises above 90 percent of par for 30 consecutive days or more.[11] Defaulted assets are marked at the lower of market value or recovery value (typically as estimated by S&P or Moody's). Assets rated CCC+ or below are carried at market value except when the covenant limit on CCC+ holdings is breached, in which case, CCC+ loans must be carried at the *lowest* market value of any loan in the CCC bucket.

CLO managers can build par value for covenant compliance in several ways. First, buying loans at a discount (subject to certain restrictions) in the secondary market can build par since purchasing loans at a discount adds to par by the difference between par value of the loan and the loan's acquisition price. Second, selling loans with market prices above par can build par by the difference between the sales price and par value. Third, as Kundu (2022) and Elkamhi and Nozawa (2022) explain, CLOs may build par for compliance by selling CCC rated loans and paying down debt.[12]

CLOs buying par build eligible loans reduces the likelihood of a covenant violation and allows the CLO to operate at higher levels of leverage, which may in turn increase the returns to equity.[13] Par building buy activity may also generate a positive externality by providing arbitrage capital that is used to buy loans selling at a discount due to sell pressure by mutual funds. However, the par building externality is likely to be limited to loans selling at prices above 85 percent of par. Indeed, CLO managers are likely to limit par building buys to loan selling at prices just above 85 to avoid losing par in the event of a ratings downgrade or a decrease in price after purchase. Consistent with this conjecture, as we show later, net par buying activity is concentrated in loans selling at 87.5 percent of par or more.

[11] Whether or not a loan purchased at a deep discount is considered as a discount obligation is based on a number of factors, including the credit rating at the time of purchase. For example, the offering memorandum for Apidos CLO XXXI contains the following definition of a discount obligation. "Discount Obligation": Any Collateral Obligation… that was purchased (as determined without averaging prices of purchases on different dates) for less than (1) in the case of Senior Secured Loans, (a) 80.0% of its principal balance, if such Collateral Obligation has (at the time of the purchase) an S&P Rating of "B-" or higher and a Moody's Rating of "B3" or above, or (b) 85.0% of its principal balance, if such Collateral Obligation has (at the time of the purchase) an S&P Rating of "CCC+" or lower or a Moody's Rating of below "B3," … *provided* that such Collateral Obligation will cease to be a Discount Obligation at such time as the Market Value (expressed as a percentage of the par amount of such Collateral Obligation) determined for such Collateral Obligation on each day during any period of 30 consecutive days since the acquisition by the Issuer of such Collateral Obligation equals or exceeds 90.0% (in the case of Senior Secured Loans) or 85.0% (in the case of Collateral Obligations that are not Senior Secured Loans) on each such day.

[12] As shown in Appendix B2, depending on the assets under management, transaction amount, and the current coverage ratio, building par through selling CCC rated loans and *purchasing* discounted loans may be more profitable than selling CCC rated loans and paying down debt.

[13] Cordell et al. (2021) find a positive relation between the returns to equity and CLO par building.

We focus our analysis on whether CLO trading activity absorbs redemption-induced fire sales because, as discussed earlier, CLOs are the largest player in the institutional leveraged loan market and their indenture contracts provide incentives to purchase loans at a discount. According to S&P, as of year-end 2020, CLOs' share of the leveraged institutional loan market was 70 percent. Besides loan funds and CLOs, the other institutional investors are hedge funds, finance companies, and insurance companies.

While insurance companies, like CLOs, have stable funding sources there are several reasons why insurance companies are unlikely to act as an important source of shock absorption in the leveraged loan market. First, insurance companies have a relatively small share of the leveraged loan market. According to the National Association of Insurance Commissioners, at year-end 2020 insurance companies held only about one percent of their investment portfolio in leveraged loans which, in aggregate, amounts to less than three percent of the leveraged loan market (Wong and Carelus, 2021). Second, insurance companies are required to report their assets at fair value rather than book value, providing little incentive to buy loans selling at a discount from par. Third, insurance companies are subject to ratings-based capital requirements, which requires them to hold substantially more capital for less than investment grade loans (see Murry and Nikolova, 2022).

3. Data and Sample Description

3.1 Sample construction

Our main data source is the Center for Research in Security Prices (CRSP) Survivor-Bias-Free Mutual Fund Database. We supplement the CRSP data with information from the Morningstar Mutual Fund database, Markit, TRACE, and CLOi databases. The performance-flow analysis is based on active funds for the period running from 2003 to 2020.[14] Our sample period starts from 2003 because (1) there are few loan funds in the CRSP database prior to 2002, and (2) we use 12 months of data to estimate the alpha of individual funds for the flow-performance tests. Our initial set of loan funds are those with a Lipper classification code "LP." We then read fund

[14] In Appendix A, we show analyses through 2019 to exclude liquidity shocks associated with the COVID-19 pandemic. A number of government programs designed to shore up the corporate bond market were implemented beginning in March of 2020 (for a description of these programs, see Falato, Goldstein and Hortacsu, 2021), the programs targeted bonds and not leveraged loans and thus may distort differences in the liquidity of loans and bonds. However, as shown in Appendix A, our main findings are similar if we exclude observations from 2020.

names and prospectuses and drop loan funds that mainly invest in mortgage assets. For our main tests, we also exclude exchange traded funds/notes (ETFs). For most of our analyses, we compare the behavior of investors in loan funds to high yield bond funds. We use high yield funds as a benchmark since previous work by Goldstein and Hotchkiss (2020) finds that bond liquidity varies inversely with credit risk. We identify general corporate and high yield bond funds using Lipper, Strategic Insights, Wiesenberger, and CRSP Objective Code identifiers in the CRSP database.

Fund-specific variables are obtained from the CRSP database, including returns, total net assets, age, expense ratio, and rear load. Our sample starts with 79 loan funds and 1,497 bonds funds. After requiring non-missing alphas, our final sample includes 78 loan funds as well as 1,422 bond funds (of which 359 are classified as high yield funds).

We examine liquidity in the loan market by investigating (1) the difference between closing prices of loan ETFs and reported net asset values, and (2) quoted bid-ask spreads for loans trading in the secondary market. We obtain information on ETF net asset values and closing prices from CRSP. As a benchmark, we compare our measures of loan liquidity to that of high yield bonds.

Finally, to test the *Shock Absorber Hypothesis*, we match at the loan level, mutual fund trades to CLO trades. For this analysis, we use information on mutual fund holdings from CRSP, CLO trade data from CLOi, and loan price information from Markit. Because loan fund holdings data is limited prior to 2010, the loan level analysis is based on a sample of loan trades from 2010 through 2020. A challenge with conducting a loan level analysis is that unlike securities, most loans do not have a common identifier such as a CUSIP number. Moreover, while CRSP holdings data provides CUSIPs for some loans, CLOi does not provide CUSIP identifiers. Given these challenges, we match loan fund holdings to Markit's Loan Pricing data and use Markit's loan identifier (LoanXID) as our main identifier.

We use a two-step procedure to match CRSP loan holdings to Markit. First, for loans with CUSIP information in CRSP, we match them to Markit pricing information using a link table provided by Markit. For the remaining loans, we manually match them to Markit by borrower name, loan type, and maturity date. We use changes in holdings from month t-1 to month t to proxy for mutual fund trading in loans. To construct our flow pressure measures, we require trading information from at least three mutual funds for a loan in a given month. Our final sample consists of 3,381 distinct loans.

Second, we manually match these loans to CLO trade data from CLOi by borrower name, loan type, and trade date. Requiring at least three mutual funds and one CLO trading a particular loan in a given month, the matched sample consists of 961 distinct loans.

To examine whether loan price changes are driven by changes in fundamentals or fire-sale discount, we match loan issuers with Markit's Credit Default Swap (CDS) trading data. The matched sample consists of 100 distinct issuers, corresponding to 230 distinct loans. Following the literature (e.g., Lee, Naranjo, and Velioglu, 2018), we utilize 5-year single-name CDS contracts on senior unsecured obligations denominated in U.S. dollars.

3.2 Flow measures

To motivate our analysis of loan fund resilience, we begin by examining the relationship between fund returns and contemporaneous investment flows. This analysis is motivated by recent work by GJN (2017) and FHLS (2021), which find that, consistent with strategic complementarities, a positive relation between returns on corporate bond funds and contemporaneous investment flows during periods of market stress.[15]

For this analysis, we follow the standard practice in the literature and define a fund's net flow in month *t* as:

$$Flow_t = \frac{TNA_t - TNA_{t-1}(1 + R_t)}{TNA_{t-1}} \quad (1)$$

where TNA_t is the fund's total net asset value at the end of month *t* and R_t is the fund return during month *t*. We winsorize fund flows and alphas at the 1% and 99% levels to mitigate the influence of outliers.

We use three measures of aggregate market liquidity: (1) the Chicago Board Options Exchange's (CBOE) VIX index, (2) the option adjusted BB bond spread, and (3) the percentage of banks tightening their lending standards as reported in the Federal Reserve Board's Senior Loan Officer Survey.

3.3 Flow pressure measures

[15] We also examine, in Appendix A, the flow-performance relationship for loan funds and corporate bond funds.

We measure fire-sale pressure on loan prices induced by investor redemptions in mutual funds, using the flow pressure measure proposed by Coval and Stafford (2007). The flow pressure for loan l (or bond b) in month t is calculated as follows:

$$Flow\ Pressure_{l,t} = \frac{Flow\ Induced\ Buys_{l,t} - Flow\ Induced\ Sales_{l,t}}{Mutual\ Fund\ Trade\ Volume_{l,t}} \quad (2)$$

where $Flow\ Induced\ Buys_{l,t} = \sum_i \max(0, \Delta Holdings_{l,i,t}) | flow_{i,t} > Percentile(75th)$,

$$Flow\ Induced\ Sales_{l,t} = \sum_i (\max(0, -\Delta Holdings_{l,i,t}) | flow_{i,t} < Percentile(25th),$$

and $Mutual\ Fund\ Trade\ Volume_{l,t}$ represents the aggregate trade volume by mutual funds. $\Delta Holdings_{l,i,t}$ is fund *i*'s change in holdings of loan *l* from month *t*-1 to *t*. To calculate the pressure measure, we require a loan to have at least three trades by mutual funds in a given month. Unlike Coval and Stafford (2007), who use cutoff points of 10th and 90th percentiles of cross-sectional flows, we use cutoff points based on quartiles. This is because of a smaller sample size of loan mutual funds than equity or corporate bond mutual funds.[16]

As a robustness check, we also examine flow-induced spillover effects for loan and bond funds using FHLS's (2021) measure of fire-sale spillovers. They measure spillover effects by identifying peer funds whose asset sales are likely to impact funds holding the same assets. Specifically, FHLS's (2021) measure of flow-induced asset sales or purchases is the weighted sum for each fund of asset-specific flow pressures emanating from peer funds with large redemptions/inflows. A fund with high exposure to fire-sale spillovers is defined as a fund with a high proportion of assets that are fire sold by other funds. We examine spillover effects as a robustness check since the economic mechanism that leads to spillover effects is a downward sloping demand for loans arising from slow moving capital.

3.3 Loan liquidity measures

Since we do not observe loan trading volume or prices, we cannot calculate traditional measures of liquidity, such as effective bid-ask spreads (Roll, 1984), price impact (Amihud, 2002) or other bond liquidity measures based on trading activity (see Feldhutter, 2012 and Dick-Nielsen

[16] Our findings are qualitatively similar when cutoff points based on deciles are used.

et al., 2012). Instead, we construct an indirect measure of loan and bond liquidity based on the observed premium for loan and bond ETFs.

Our ETF-based measure of loan liquidity compares the closing price for loan and high yield ETFs with the net asset value of the funds at close. Unlike equity ETFs, the underlying holdings of loan and bond ETFs trade infrequently. As a result, the convention for loan and bond ETFs is to calculate NAV based on quoted bid or ask prices (see Fulkerson, Jordan, and Riley, 2013). ETFs allow APs to create or exchange shares to minimize the difference between trading prices of the ETF and the NAV. APs have an incentive to arbitrage price differences that exceed the cost of trading. For example, if an ETF sells consistently at a premium relative to the NAV, the AP will have an incentive to acquire the underlying loan or security and issue additional shares so long as the premium is greater than the value of the underlying portfolio based on the ask price. The arbitrage profit is the difference between the bid price of the ETF and the ask price associated with the underlying portfolio. APs will have an incentive to buy shares and redeem them for the underlying portfolio when the ETF shares sell at a discount and the ask price of the ETF is less than the NAV of the underlying portfolio (valued at the bid price). We compute average daily differences between the ETF closing prices and the NAV for our sample of loan ETFs and compare these differences to those of bond ETFs. In addition, we estimate the relation between share creations/redemptions and the premium/discount associated with the ETF price. If the cost of arbitrage is less for loans than for corporate bonds, we expect the sensitivity of share creations and redemptions to changes in premium/discount to be greater for loan ETFs than for bond ETFs.

3.4 Par building measures

The *Shock Absorber Hypothesis* predicts that CLO par building activity mitigates the impact of flow pressure on loan prices. The idea is that loan fund flow pressure may create downward pressure on loan prices, but what offsets this pressure is CLOs' ability to sell liquidity due to their structure and incentives to buy loans selling at a discount from par. For this analysis, the matched CRSP mutual funds' and CLO holdings data.

For each loan *l* in month *t*, we calculate par building activity by CLOs as follows:

$$Par_{l,t} = \frac{\sum_c Par\ Buy_{l,c,t} + \sum_c Par\ Sell_{l,c,t}}{CLO\ Dollar\ Trade\ Volume_{l,t}} \quad (3)$$

where $Par\ Buy_{l,c,t} = \frac{(100 - Trade\ Price_{l,c,t})}{100} * Face\ Amount_{l,c,t}$ for buy trades of CLO c and $Par\ Sell_{l,c,t} = \frac{(Trade\ Price_{l,c,t} - 100)}{100} * Face\ Amount_{l,c,t}$ for sell trades of CLO *c*.[17] In equation (3), $CLO\ Dollar\ Trade\ Volume_{l,t}$ denotes the face value of CLOs' aggregate trade volume in loan *l* in month *t*. $Trade\ Price_{l,c,t}$ is the transaction price paid or received for CLO c and $Face\ Amount_{l,c,t}$ is the face value of CLO *c*'s trade on loan *l* in month *t*. In addition, we separately calculate the par built from loan acquisitions and sales. *Par from Buy* refers to the first component of equation (3) relative to CLO trading volume, while *Par from Sell* refers to the second component relative to CLO trading volume.

To study the role of CLOs selling liquidity in the leveraged loan market, we examine the relationship between par building activity and fund flow pressure. If par building serves to mitigate fire-sale discounts, we would expect a negative relationship between *Par* and contemporaneous *Flow Pressure*.

3.5 Descriptive statistics: Comparing loan funds to corporate bond funds

Fund-level summary statistics for our sample of loan and bond funds are reported in Table 1. Our sample includes 78 loan funds and 1,422 bond funds (359 of which are high yield bond funds) from CRSP during the period from 2003 through 2020. The return-flow analysis is based on the entire sample period. However, due to data availability, our analyses of fire-sale discounts, spillover effects, and par building activity are based on the period from 2010 through 2020. Specifically, there is little information on loan fund holdings before 2010.

As shown in Table 1, loan funds are on average much younger than bond funds, reflecting the increased participation of mutual funds in the loan market. Indeed, the oldest loan fund in our sample was 24 years old, compared to 96 years for the oldest bond fund.[18] Given the rapid growth of loan funds over the past decade, it is perhaps not surprising that loan funds have on average

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[17] We exclude CLO trades executed at prices below 80 in our main analysis since purchases below 80-85 do not build par and for sales it is not clear whether these trades add or destroy par since we do not know the original purchase price. Our results are robust to including these trades but setting the par build for these buy trades at zero and conservatively setting par for sales at zero (since, as explained in Section 2, depending on the rating, sales at or below 80 may build par).

[18] The name of the oldest loan fund in our sample is "AIM Counselor Series Trust (Invesco Counselor Series Trust): Invesco Floating Rate ESG Fund" and the oldest bond fund in our sample is "Nicholas High Income Fund," which was first offered in 1924.

higher percentage inflows than bond funds. The volatility of investment flows is also significantly higher for loan funds than bond funds, even though loan funds are significantly larger on average than corporate or high yield bond funds.

Interestingly, despite greater variability in investment flows, loan funds hold on average about the same percentage of their assets in cash as bond funds. The need for cash buffers may be less for loan funds because of the higher frequency with which they impose redemption fees and rear end loads. GJN (2017) provide evidence that institutional investors may internalize strategic complementarities thus making runs on funds with a larger share of institutional investors less likely. However, the percentage of fund shares held by institutional investors (as measured by percentage of Institutional Shares) is similar for loan and bond funds.

Regardless of the benchmark used to evaluate performance, relative to high yield funds, loan funds appear to be less volatile while maintaining a similar level of average performance. Corporate bond fund performance is significantly better based on alphas estimated using the ICE BofA US Corporate Index (hereafter the BofA index) as the bond market factor.

Finally, as shown in Table 1, Panel A, loan and high yield bond funds hold a much narrower set of assets than general corporate bond funds. Specifically, loan funds hold on average 66% of their portfolio in leveraged loans and about 20% in floating rate notes. Only 0.4% of the assets are held in government bonds and 3.3% are held in other assets, which consist mostly of asset-backed and mortgage-backed securities. High yield bond funds hold a similarly narrow set of assets (84% in bonds, 1.4% in government bonds, and 4% in other assets). In sharp contrast, corporate bond funds hold on average only about 50% of their portfolio in corporate bonds. As shown, corporate bond funds hold a substantial portion of their portfolio in government bonds and assets classified as Other. Finally, despite the average loan fund being larger than the average bond fund, loan funds hold slightly fewer positions. In addition, the mean (median) Herfindahl-Hirschman index (HHI) of fund holdings is 158 (81) versus 311 (135) for loan funds and general corporate bond funds, respectively (we find no difference in the concentration of holdings between loan and high yield bond funds).

Panel B provides descriptive statistics concerning fund returns, flow and peer flow pressure measures for loan and high yield bond funds for 2010-2020.[19] As shown, the mean (median) sell pressure is higher for loan funds than for high yield bond funds. The average (median) loan sell pressure is 22 (2.0) percent compared to 17 (1.0) percent for high yield bonds. These differences are consistent with the greater flow volatility for loan funds relative to bond funds as shown in Figure 1. This pattern is consistent with loan funds experiencing larger outflows than investment-grade and government bond funds during the COVID-19 crisis (Ma, Xiao, and Yao, 2022).

Finally, we note that prices for loans are tightly distributed around a mean (median) of 97.4 (99.8) percent of par. Roughly 90 percent of loan fund holdings are within the price interval of 85 to 100 percent of par. In contrast, high yield bonds have a wider distribution of prices. There are several potential explanations for these differences. First, loans are relatively short-term floating rate instruments and are typically prepayable. The average maturity of loans held by the funds in our sample is 4.95 years compared to an average maturity for high yield bonds of 6.72 years. Second, while the average rating for holdings of both loans and bonds is B1 (14 in number), high yield funds have on average a higher percentage of holdings rated B3 (16 in number) or below (10%) than loan funds (7%). Third, high yield bonds are typically unsecured while leveraged loans are secured. Collateral is associated with higher recovery rates in default and expected recovery rates are likely to serve as a floor on loan and bond prices. For example, Badoer, Dudley, and James (2020) find mean recovery rates for secured loans of 95 percent, compared to recovery rates of between 56 and 40 percent for senior unsecured and subordinated bonds. Finally, if, as we hypothesize, CLO par building activity enhances loan market liquidity, funds may concentrate their holdings on par build eligible loans.

In the empirical tests that follow, we control for differences in the prices of loans and high yield bonds by examining the impact of outflow-induced selling pressure for loan and high yield bonds in price bins around the par buying threshold.

4. Motivating Evidence: Are Loan Returns Less Sensitive to Outflows?

[19] This sample starts from 2010 because holdings information on loan mutual funds are mostly populated after 2010. Prior to 2010, there are fewer than four loan funds in CRSP that have non-missing holdings information.

A first mover advantage arises when investor outflows lead to lower contemporaneous fund returns. To examine potential differences in first-mover advantage between loan and bond funds we investigate the relationship between excess fund returns and contemporaneous flows.[20] We define excess returns as the difference between fund returns and returns on the S&P Leveraged Loan Index (S&P LLI index) for loan funds, the BofA index for bond funds, and the S&P U.S. High Yield Corporate Bond Index (HY Bond index) for high yield funds, respectively. If fund flows influence the price at which a fund can purchase or sell loans or bonds, we expect a positive relation between excess returns and flows. We examine whether the excess return-flow relationship is more pronounced during periods of market stress by estimating the following regression:

$$EReturn_{i,t} = \alpha + \beta_1 Flow_{i,t} + \beta_2 Flow_{i,t} \cdot I(Illiquid\ Period_t)$$

$$+\beta_3\, I(Illiquid\ Period_t) + \beta_4 Alpha_{i,t-1} + \gamma' X_{i,t} + \theta_t + \varepsilon_{i,t} \quad (4)$$

where $EReturn_{i,t}$ is fund i's return net of the benchmark return in month *t*. $Flow_{i,t}$ is fund i's net flow in month *t*, as defined in equation (1). $Alpha_{i,t-1}$ is fund i's monthly performance measure for the past year. For loan funds, we measure performance using a two-factor model, where the two factors are the S&P LLI index and the BofA index. We compare the flow-performance relationship of loan funds to that of both corporate bond funds generally and high yield bond funds. For bond funds, we follow GJN (2017) and estimate alpha using a two-factor model where the two factors are the BofA index and HY Bond index. We include in the matrix $\boldsymbol{X}$ for fund-level controls including lagged investment flows, the natural log of fund net assets, the fund's expense ratio, and whether the fund has a rear end load or redemption fee. The parameter θ_t represents time fixed effects. Standard errors are clustered at the fund level.

If fund-specific selling pressure leads to a positive return-flow relationship, we expect funds with larger outflows to have poorer relative performance. However, as shown in columns (1)-(3)

[20] We also estimate the relationship between fund flows and performance using a specification like the one used in GJN (2017). However, as GJN (2017) point out, flow-performance concavity provides only indirect evidence of outflow-induced fire-sale discounts. In a recent paper, Cetorelli, La Spada, and Santos (2022) (hereafter CLS) find evidence that the flow-performance relationship for loan funds is more concave than for bond funds. As shown in Appendix Table A1, we find no evidence of a concave flow-performance relationship among loan funds. Using CLS's (2022) specification, we find that loan fund flow-performance relationship is more concave than that for bond funds, but as shown in Appendix Table A1, this is because bond fund flows are less sensitive to overall performance than loan funds (as Figures 1 and 2 suggest). In addition, while CLS (2022) measure performance using lagged raw returns, we find no evidence of a concave flow-performance relationship using $Alpha_{i,t-1}$ as a measure of performance.

of Table 2, the sensitivity of loan funds to outflows is *less* than that for both bond funds and high yield funds during periods of market stress, with two of the three illiquidity measures being insignificantly different from zero.[21] Consistent with the findings of GJN (2017), we find for corporate bond funds a positive and significant relation between excess returns and fund flows during periods of market stress using all three illiquidity measures. The findings reported in Table 2 provide indirect evidence of strategic complementarities during periods of market illiquidity adversely affecting the returns on corporate bond funds but not the returns on loan funds. However, as discussed earlier, the regressions in Table 2 focus on cross-sectional differences among funds. If all returns to loan funds respond similarly to outflows and there is little variation across funds in investment flows during periods of market stress, then the tests reported in Table 2 may fail to detect fragility. Given these concerns, in the next section we directly test for differences in flow-induced sales on loan and high yield bond prices.

5. Fire-Sale Discounts

5.1 Loan and bond price impact of flow-induced trading

We begin by examining the price impact of loan and bond fund investment outflows by investigating the relationship between monthly changes in prices and the Coval and Stafford (2007) measure of flow pressure. Coval and Stafford (2007) argue that sales by funds experiencing large outflows represent distressed sales. In addition, a necessary condition for fire-sale spillover is for distressed sales to lead to a decrease in loan or bond prices. We calculate changes in the prices of loans and bonds as follows. For each loan-month in our sample, we calculate the average bid price and ask price from daily quotes by dealers from Markit. We then take the average of bid and ask prices as the mid-price for each loan-month and calculate its percentage change from the prior month. For each bond-month, we calculate the value-weighted average sell price and buy price from Enhanced TRACE and then calculate the average of buy and sell prices to obtain the mid-price. Flow pressure measures are standardized for ease of interpretation.

[21] The estimates reported in Table 2 are based on a sample period that includes the sharp decline in loan and bond prices at the start of the COVID-19 period and the subsequent government intervention in the bond market. As shown in Appendix Table A2, if we end the sample at year-end 2019, we find even larger differences between loan and bond funds.

The results of our loan/bond price impact analysis are reported in Table 3. We include loan/bond fixed effects so that identification is through within loan/bond variation in prices due to changes in flow pressure. As shown in Table 3, consistent with the findings of Coval and Stafford (2007) and FHLS (2021), we find a positive and significant relation between prices and flow pressure for both loan and high yield bonds. The positive coefficient on the flow pressure indicates that sales by loan or bond funds experiencing large outflows are associated with a decrease in loan and bond prices. Interestingly, we find that bond prices are significantly *more* sensitive to flow pressure than loan prices. The difference in price sensitivity is economically large, with the impact of flow pressure on loan prices being less than one third of that on bond prices. As shown in columns (5) and (6), the difference in price sensitivity to flow pressure for loans is significantly less than bonds at the one percent level.

One potential explanation for the difference in price sensitivity between loans and high yield bonds is that the distribution of loan prices is more closely clustered around par than bond prices (as shown in Table 1). Since liquidity may be increasing in credit quality, the differences in the price sensitivity of loans and bonds may be driven more by deeply discounted holdings among high yield bond holdings. To address this concern, we restrict both the bond and loan samples to holdings with prices above 80. As shown in columns (8) and (10), we find that the impact of sell pressure on bond prices is significantly greater than the impact on loan prices. Indeed, the absolute value of the price effect on high yield bonds is more than twice as large as the price impact on loans.[22]

As a robustness check, we also examine flow-induced spillover effects. We describe our methodology and findings in Appendix B. Consistent with the findings of FHLS (2021), we find for both loan funds and high yield bond funds a positive and highly significant relationship between fund returns and peer flow pressure. However, consistent with the findings reported in Table 3 the impact of flow pressure on fund returns is significantly less for loan funds than for high yield bond funds.

[22] Another potential explanation for the smaller pressure induced price changes for loan funds than high yield bonds is that loan prices may adjust more slowly due to stale pricing. Choi, Kronlund, and Oh (2022) find evidence of stale pricing in bond mutual funds. However, our analysis is based on monthly prices changes and we find no significant autocorrelation in monthly returns for loan or high yield bond funds. In addition, it is difficult to explain the discontinuity in sell pressure around the par eligibility threshold based on stale prices.

5.2 Do price impacts vary with par build eligibility? Preliminary evidence

As we discuss later, CLO par building buy activity is concentrated in loans trading between 87.5 and 100 percent of par. As we show later there is a discontinuity in both par building activity and CLO trade imbalance (buys minus sales) at the 87.5 price threshold. To analyze the potential impact of par buying on fire-sale discounts in the loan market, we divide the sample of loans into two groups, based on those with transaction prices of 87.5 or above and those selling at below 87.5 percent of par. We then examine whether the impact of distressed sales on loan prices varies depending on whether the loan is trading in the price range where par building activity is concentrated. We refer to the loans selling at prices of 87.5 or above as par build eligible loans and loans priced below 87.5 as par build ineligible loans. To isolate the potential impact of par buying activity, we also divide the sample of high yield loans into similar groups based on trading prices.

Figure 4 presents the coefficient estimates for sell pressure for loans and high yield bonds. To ensure comparability, we present estimates for the sample of loans and bonds trading at prices between 80 and 95. For par build loans, we find that the impact of sell pressure on loan prices is relatively small and statistically insignificant. The impact of sell pressure on high yield bonds is much larger in absolute value and significantly different from zero at the 1% level. The difference in the magnitude of sell pressure on prices is economically large as well with a one standard-deviation increase in sell pressure leading to more than two times larger (in absolute value) price impact on bonds than loans.

If par building mitigates the impact of flow-induced sell pressure, we expect sell pressure to have a similar effect on par build ineligible loans and on high yield bonds in the same price range. As shown in Figure 4, that is exactly what we find. Specifically, the magnitude of fire-sale discounts is much greater for both deeply discounted loans and bonds. However, unlike trades in the par build price range, the impact of sell pressure is similar for loans and high yield bonds in the par build ineligible range. In Section 7, we examine in more detail par building activity and its potential impact on prices. Specifically, we examine whether par build eligible loans are the same loans under sell pressure from loan mutual funds.

6. Differences in Loan and Bond Market Liquidity

Our analysis in the previous sections provides evidence of a surprising degree of resilience among loan funds, particularly given the presumed lack of loan market liquidity. To better understand the source of this resilience, in this section we examine various proxies for the cost of arbitrage in the loan and bond markets. We proceed by first examining the premium associated with loan ETFs and comparing it with the premium of high yield bond ETFs. Second, we examine the relationship between share creations/redemptions and premiums/discounts for loan and high yield ETFs to gauge the cost of arbitrage.

Like mutual funds, ETFs are required to estimate the net asset value of their holdings daily. Calculating NAVs for loan and bond funds is challenging because unlike equity funds, many of the underlying holdings of loan and bond funds do not trade daily. For loans, calculating NAVs is particularly challenging because unlike most corporate bonds, there is no post-trade transparency for loan trades.

Given that bonds trade infrequently and loan trades lack transparency, the convention for loan and bond funds is to calculate the portfolio NAV using bid prices for bond and loan holdings. As explained by Fulkerson et al. (2013), bond ETFs typically sell at a premium relative to the reported NAV. The size of the premium reflects the authorized participants' (APs) cost of arbitraging differences between the value of the ETF and the value of underlying holdings.[23] Because shares of bond and loan ETFs are more liquid than the underlying holdings, the bid-ask spread for bond and loan ETFs is much lower than the bid-ask spread for bonds and the quoted half spread for loans.[24]

APs have an incentive to engage in arbitrage for ETFs selling at a premium, i.e., when the prices of ETF shares are above the value of the holdings calculated at the ask price. In this case, the APs can profit by buying the underlying (at the ask) and creating new shares. For ETFs selling at a discount, arbitrage opportunities exist when the ask price of the ETF falls below the value of the fund's holdings based on bid prices. As a result, arbitrage opportunities are limited by the cost of trading the underlying portfolio. Funds with less liquid holdings, all else equal, will sell at larger premiums (discounts). As a result, an indirect measure of the relative liquidity of loans and bonds is the size of the premium (discount) of loan and bond ETF prices relative to their reported NAVs.

[23] In the case of cash redemptions/creations, ETFs with more illiquid holdings have higher fees for creations than redemptions. The higher fees for redemptions may contribute to bond ETFs selling at persistent premiums.
[24] The average quoted half spread from Markit for loans held by funds in our sample is 40 basis points.

More importantly, if arbitrage costs in the loan market are significantly greater than in the bond market, we expect share creations and redemptions for loan ETFs to be significantly *less* sensitive to differences between ETF prices and the portfolio NAV than in the bond market. Alternatively, if arbitrage costs are less in the loan market than in the bond market, we expect the marginal effect of ETF premiums and discounts on redemptions to be larger for loan ETFs than bond ETFs.

Our analysis of ETF premiums focuses on comparing premiums and share creation/redemptions of loan funds to high yield bond funds. Our sample consists of 10 loan ETFs and 68 high yield bond ETFs. As shown in Table 1, loan funds invest in a narrow set of securities and liquidity is likely to vary with the credit risk of the holdings. Table 4, Panel A provides summary statistics for our sample of loan and high yield ETF funds. As shown, the average loan ETF premium is significantly lower than the average premium of high yield ETFs. Premiums are smaller based on either the bid or ask price (significant at the 1% level) and only slightly higher if we use the midpoint of ETF bid-ask spread to calculate the premium. As shown, the volatility in premiums is also lower for loan ETFs than for bond ETFs. Overall, these findings suggest that costs of arbitrage in the loan market are less than in the bond market. [25]

As shown, both creations and redemptions occur in large blocks. For loan ETFs, the median creation is 200,000 shares and the median redemption is 425,000 shares. The smallest creation and redemption are both 50,000 shares. As discussed earlier, an AP has an incentive to create additional shares when the ETF premium exceeds the cost of arbitrage and to redeem shares when the ETF discount is larger than the cost of arbitrage. Since redemptions involve acquiring shares during periods of stress in the loan and bond markets, arbitrage costs are likely to be higher in the case of share redemption than in share creation.[26]

We investigate the relationship between creations (or redemptions) and ETF premiums (or discounts) by estimating a multinomial logit model. We create a categorical variable equal to 1 for days on which shares are created, -1 for days on which shares are redeemed, and 0 otherwise. The last category is deemed as the reference category, "no share issuances," so that interpretation of the coefficient is in relation to days on which there are no share creations or redemptions. In

[25] In untabulated analyses we compare loan fund ETFs to corporate bond ETFs and find similar differences between loan and bond fund ETFs.

[26] Some loan and bond ETFs allow full or partial creations and redemptions in cash. However, there are fees associated with cash transactions to cover the fund's transaction costs.

estimating the multinomial logit model, we model the decision to create or redeem shares as a function of lagged premiums (up to three days), asset size of the ETF, as well as the trading volume and bid-ask spread of shares of the ETF.

Estimates of the multinomial logit model are presented in Panel B of Table 4 (for brevity, we report only the estimates of the coefficients for the lagged premia). Not surprisingly, we find a positive relationship between the likelihood of share creation and premiums, and a negative relation between share redemption and premiums. In other words, share creations tend to follow periods of persistent premiums and share redemptions follow periods when ETF shares sell at persistent discounts. More importantly, the propensity for creations and redemptions appears to be more sensitive to changes in premiums for loan funds than for high yield funds.

We also report the marginal effect (evaluated at the mean) associated with a one-unit increase in 3-day cumulative premiums on the propensity of APs to create and redeem shares. As shown, the marginal effect of premiums and discounts are orders of magnitude greater for loan ETFs than for high yield ETFs generally. Specifically, a one percentage-point increase (decrease) in the 3-day cumulative premium is associated with a 0.7 (1.22) percentage-point increase (decrease) in the probability of share creation (redemption). This effect is nontrivial, especially for redemptions, considering that the unconditional probability of creation (redemption) in our sample is 6.4 (3.3) percent. In contrast, for high yield ETFs, a one percentage-point increase (decrease) in the 3-day cumulative premium is associated with only a 0.04 (0.16) percentage-point increase (decrease) in the probability of share creation (redemption), comparing to the unconditional probability of 3.3 (1.2) percent. These findings suggest that the cost of arbitrage in the loan market is substantially less than in the high yield bond market.

7. Does CLO Par Building Mitigate the Impact of Fund Outflows on Loan Values?

7.1 CLO par building and mutual fund flow-induced sales

What explains the lower arbitrage costs in the loan market and the apparent resilience of loan fund returns to investment outflows? One explanation is that CLOs have the ability and incentive to provide liquidity for loans trading at a discount from par. As CRS (2021) explain, CLOs are a resilient source of loan financing due to their long-term funding structure and that OC tests are based primarily on par values instead of market prices. The former feature insulates them from rollover risk and the latter feature implies that market volatility is less likely to require diversion of cash flows to pay down debt tranches.

In this section, we examine whether CLO par building serves to mitigate the fire-sale discounts and spillover effects arising from mutual fund outflow-induced sell pressure. For this analysis, we examine CLOs' purchases and sales of loans held by the loan mutual funds. As shown in Panel C of Table 1, most CLO purchases of loans add par. Specifically, the mean of par from buy is 1%, indicating that on average buy transactions add about 1% of the face value of the trade to par (since CLO trade volume is in terms of face value). Since most CLO sales are below par, the average sale reduces par.

To get some understanding of where CLOs concentrate their trading and par building activity for loans held by loan funds, Figure 5 provides average net monthly trade amounts by pricing bin. Pricing bins are based on the reference price defined as the midpoint of monthly average bid and ask prices from Markit. Each bin, except for the lowest and highest price bins, represents the average net amount purchased based on price intervals of 2.5, so the 87.5 bin is the monthly average face value of loans purchased net of the face amount sold with the reference price between 87.5 (inclusive) and 90.0 (exclusive). The lowest bin consists of all loans with reference prices below 70 percent of par and the highest bin consists of all loans with prices above 110. As shown, net buying activity is positive for loans priced between 87.5 and 105.

If par building provides a source of liquidity for loan funds, we expect par building activities to be negatively related to the Coval and Stafford (2007) pressure measure at the loan level. The lower the pressure measure, the higher the potential fire-sale pressure on a loan due to outflows from loan mutual funds. We also examine separately the relationship between par building from purchases (sales) and mutual fund sell (buy) pressures.

We examine the relationship between CLO par building and mutual fund buy and sell pressures by estimating the following loan level regression:

$$Par_{l,t} = \alpha + \beta_1 \, Flow\ Pressure_{l,t} + \lambda_l + \theta_t + \varepsilon_{l,t} \qquad (5)$$

where $Par_{l,t}$ is CLO par building purchases *net* of sales for loan *l* at time *t*, $Flow\ Pressure_{l,t}$ is the net flow pressure by mutual funds for loan *l* at time *t*, and λ_l and θ_t are loan and time fixed effects. $\varepsilon_{l,t}$ refers to standard errors that are clustered at the loan level. We estimate equation (5) using net par, defined as in equation (3), and net pressure measures, defined as in equation (2), as well as separately for par buy (sell) activity and sell (buy) pressure for loans by mutual funds, controlling for loan and time fixed effects. Note that we define par build as net par from purchase and sales, so net sales of discounted loans destroy par, whilst net purchases of loans at prices between 80 and 100 add par.[27]

Panel A of Table 5 contains estimates of equation (5). Consistent with CLOs providing liquidity, Column (1) shows that CLOs' par building activity is negatively associated with flow pressure. The lower the pressure measure, the higher the likelihood of fire-sale risk among loans in the secondary markets and the higher the amount of par built by CLOs. Since we include loan and year fixed effects, identification is through par building activity associated with changes in flow pressure for a given loan each year.

We also examine the relationship between par building and flow-induced pressure by focusing on buy and sell activities. Results are reported in columns (2)-(5) of Panel A. As shown in column (2), we find a negative relationship between the par building activity of CLOs from their buy trades and the flow-induced buy pressure from mutual funds. If a loan is sought by mutual funds due to inflows, CLOs are less likely to build par on such a loan. More importantly, the estimate in column (3) indicates that CLOs build par on loans for which there is a flow-induced sale pressure. The relationship between par building buy activity and mutual fund sell pressure is both statistically and economically significant. For example, the coefficient estimate on sell pressure indicates a one standard-deviation increase in sell pressure is associated with a 20% increase in par building purchases by CLOs (relative to the average par from buy trades). As shown in columns (4) and (5), we find no relationship between CLOs sell trades and either mutual fund buy or sell pressure.

Does CLO par building activity vary with market conditions? Specifically, does par building increase during periods of outflows from loan funds and is sell pressure positively associated with more par building activities during these times? To address these questions, we focus on months when there are net outflows from bank loan funds. We then interact the dummy

[27] As a robustness check we also estimate equation (5) by replacing *Par* with the ratio of the difference between the dollar volume of CLO buys and sells relative to total volume of trading. Unlike net par, this measure does not weight trades by the difference between par value and the purchase price. Using this specification, we find results similar to those reported in Table 5.

variable with our flow pressure measures. If CLOs' purchase activities mitigate sell pressure, we expect CLOs to engage in more par building in periods when loan funds in aggregate are experiencing net outflows. For brevity, we focus on par building (the results are similar for par building buy activity). As shown in Panel B of Table 5, we find that par building activity is significantly greater in months of net outflows from loan funds. Indeed, as shown in column (4), we find that par building activity is significantly related to flow-driven sell pressure *only* during periods of net outflows from loan funds. This finding is consistent with CLOs providing arbitrage capital to loan mutual funds during periods of large outflows.

Overall, the findings in Table 5 suggest a synergistic relationship between CLO purchases and sales and flow-induced buys and sells by mutual funds. In short, CLOs appear to focus their par building purchases on loans with heavy sell pressure from mutual funds. Par buying activity is also significantly greater when there are net outflows from loan mutual funds.

7.2 Par building and fire-sale-induced discounts

Does the focus of CLO par building activity of loans under sell pressure from mutual funds reduce fire-sale discounts? We investigate this by examining whether the impact of flow-driven sell pressure on loan prices differs based on CLO par building activity. As discussed earlier, while loans purchased by CLOs at discounts of less than 15 or 20 percent of par can, in theory, build par, CLO managers are unlikely to have much interest in engaging in par building purchases of loans close to the threshold of par build eligibility. The reason for this is that purchasing a loan close to the par build eligibility threshold puts a manager at risk of losing par if the loan declines further in value or is downgraded by rating agencies. For example, most loans with prices below 87.5 are rated B3 or less and as a result purchasing these loans increases the risk that a small downgrade may lead to a significant loss of par and the CLO breaching the covenant limiting its CCC holdings.

While Figure 5 suggests that CLO buying activity is concentrated in discount loans with prices between 87.5 and 100, it is not clear, a priori, at what price, if any, there is a structural break in CLO purchasing (controlling for fund flow pressure) and over what price range CLO par building has the greatest impact on price.

To investigate these issues, we test for a breakpoint price using the "fixed-point" method proposed by Card, Mas, and Rothstein (2008) and Hansen (2000) for identifying break or tipping points. This method involves fitting *Par* to a fourth-order polynomial in price using loan-month observations in the price range 80 to 100. We identify the break point \$87.5 by calculating the root of the polynomial.[28] Figure 6 illustrates par building activity around this breakpoint. Each dot represents the average within each of 10 equally spaced price bins above and below the \$87.5 threshold. The solid line is the estimate of the fourth-order polynomial with an intercept shift at \$87.5. As shown in Figure 6, we find a significant discontinuity in par building activity at the \$87.5 threshold. The mean (median) net par building below the threshold is -0.021 (-0.027) while above the breakpoint the mean (median) net par is 0.011 (0.014), with the difference being statistically significant at the 1% level.[29] For robustness, we employ a search technique, proposed by Hansen (2000) and recently used by Card, Mas, and Rothstein (2008), which also identifies \$87.5 as the breakpoint.[30]

To examine differences in the price impact of flow pressure around the 87.5 threshold we estimate the following regression:

$$Return_{l,t} = \alpha + \beta_1 Flow\ Pressure_{l,t} + \beta_2 Flow\ Pressure_{l,t} * I(P_{l,t} < 87.5) + \lambda_l + \theta_t + \varepsilon_{l,t} \quad (6)$$

where $Return_{l,t}$ is the return on loan *l* at time *t* and $I(Price_{l,t} < 87.5)$ is an indicator equal to one if the monthly average price of loan *l* is in the price range 80 to 87.5 and zero otherwise. λ_l and θ_t are loan and year fixed effects. $\varepsilon_{l,t}$ refers to standard errors that are clustered at the loan level.

As shown in column (1) of Table 6, the price impact of flow pressure is significantly greater for loans with prices less than 87.5 percent of par. In column (2), we report the estimates where we break out flow pressure into buy and sell components. As shown, sell pressure has a significantly greater impact on prices for loans priced under 87.5. Indeed, as shown in column (2),

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[28] If there is a discontinuity at price P^*, then $E[Par_{l,t}|P = P^* - \varepsilon] < E[Par_{l,t}] < E[Par_{l,t}|P = P^* + \varepsilon]$ for $\varepsilon > 0$ and $80 \leq P \leq 100$. To identify this fixed point, we follow Card, Mas, and Rothstein (2008) and smooth the data to obtain a continuous approximation, $R(P)$, to $Par_{l,t} - E[Par_{l,t}]$, and then select the root of this function. Since $E[Par_{l,t}]$ is a constant, we fit $Par_{l,t}$ to a quartic polynomial in P to obtain $R(P)$. We find several roots in the range, with 87.5 being the root at which the slope of $R(P)$ is largest (the other roots are above 97.5). We select 87.5 as the breakpoint price following Card, Mas, and Rothstein (2008).

[29] In the interval just below the breakpoint (between 86.5 to 87.5) Par is -0.017 while just above the breakpoint (from 87.5 to 88.5) Par is 0.024.

[30] The idea is that CLO net trading (as shown in Figure 5) is likely to be a smooth function of loan prices and investment flows except perhaps at the breakpoint price P^*. Using \$0.50 price intervals we search for the price that maximizes the estimated R^2 of regressing CLO net trading on $I(P_{l,t} < P)$, which is an indicator equal to one if the monthly average price of loan l is below the threshold price P (but above \$80) and zero otherwise. Hansen (2000) shows that, if the specification is correctly specified, this procedure yields consistent estimates of the true structural breakpoint.

for the full sample, we find a positive but statistically insignificant coefficient on sell pressure for loans with prices of 87.5 or above.

One explanation for the lack of any price impact of selling pressure for loans priced above 87.5 is CLO par building purchases of loans in this price range. An alternative explanation is simply that price sensitivity to sales pressure decreases with credit quality. As Dang, Gorton and Holstrom (2015) and Benmelech and Begman (2018) explain, debt becomes more informationally sensitive and less liquid as credit risk increases. As a result, the increase in the impact of sales pressure for loan below the 87.5 percent of par threshold may simply reflect a decrease in liquidity as the discount from par (credit risk) increases. This alternative explanation suggests that we should not find a significant price impact of selling pressure for high yield bonds priced at or above 87.5 percent of par. However, as shown in columns (4) and (8) of Table 6, we find a negative and statistically significant relation between high yield bond returns and sell pressure for bonds priced at or above 87.5 percent of par. More importantly, we find that the price impact of sales pressure in this price range is significantly larger for high yield bonds than loans. Comparing the coefficient estimates on sell pressure in columns (2) to (4) and the estimates in columns (6) to (8), the impact of sell pressure is about two to three times larger (in absolute value) for high yield bonds than loans. The comparisons for estimates in columns (6) to (8) are also presented graphically in Figure 4.

In sharp contrast to the impact of sell pressure on loans at or above the 87.5 threshold, as shown in Table 6, we find the negative impact of sell pressure is similar for loans and high yield bonds selling below the par build threshold. These findings suggest that the resilience of loan funds is state contingent. Specifically, for large adverse economic shocks that lead to loan prices decreasing below the par build threshold, arbitrage capital from CLOs will not be available to mitigate sales-induced declines in loan prices, leading to greater fragility of loan funds than bond funds.

A final set of concerns is that loans above or below the par build threshold may differ in some ways other than prices that affect their liquidity, or that flow pressures may reflect negative information shocks concerning fundamental values and not fire-sale discounts. We address these concerns in two ways. First, we compare the characteristics of loans just below and just above the 87.5 percent of par threshold (i.e., in the 80 to 95 price range). Virtually all loans (99 percent) in this price range are secured. Loans below and above the threshold have similar ratings at issuance (the mean rating for both is B1), are similar in issue size (mean size of $1.07 billion below the threshold versus $1.01 billion above the threshold), and both groups are priced initially at very close to par (99.74 and 99.9 percent of par). No surprisingly, during the flow pressure month, the two groups, loans in the 80 to 87.5 range and those in the 87.5 to 95 range, differ in terms of their average price and rating, with the lower priced loans having an average rating of B3 versus B2 for the higher priced loans.

Coval and Stafford (2007) address the concern that the effect of flow pressure on returns may not reflect fire sales but rather negative information shocks. Specifically, they address this concern by examining whether the pattern in abnormal returns eventually reverses after sales pressure dissipates. We conduct a similar analysis by examining cumulative average abnormal returns (CAARs) around flow-pressure months and compare the pattern of abnormal returns for par eligible and par ineligible loans. The event month for this analysis is the flow pressure month. Abnormal returns are calculated by subtracting the equally weighted return on loans held by the mutual funds in our sample from the return on loans subject to flow-induced selling pressure.

As shown in Figure 7, we find for par build ineligible loans, which are priced below 87.5 percent of face value, a pattern of negative (and statistically significant) abnormal returns in the month of forced selling and the month immediately preceding the event month.[31] In addition, we find that the downward trend in returns reverses itself in the months immediately following the forced sale. The return reversal is consistent with fire-sale pressure pushing loan prices down rather than price changes caused by information shocks affecting fundamental values. In contrast, for par eligible loans, we find a small increase in returns in the months preceding the event month and a slight decline following the event month. Overall, the patterns shown in Figure 7 suggest that par ineligible but not par eligible loans sell at fire-sale discounts.

Evidence of asset fire sales among bond mutual funds is mixed. In particular, while GJN (2017), FGH (2022), and Manconi, Massa, and Yasuda (2012) find evidence of strategic commentaries and fire sales for bond mutual funds, Choi, Hoseinzade, Shin and Tehranian (2020) find little evidence of general corporate bond fund redemptions driving fire-sale price declines.

[31] We use the standard deviation of the time series mean return around the event month for loans that are not subject to fire sales to test for statistical significance.

Choi et al. (2020) argue that corporate bond funds avoid fire sales by maintaining significant liquidity cushions and trading liquid assets in response to redemption outflows. However, loan and high yield bond funds are likely to have less flexibility in meeting redemptions demands through cash and government bond holdings because of their investment focus. Specifically, SEC Rule 35d-1 requires funds to invest at least 80 percent of their assets in accordance with the investment focus the funds' name suggests. Consistent with this explanation, Choi et al. (2020) report for the corporate bond funds in their sample the average percent of corporate bonds, cash, and treasury/agency securities to total assets of 55.42, 13.21 and 23 percent respectively. However, as shown in Table 1, loan and high yield bond funds hold virtually no government securities and on average only about 5 to 6 percent of their assets in cash.

As an additional test of fire-sale discounts for loan funds, we examine whether flow pressure on loans is related to the spread on CDS contracts for firms with both loans and CDS trading in flow pressure months. This test is motivated by Choi et al. (2020) who control for time varying firm-level fundamentals by comparing the price changes of bonds under sell pressure to bonds issued by the same firms that are not under sell pressure. To examine whether negative returns on loans are due to information concerning fundamentals or fire sales, we estimate the relation between the adjusted CDS spread relatives (adjusted for the duration of the CDS contract) and flow pressures on the loans of the same issuer traded by mutual funds.[32] We focus on the adjusted CDS relatives so that the change is comparable to loan returns. This analysis is based on 100 firms with loans and CDS trading in the same flow pressure month.

To compare the impact of investment flows on loan returns and CDS returns we estimate the relation between returns and flows including issuer and time fixed effects so that we compare the impact of flows on returns on loans and CDS for the same issuer at the same point in time. As shown in Table 7, we find that the impact of flow pressure is significantly less for CDS than loans. Indeed, we find no significant relations between adjusted CDS spread returns and flow pressure

[32] For perpetuities and very long-term bonds, assuming no changes in the level of risk-free interest rates, the return can be calculated as the change in spread relatives. The spread relative is defined as $-(S_t - S_{t-1})/S_t$, where S_t is the credit spread at time *t*. We adjust the spread relative to reflect the duration of the CDS contract by multiplying the spread relative by the ratio of the duration of the CDS contract relative to the duration of a perpetuity. Our findings are not sensitive to whether we adjust the spread relative for the duration of the CDS contract.

for firms with loans trading either above or below 87.5. Overall, these findings are consistent with the argument that flow-induced price declines for par ineligible loans reflect fire-sale discounts.

8. Summary and Conclusion

The growth of open-end loan mutual funds over the past decade has raised concerns that these funds may increase the fragility of the financial system. Specifically, because loan funds invest in thinly traded and presumably illiquid loans, while issuing redeemable on-demand claims on the underlying portfolio (albeit at a variable price), they are exposed to the risk of redemption runs that can potentially result in large fire-sale discounts.

In this paper, we examine the resilience of open-end loan mutual funds and the liquidity of their holdings. Surprisingly, despite the lack of transparency of loan trading, using a variety of tests we find little evidence of greater fragility among loan funds than corporate bond funds. Indeed, depending on the measure used, we find evidence of greater resilience in loan funds than in high yield bond funds. We provide evidence that the source of this greater resilience arises from lower arbitrage costs in the loan market for modestly discounted loans than in the high yield bond market. We also provide novel evidence that CLOs' par building activities provide positive externalities for loan funds through purchasing modestly discounted loans under heavy selling pressure from mutual fund outflows. In other words, CLO purchases of loans selling at a discount appear to serve as shock absorbers, resulting in smaller fire-sale discounts for bank loans than high yield bonds arising from redemption-induced sales by mutual funds. However, we also find that, for deeply discounted loans for which CLOs are not able to par build through purchasing, flow-induced fire-sale discounts are at least as large as bonds. This finding suggests loan fund fragility may increase if economic shocks lead to a large portion of loan fund holdings selling at deep discounts. Overall, these findings suggest that the resilience of loan funds is state contingent and that during our sample period the loan market did not receive shocks sufficient to lead to widespread discounts of more than 10% of par.

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Table 1. Summary Statistics

The sample period is from January 2003 to December 2020 for Panel A and January 2010 to December 2020 for Panels B and C. Panel A shows fund-level summary statistics for bank loan, corporate bond, and high yield bond mutual funds. The sample includes observations with non-missing values for past alpha. There are 78 loan, 1,422 corporate bond, and 359 high yield bond mutual funds, respectively. Our main variables are from the CRSP Mutual Fund database. *TNA ($Bil)* is total net assets in billions. *Turnover Ratio (%)* and *Expense Ratio (%)* represent fund average turnover ratio and expense ratio per year in percent, respectively. *Age (Years)* is a fund's age in years since its inception in the CRSP database. *I(Rear Load)* is an indicator that equals one if a fund charges rear loads and zero otherwise. *% Institutional Shares* is the percentage of institutional share classes in a fund. *Monthly Return (%)* is the value-weighted monthly return in percent across all share classes in a fund. *Excess Return Over LLI/BofA/HYBond (%)* represents the difference between the monthly percentage returns of the fund and the S&P/LSTA Leveraged Loan Index (*LLI*) for loan funds, the ICE BofA US Corporate Index (*BofA*) for corporate bond funds, and the S&P U.S. High Yield Corporate Bond Index (*HYBond*) for high yield funds. *Flow (%)* is the monthly fund flow in percent, imputed using fund total net assets and fund returns. *Flow Volatility [t-11 : t]* is the rolling standard deviation for the past 12 months inclusive of month *t*, requiring 9 minimum observations. *2-factor Alpha [t-12 : t-1] (BofA + LLI/HYBond, %)* is the intercept from a 12-month rolling regression of excess fund returns on two excess index returns, requiring 9 minimum observations. The first factor is the *BofA* index return in excess of the risk-free rate, and the second factor varies by fund type, i.e., for loan funds, it is the *LLI* index return in excess of the risk-free rate; for general corporate bond funds and high yield funds, it is the *HYBond* index return in excess of the risk-free rate. Flow and alpha measures are winsorized at 1% and 99% levels. *Number of Holdings* are monthly number of holdings positions from CRSP. *Holdings Concentration (HHI)* is calculated by summing the squared percentage weight of each holding of a fund. Categorical holdings data from Morningstar are reported for all funds from CRSP that can be matched to Morningstar. *% in Cash, % in Government, % in Loans, % in Bonds,* and *% in Other* are the percentages of a fund's net assets in cash and cash equivalents, government plus government-related, bank loans, corporate bonds, and other assets (including mortgage- and asset-backed securities, and swaps), respectively. We remove outliers by excluding observations in which the sum of all holdings scaled by total net assets is below the 5^{th} or above the 95^{th} percentile. For loan funds, bond holdings consist primarily of floating rate notes. We report *t*-test results comparing the means of bond funds and loan funds, and high yield funds and loan funds, with ***, **, and * indicating statistical significance at the 1%, 5%, and 10% levels, respectively. In Panel B, we report descriptive statistics on monthly returns and flow pressure measures for loan and high yield funds. We include total flow pressure as well as buy/sell flow pressure measures at the fund level (see equation (3)) and at the security level (see equation (2)). We report these figures in percent. *Loan Price* is the monthly average of daily midpoint of bid and ask prices quoted by dealers from Markit. *Bond Price* is the monthly value-weighted average of transactional prices reported on Enhanced TRACE. *% Change in Price* is the percentage change in the average price from the previous month. *Loan (Bond) Rating* is the enumerated Moody's rating at the beginning of a month, and a higher number represents higher credit risk (Aaa =1, Aa1=2, …, Ba1=11, …, B1=14, B2=15, B3=16, …). In Panel C, we report loan-level par building measures according to equation (4). In all panels, we exclude index funds, exchange-traded funds, and exchange-traded notes.

Panel A: Fund characteristics

	Loan Funds				Bond Funds				High Yield Funds			
	Mean	Median	Std. Dev.	Obs.	Mean	Median	Std. Dev.	Obs.	Mean	Median	Std. Dev.	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TNA ($Bil)	1.75	0.71	2.70	7,836	1.61*	0.31	6.95	161,262	1.17***	0.33	2.55	37,337
Turnover Ratio (%)	65.88	58.00	45.68	6,670	135.46***	74.00	197.29	129,824	88.99***	62.00	223.65	29,388
Expense Ratio (%)	1.10	1.11	0.24	6,810	0.89***	0.86	0.39	130,997	1.10*	1.09	0.37	29,616
Age (Years)	7.40	6.33	4.79	7,863	15.87***	14.17	11.13	161,910	15.94***	13.58	12.22	37,490
I(Rear Load)	0.63	1.00	0.48	7,863	0.40***	0	0.49	161,914	0.54***	1.00	0.50	37,490
% of Institutional Shares	19.41	16.67	20.35	7,863	19.85	0	27.75	161,914	19.03	11.11	25.89	37,490
Monthly Return (%)	0.33	0.38	1.82	7,833	0.38**	0.35	1.81	161,231	0.56***	0.71	2.47	37,331
Excess Return Over LLI/BofA/HYBond (%)	-0.08	-0.06	0.55	7,833	-0.09	-0.11	1.66	161,231	-0.13***	-0.08	1.16	37,331
Flow (%)	0.81	0.05	6.68	7,813	0.23***	-0.15	5.69	160,896	0.08***	-0.30	6.15	37,242
Flow Volatility [*t*-11 : *t*]	4.66	3.75	3.63	7,777	3.76***	2.44	3.73	153,605	4.18***	2.85	4.10	35,831
2-factor Alpha [*t*-12 : *t*-1] (BofA + LLI/HYBond, %)	-0.04	-0.04	0.15	7,863	-0.02***	-0.01	0.26	161,914	-0.04	-0.03	0.25	37,490
Number of Holdings	315.9	296	165.3	4,687	340.7***	297	220.0	47,233	294.1***	275	170.0	15,671
Holdings Concentration (HHI)	158.2	81.4	457.5	4,687	311.1***	135.2	724.5	47,233	151.8	66.1	444.2	15,671
Holdings from Morningstar												
% in Cash	6.22	5.25	7.29	4,590	6.99***	4.88	23.67	78,360	5.78***	4.01	10.73	18,221
% in Government	0.40	0	2.18	4,590	15.03***	10.66	17.56	78,360	1.39***	0	5.28	18,221
% in Loans	66.37	80.40	31.71	4,590	1.03***	0	3.60	78,360	2.59***	0	5.07	18,221
% in Bonds	20.51	8.38	27.89	4,590	48.93***	43.45	28.39	78,360	83.75***	87.65	15.13	18,221
% in Other	3.25	0.28	12.11	4,590	26.66***	24.41	30.77	78,360	4.06***	2.13	8.91	18,221

Panel B: Peer flow pressure for loan and high yield bond funds

	Mean	5th Percentile	Median	95th Percentile	Std. Dev.	Obs.
Loan Funds						
Fund-level Variables						
Monthly Return (%)	0.31	-1.37	0.41	2.43	1.77	3,201
Peer Flow Pressure (%)	-0.02	-0.10	-0.01	0.01	0.09	3,201
Peer Buy Pressure (%)	0.01	0	0	0.02	0.03	3,201
Peer Sell Pressure (%)	0.03	0	0.01	0.11	0.09	3,201
Loan-level Variables						
Rating (AAA=1, …)	13.92	11.00	14.00	17.00	1.66	20,521
Price	97.37	85.50	99.77	101.11	7.72	28,826
% Change in Price	-0.14	-2.90	0	2.32	2.32	27,534
Flow Pressure (%)	-15.12	-94.63	-1.05	45.73	39.38	28,826
Buy Pressure (%)	6.50	0	0.00	49.05	18.57	28,826
Sell Pressure (%)	21.62	0	1.99	94.78	31.59	28,826
High Yield Funds						
Fund-level Variables						
Monthly Return (%)	0.54	-2.40	0.62	3.62	2.04	10,009
Peer Flow Pressure (%)	-0.01	-0.05	0	0.04	0.04	10,009
Peer Buy Pressure (%)	0.01	0	0.01	0.05	0.02	10,009
Peer Sell Pressure (%)	0.02	0	0.01	0.06	0.03	10,009
Bond-level Variables						
Rating (AAA=1, …)	14.42	11.00	14.00	18.00	2.13	28,633
Price	100.17	77.82	102.23	113.33	12.24	32,585
% Change in Price	0.12	-5.63	0.16	5.46	3.49	30,264
Flow Pressure (%)	-0.21	-81.79	0	80.00	42.85	32,585
Buy Pressure (%)	17.06	0	0.01	82.42	27.02	32,585
Sell Pressure (%)	17.27	0	0.99	83.16	27.07	32,585

Panel C: Par Building Measures for Loans

	Mean	5th percentile	Median	95th percentile	Std. Dev.	Obs.
Par	-0.006	-0.056	0	0.038	0.060	6,077
Par from Buy	0.008	-0.006	0.001	0.047	0.025	6,077
Par from Sell	-0.014	-0.068	0	0.005	0.054	6,077

Table 2. Effects of Flow on Monthly Excess Percentage Returns in Illiquid Periods

This table shows the fund-level impact of flow on monthly excess percentage returns in illiquid periods for loan funds, bond funds and high yield funds from January 2003 to December 2020. The unit of observation is fund-month. The dependent variable is monthly excess fund return in percentage, calculated as the difference between a fund's return and the return of *LLI*, *BofA*, and *HYBond* indexes for loan funds, bond funds, and high yield funds, respectively, as defined in Table 1. Fund return is the value-weighted monthly return across share classes in a fund. We use three illiquid periods measures based on VIX, HYBB, and TIGHTEN. VIX is the CBOE's VIX index; HYBB is the ICE BofA BB US High Yield Index option-adjusted spread; TIGHTEN is the net percentage of domestic banks tightening standards for commercial and industrial loans to large and middle-market firms. For the first two variables, *I(Illiquid Period)* equals one if the corresponding variable is above the sample average and zero otherwise. For TIGHTEN, *I(Illiquid Period)* equals one if the net percentage is positive and zero otherwise. TIGHTEN is of quarterly frequency and we assign the same value for all three months within a quarter. Fund controls include *Alpha*, *Lagged Flow*, *Log(TNA)*, *Log(Age)*, *Expense Ratio* and an indicator for whether the fund has a rear load charge, *I(Rear Load)*. Month fixed effects are included in all specifications. T-statistics are reported in parentheses. Standard errors are clustered at the fund level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Monthly Excess Percentage Returns								
	Loan Funds			Bond Funds			High Yield Funds		
	VIX	HYBB	TIGHTEN	VIX	HYBB	TIGHTEN	VIX	HYBB	TIGHTEN
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flow	0.326***	0.451***	0.453***	0.019	0.107	0.505	-0.860	-0.791	-0.586
	(3.32)	(3.38)	(2.88)	(0.05)	(0.31)	(1.42)	(-1.07)	(-0.94)	(-0.77)
Flow × I(Illiquid Period)	0.845**	0.428	0.534	2.085***	1.867***	0.997**	1.854**	1.619**	1.342*
	(2.02)	(1.08)	(1.22)	(5.36)	(4.78)	(2.57)	(2.24)	(2.00)	(1.65)
I(Illiquid Period)	0.184*	0.150	-0.735**	-0.152***	-0.103*	0.571***	-0.153**	-0.120	-0.546*
	(1.72)	(0.99)	(-2.07)	(-3.04)	(-1.79)	(3.02)	(-2.10)	(-1.42)	(-1.83)
Fund Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,768	6,768	6,768	129,872	129,872	129,872	29,388	29,388	29,388
R-squared	0.16	0.16	0.16	0.27	0.27	0.27	0.14	0.13	0.13

Table 3. Price Impact Analysis

The following table presents estimates of linear regression models where the dependent variable is the percentage change in prices from month *t*-1 to *t* for loans (bonds) held by loan (high yield bond) funds from January 2010 to December 2020. The unit of observation is security-month. We calculate changes in the prices of loans and bonds as follows. For each loan in a month, we calculate the average bid price and ask price from daily quotes by dealers from Markit. We then take the average of the two as the mid-price and calculate its percentage change from the previous month. Similarly, for each bond in a month, we calculate the value-weighted average sell price and buy price from Enhanced TRACE. We then calculate the average of the two as the mid-price. Monthly mutual fund flows and holdings are from the CRSP Mutual Fund database and the security-level flow pressure measures are calculated according to equation (2). We standardize the flow pressure measures to aid interpretation. *I(Loan)* is an indicator equal to one for loans and zero otherwise. T-statistics are in parentheses. Standard errors are clustered at the security level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Percentage Change in Price											
	Full Sample						Sample with Price (*t*) > 80					
	Loans		High Yield Bonds		Loans and HY Bonds		Loans		High Yield Bonds		Loans and HY Bonds	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Flow Pressure Sd	0.162***		0.539***		0.547***		0.156***		0.373***		0.386***	
	(7.50)		(16.00)		(16.16)		(10.82)		(18.65)		(19.21)	
Flow Pressure Sd × I(Loan)					-0.398***						-0.235***	
					(-9.78)						(-9.46)	
Buy Pressure Sd		0.095***		0.401***		0.409***		0.087***		0.199***		0.212***
		(6.15)		(10.44)		(10.69)		(7.81)		(8.73)		(9.31)
Sell Pressure Sd		-0.118***		-0.282***		-0.284***		-0.115***		-0.270***		-0.274***
		(-4.85)		(-9.23)		(-9.35)		(-7.05)		(-14.74)		(-15.04)
Buy Pressure Sd × I(Loan)						-0.317***						-0.127***
						(-7.64)						(-5.00)
Sell Pressure Sd × I(Loan)						0.180***						0.161***
						(4.62)						(6.62)
Security FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,534	27,534	30,264	30,264	57,798	57,798	26,589	26,589	28,410	28,410	54,999	54,999
R-Squared	0.12	0.12	0.20	0.20	0.18	0.18	0.09	0.09	0.22	0.22	0.19	0.19

Table 4. Share Creations and Redemptions by Exchange-Traded Funds

This table provides summary statistics and estimates of a multinomial logistic regression of share creations/redemptions for loan exchange-traded funds (ETFs) and high yield bond ETFs from January 2010 to December 2020. The unit of observation is fund-day. The data are from the CRSP Mutual Fund database. Loan and high yield bond ETFs are identified using the ETF/ETN indicator from CRSP. In Panel A, *Premium* equals (Price – NAV)/NAV. *Spread* equals (Ask Price – Bid Price)/Price. *Shares Outstanding* is the number of shares outstanding in thousands. *TNA ($mil)* is monthly total net assets in millions. *Δ(Shares)* equals Shares Outstanding at *t* minus Shares Outstanding at *t*-1. *%Δ(Shares)* equals Δ(Shares)/Shares Outstanding at *t*-1. The creation sample is limited to observations with positive values for Δ(Shares), and the redemption sample to negative values. We report *t*-test results comparing means and median test results comparing medians for premium and spread between the two groups. In Panel B, we report results from a multinomial logistic analysis of the relationship between share creations/redemptions and lagged premiums/discounts. The dependent variable *Creation/No Change/Redemption* equals 1 if Δ(Shares) is positive (creation), -1 if Δ(Shares) is negative (redemption), and 0 if Δ(Shares) is zero (no change). *Premium[t-1]*, *Premium[t-2]*, and *Premium[t-3]* are the premium measures lagged by one, two, and three days, respectively. *Cumulative Premium[t-3:t-1]* is the sum of premiums over the past three days. Control variables (not displayed) include lagged trading volume, average spread over the past five days, and monthly total net assets. We also report the change in marginal probability of creation and redemption induced by a one percentage point change in *Cumulative Premium[t-3:t-1]* from its sample average. In Panel B, *t*-statistics are in parentheses. Standard errors are clustered at the share class level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Summary statistics

	Loan ETFs				High Yield ETFs			
	Mean	Median	Std. Dev.	Obs.	Mean	Median	Std. Dev.	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Premium (%)	0.03	0.05	0.40	11,614	0.20***	0.15***	1.61	72,160
Spread (%)	0.27	0.08	0.74	11,614	0.24***	0.12***	0.54	72,160
Shares Outstanding (thd)	55,633	14,300	95,981	11,614	27,475	3,700	58,964	72,160
TNA ($mil)	1,497	434	2,242	554	1,366	147	3,518	3,449
Creation Sample								
Δ(Shares) (thd)	1,448	200	4,457	747	1,500	300	4,457	2,358
%Δ(Shares) (in %)	8.53	1.14	126.3	747	11.04	4.35	28.86	2,358
Premium (%)	0.10	0.11	0.20	747	0.36***	0.24***	1.49	2,358
Redemption Sample								
Δ(Shares) (thd)	-2,070	-425	5,300	382	-2,681	-450	8,722	843
%Δ(Shares) (in %)	-3.78	-2.44	4.27	382	-6.91	-3.53	10.36	843
Premium (%)	-0.17	-0.06	0.50	382	-0.26*	-0.11***	0.99	843

Panel B. Multinomial logistic model

	Dependent variable: Creation/No Change/Redemption			
	Loan ETFs		High Yield ETFs	
	(1)	(2)	(3)	(4)
Creation				
Premium[*t*-1]	56.59**		0.198	
	(2.30)		(0.03)	
Premium[*t*-2]	73.81		10.29	
	(1.04)		(1.45)	
Premium[*t*-3]	-51.61		-6.441	
	(-1.53)		(-1.53)	
Cumulative Premium[*t*-3:*t*-1]		26.03		1.314
		(0.78)		(1.25)
Redemption				
Premium[*t*-1]	-84.27**		-40.32***	
	(-2.42)		(-3.86)	
Premium[*t*-2]	-52.83***		-4.794**	
	(-2.72)		(-2.30)	
Premium[*t*-3]	-48.49*		-4.918	
	(-1.81)		(-1.48)	
Cumulative Premium[*t*-3:*t*-1]		-61.80***		-15.22***
		(-2.91)		(-3.57)
ETF Controls	Yes	Yes	Yes	Yes
Observations	11,525	11,525	71,156	71,156
Pseudo R-squared	0.081	0.079	0.017	0.016
Marginal Probability of Creation		0.70%		0.04%
Marginal Probability of Redemption		1.22%		0.16%

Table 5. CLO Par Building and Mutual Fund Flow-Induced Pressure

This table presents estimates of the relationship between CLO par building activity and flow-induced pressure using a sample of loans held by CLOs and mutual funds during the period between January 2010 and December 2020. The unit of observation is loan-month. Par and flow pressure measures for individual loans are calculated according to equations (3) and (2), respectively. We require a loan to be traded by at least three mutual funds to calculate its flow pressure. CLO trades with a transaction price below 80% (i.e., distressed trades) or above 110% (i.e., erroneous observations) of the face value are dropped. In Panel A, we report estimates of a linear regression model where the dependent variable is par and the main independent variable is flow pressure. In Panel B, *I(Negative Outflows from Loan Funds)* equals 1 if the aggregate flow to loan funds in the month is negative and 0 otherwise. T-statistics are in parentheses. Standard errors are clustered at the loan level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. CLO par building and flow-induced pressure

Dependent variable:	Par	Par from Buy		Par from Sell	
	(1)	(2)	(3)	(4)	(5)
Flow Pressure	-0.005***				
	(-2.95)				
Buy Pressure		-0.003**		0.001	
		(-2.31)		(0.40)	
Sell Pressure			0.005***		0.002
			(3.84)		(1.31)
Loan FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Observations	6,077	6,077	6,077	6,077	6,077
R-Squared	0.42	0.33	0.33	0.50	0.50

Panel B. Par building and flow pressure during periods of market stress

	Par			
	(1)	(2)	(3)	(4)
Flow Pressure	-0.006***	-0.002		
	(-3.30)	(-0.91)		
I(Net Outflow from Loan Funds)	-0.009***	-0.009***	-0.009***	-0.010***
	(-3.21)	(-3.48)	(-3.18)	(-3.43)
Flow Pressure × I(Net Outflow from Loan Funds)		-0.003**		
		(-2.50)		
Buy Pressure			-0.001	-0.003
			(-0.42)	(-0.71)
Sell Pressure			0.008***	0.002
			(3.49)	(0.46)
Buy Pressure × I(Net Outflow from Loan Funds)				0.000
				(0.21)
Sell Pressure × I(Net Outflow from Loan Funds)				0.003**
				(2.22)
Loan FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	6,077	6,077	6,077	6,077
R-squared	0.42	0.42	0.42	0.43

Table 6. Price Impact of Flow Pressure by Par Build Eligibility

This table presents estimates of the relationship between flow-induced price changes and par build eligibility. The dependent variable is the percentage change in prices from month *t*-1 to *t* for loans (bonds) held by loan (high yield bond) funds. For loans, price refers to the monthly average of daily midpoint of quoted bid and ask prices. For bonds, price refers to the value-weighted average of sell and buy prices in a month. The sample period is from January 2010 to December 2020. Flow pressure measures for loans and high yield bonds are calculated according to equation (2). Par build eligible loans are loans with prices of 87.5 percent of par or greater. Results reported in columns (1)-(4) are estimated using the full sample and columns (5)-(8) for those priced between 80 and 95. Columns (1), (2), (5), and (6) are for loans, and columns (3), (4), (7), and (8) are for high yield bonds. The unit of observation is security-month. T-statistics are in parentheses. Standard errors are clustered at the security level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Percentage Change in Price							
	Full Sample				Price (*t*) in [80 : 95]			
	Loans		High Yield Bonds		Loans		High Yield Bonds	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Flow Pressure Sd	0.086***		0.350***		0.435***		0.870***	
	(6.10)		(17.83)		(3.78)		(7.53)	
Flow Pressure Sd × I(Price (*t*) < 87.5)	1.100***		2.095***		0.858***		0.448	
	(5.25)		(7.40)		(3.54)		(1.48)	
Buy Pressure Sd		0.109***		0.325***		0.612***		0.548***
		(8.84)		(11.56)		(5.21)		(4.82)
Sell Pressure Sd		-0.028*		-0.116***		-0.165		-0.512***
		(-1.67)		(-4.90)		(-1.43)		(-4.28)
Buy Pressure Sd × I(Price (*t*) < 87.5)		-0.377		0.806***		-0.388		0.024
		(-1.58)		(2.98)		(-1.55)		(0.09)
Sell Pressure Sd × I(Price (*t*) < 87.5)		-1.113***		-1.825***		-0.922***		-0.651***
		(-6.21)		(-9.25)		(-4.29)		(-2.99)
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,534	27,534	30,264	30,264	3,075	3,075	4,041	4,041
R-squared	0.12	0.13	0.21	0.21	0.34	0.34	0.50	0.50

Table 7. Price Impact of Flow Pressure by Par Build Eligibility for Loans and CDS Contracts

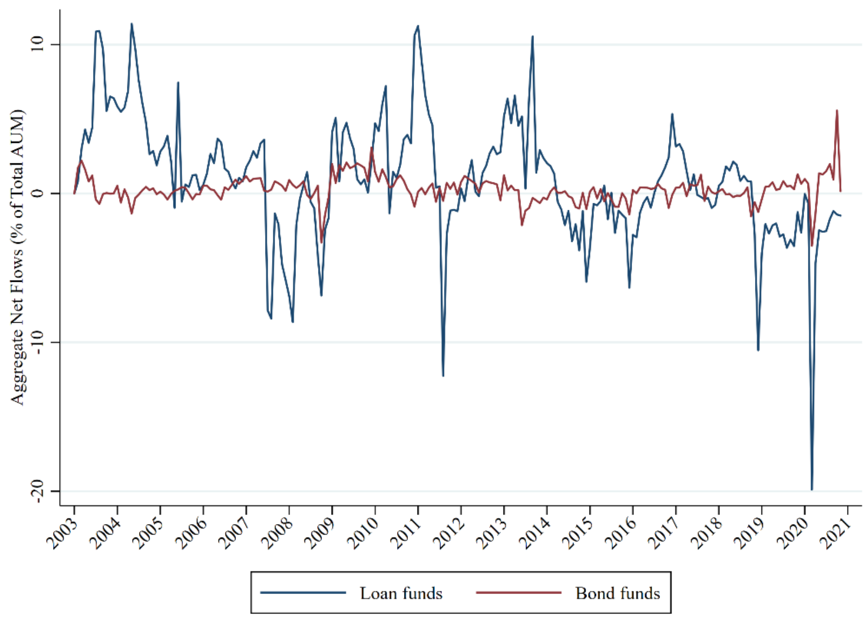
This table presents estimates of the relationship between flow-induced changes in prices/quotes and par build eligibility for the sample of loans whose issuers have CDS contracts outstanding. The sample period is from January 2010 to December 2020. The unit of observation is loan-month. In columns (1) and (2), the dependent variable is the percentage change in quotes from month *t*-1 to month *t* for loans held by loan mutual funds. Loan quotes are calculated as the monthly average of the midpoints of bid quotes and ask quotes. In columns (3) and (4), the dependent variable is the estimated percentage change in prices from month *t*-1 to month *t* for 5-year CDS contracts of the corresponding issuers as in columns (1) and (2). The CDS contracts are written on senior unsecured obligations denominated in U.S. dollars, with modified restructuring (MR) documentation clause prior to April 2009 and no restructuring (XR) clauses afterwards. The estimated percentage change in prices is calculated as the yield relative as if it were a perpetuity and then adjusted for the relative duration assuming an interest rate of 2.5%. Specifically, the percentage change in prices in month *t* equals [spread(*t*-1) – spread(*t*)]/spread(*t*)×100×(5/41), in which 5 and 41 represent the durations of a CDS and a perpetuity (in years), respectively. The independent variables and control variables are for loan-month. Flow pressure measures are calculated according to equation (2). *I(Price (t) < 87.5)* is a dummy variable equal to 1 for loans with quotes below 87.5 percent of par and 0 otherwise. When it equals 0, it indicates that the loan is eligible for par building. T-statistics are in parentheses. Standard errors are clustered at the security level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Percentage Change in Price	
	Loans	CDS
	(1)	(2)
Flow Pressure Sd	0.063	0.016
	(0.97)	(0.29)
Flow Pressure Sd × I(Price (*t*) < 87.5)	2.171***	0.348
	(2.95)	(1.35)
Security FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	1,679	1,679
R-squared	0.37	0.23

Figure 1. Monthly Net Flows as a Percentage of Total AUM by Fund Type

This figure plots aggregate monthly fund net flows as a share of total assets under management (AUM) from CRSP. Panel A compares loan funds and bond funds; Panel B compares loan funds and high yield bond funds. The sample is from January 2003 to November 2020.

Panel A: Loan funds and bond funds



Panel B: Loan funds and high yield funds

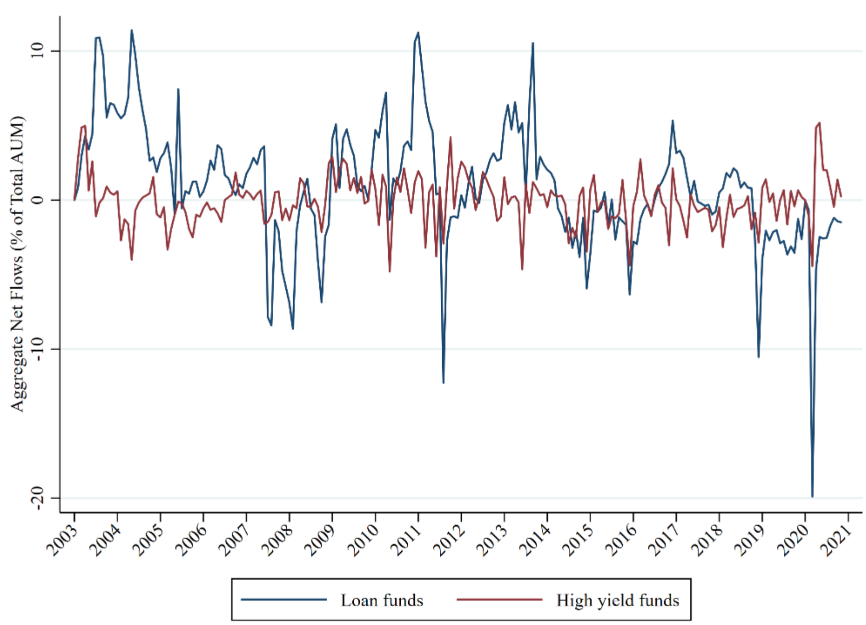
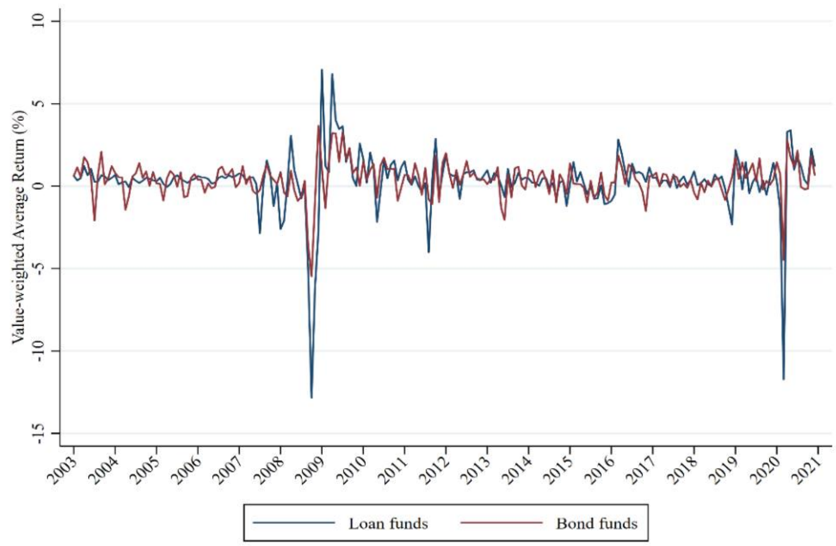


Figure 2. Average Monthly Returns by Fund Type

This figure plots average monthly fund percentage returns weighted by funds' total net assets from CRSP. Panel A compares loan funds and bond funds; Panel B compares loan funds and high yield bond funds. The sample is from January 2003 to November 2020.

Panel A: Loan funds and bond funds



Panel B: Loan funds and high yield funds

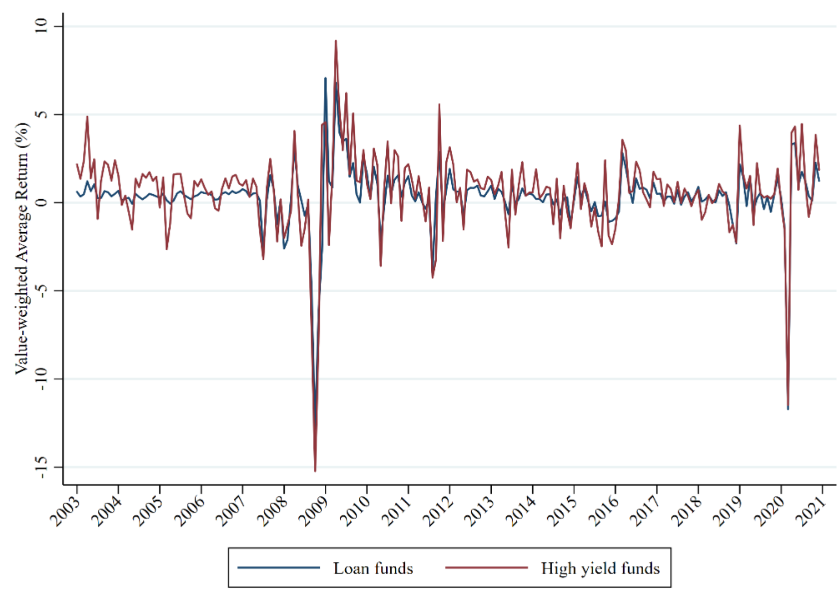


Figure 3: Effects of Selling Pressure on Loan Prices by Par Build Eligibility

This figure plots the impact of flow-induced selling pressure on returns of loans in our sample based on whether a loan is par build eligible. The estimates are based on equation (6) with one exception: instead of using a breakpoint price to determine par eligibility, we define the dummy variable, *I(Par Ineligible)*, based on information from CLO indentures. Specifically, a loan is par ineligible if its rating is less than B. Also, a loan is par ineligible if it is rated above CCC+ and priced below 80. The Par Eligible bar in the figure corresponds to the estimated coefficient β_1 from equation (6) while the Par Ineligible bar refers to the sum of estimated coefficients β_1 and β_2 in the equation. The model includes loan and year fixed effects. Standard errors are clustered at the loan level.

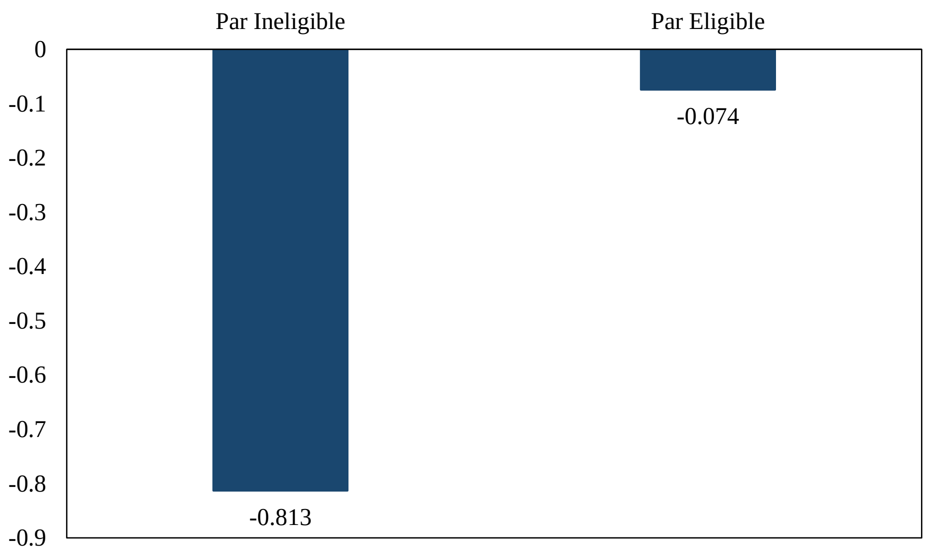


Figure 4. Effects of Selling Pressure on Loan and Bond Prices by Par Buy Price Threshold

This figure plots the impact of flow-induced selling pressure on loan and high yield bond returns based on regression results reported in Table 6 (columns (6) and (8)). Loans (high yield bonds) are designated as par build eligible if they are priced between 87.5 (inclusive) and 95 (exclusive) percent of face value, and par build ineligible if between 80 (inclusive) and 87.5 (exclusive).

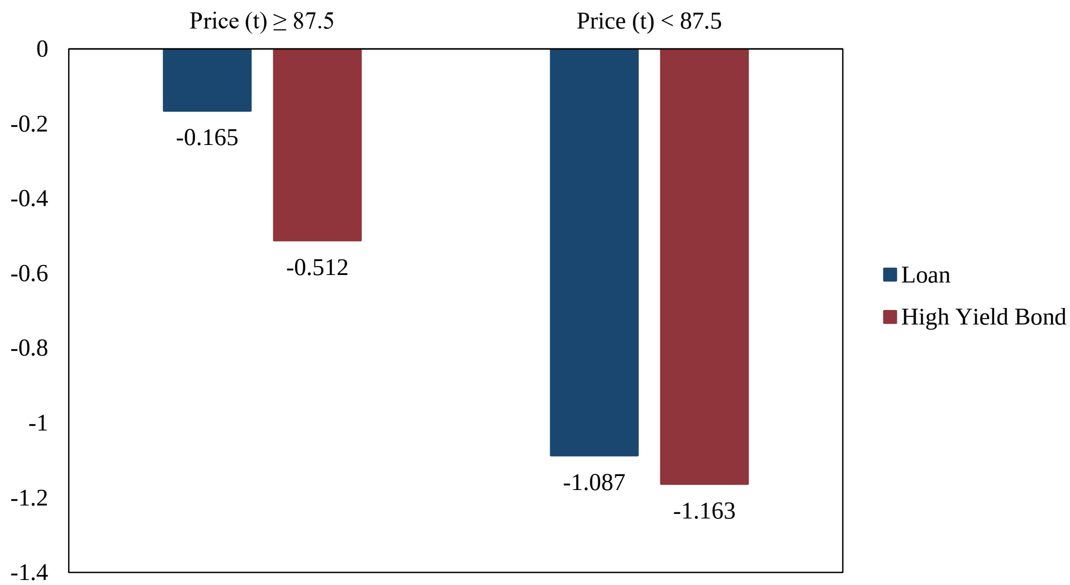


Figure 5. Par Building Activity by Loan Price

This figure plots the average of net CLO trade amount by loan price. We construct a sample of loan-month observations that are in the intersection of loan fund holdings and CLO holdings datasets. We restrict the sample to trades that were executed between January 2010 and December 2020. For each loan-month, we aggregate the net trade amount by CLOs at face value. The net trade amount is calculated as total buy trades at face value minus total sell trades at face value for each loan-month. The Y-axis represents the average net trade amount among the loan-month observations. Loans are grouped into bins based on monthly average of daily quoted prices. The first (last) bin indicates all trades executed by CLOs in loans that are priced below 70 (above 110). Other bins are created by an increment of 2.5 of par value. For example, the 80 bin includes CLO trades involving loans that are priced between 80 (inclusive) and 82.5 (exclusive).

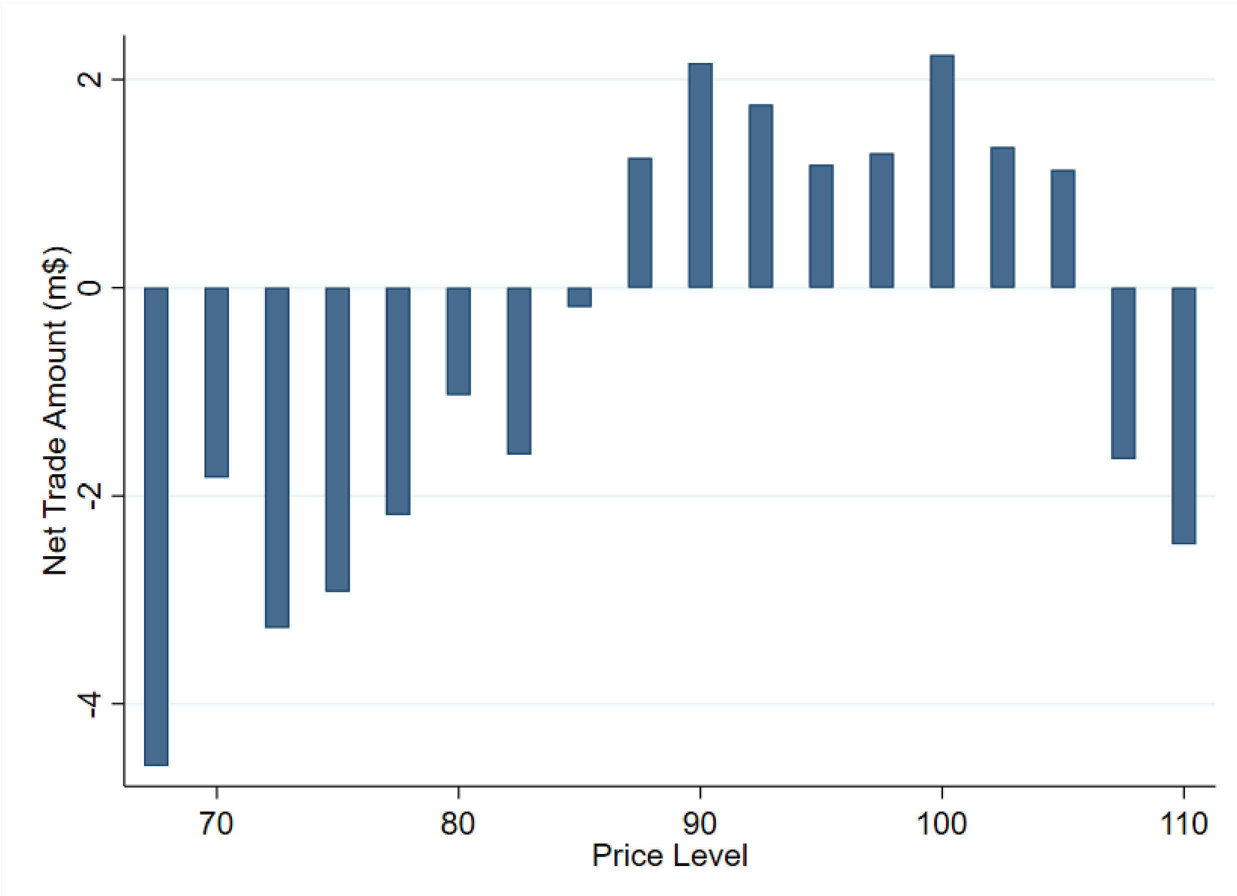


Figure 6. Par Building Activity Around the Breakpoint Price of 87.5

This figure plots the average par built for 10 equally spaced price bins below and above the breakpoint price of 87.5. Each point represents the average par built in a respective price bin while the solid lines represent a fourth-order polynomial fit. The sample contains loans that are traded by both CLOs and loan funds in a given month. The sample is restricted to loans that are priced between 80 and 95.

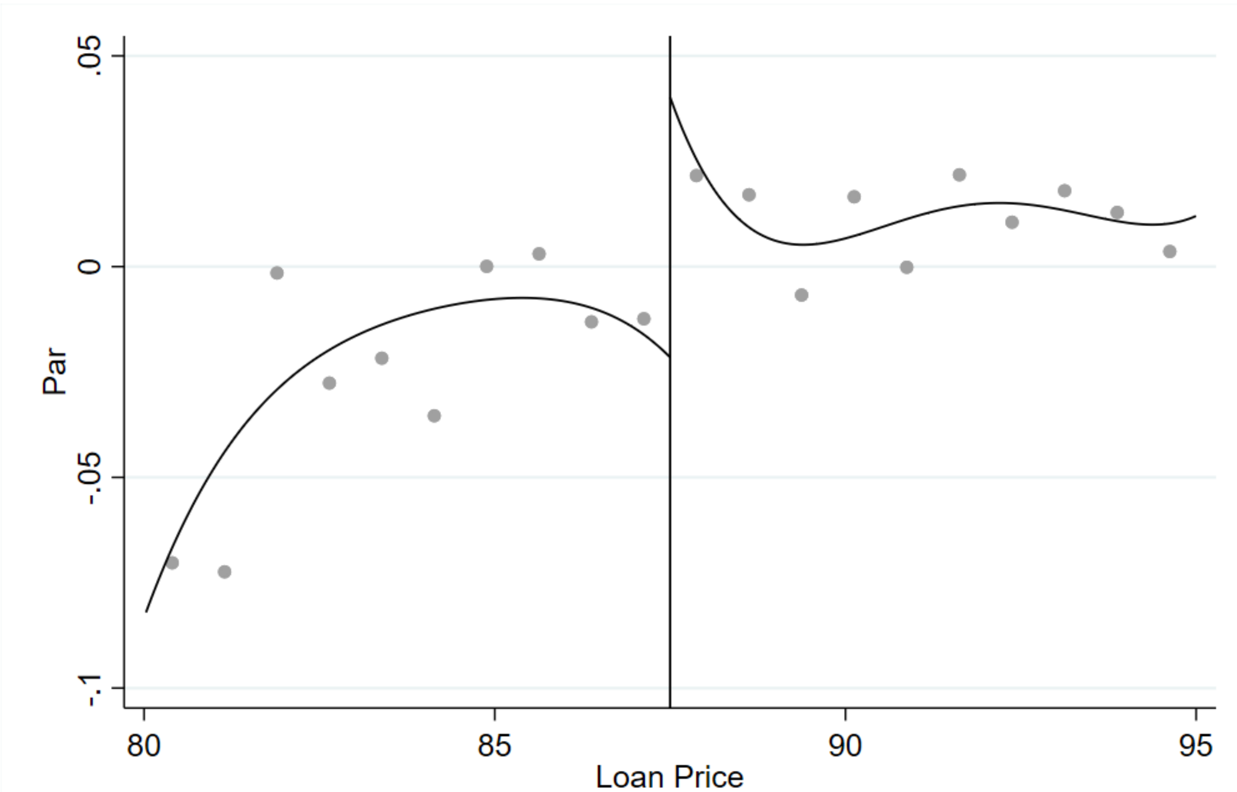
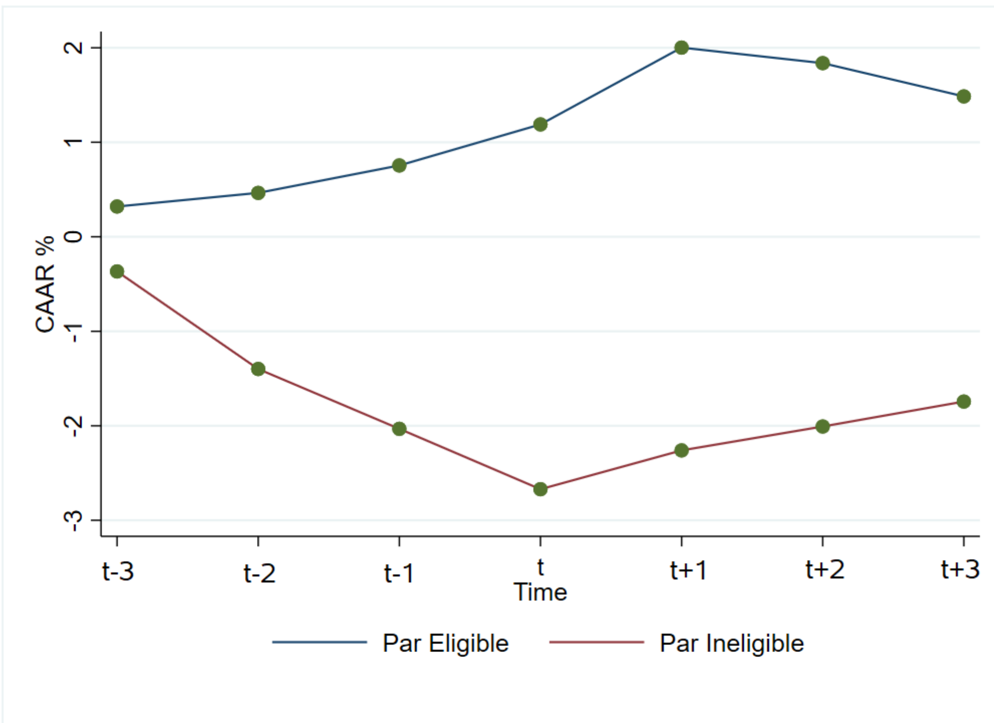


Figure 7. Cumulative Abnormal Returns Around Loan Fund Fire Sales by Par Build Eligibility

This figure plots cumulative average abnormal returns (CAARs) for loans that are subject to mutual fund sell pressure. CAARs are measured as monthly returns in excess of the equally weighted average return of all loans held by loan mutual funds at the start of the month. Transactions in the event month are identified as "forced" if its flow pressure measure is in the bottom quartile. The blue line represents loans that are par build eligible, which are priced at or above 87.5 percent of face value in the event month. The red line represents loans that are par build ineligible, which are priced below 87.5 percent of face value. The sample is restricted to loans priced between 80 and 95 percent of par.



Appendix A.

Table A1. Flow-Performance Relationship in Loan, Bond, and High Yield Funds.

This table provides estimates of the flow-performance relationship for loan funds, general corporate bond funds, and high yield bond funds. The sample is from January 2003 to December 2020. The unit of observation is share class-month. The dependent variable, $Flow_t$, is the net flow as a percentage of the prior month's total net assets (TNA). For the lagged performance measure, in columns (1)-(3) we use raw returns and in columns (4)-(6) we use alpha. *Return* is the annualized net return in percent. *Alpha [t-12:t-1]* is estimated using a 2-factor model on a 12-month rolling sample up to last month, requiring 9 minimum observations. The factors used in estimating alpha for loan funds are excess returns of the ICE BofA US Corporate Index (*BofA*) and the S&P/LSTA Leveraged Loan Index (*LLI*). For bond funds and high yield funds, the two factors are excess returns of the *BofA* index and the S&P U.S. High Yield Corporate Bond Index (*HYBond*). Flow, Return and Alpha are winsorized at 1% and 99% levels. *I(Performance < 0)* is a dummy variable equal to one if the corresponding performance measure is negative. Controls include lagged flow, the natural logarithm of total net assets in millions (*Log(TNA)*), the natural logarithm of share class age (*Log(Age)*), the net expense ratio in percent (*Expense Ratio*), and an indicator variable for whether the share class charges rear loads (*I(Rear Load)*). All regressions include share-class and month fixed effects. Standard errors are clustered at the share-class level and *t*-statistics are reported in parentheses. ***, **, and * represent 1%, 5%, and 10% statistical significance, respectively.

	Performance: Return			Performance: Alpha		
	(1)	(2)	(3)	(4)	(5)	(6)
	Loan Funds	Bond Funds	High Yield Funds	Loan Funds	Bond Funds	High Yield Funds
Performance_{t-1}	0.071***	0.001	0.025***	13.768***	1.601***	2.959***
	(2.70)	(0.22)	(3.52)	(4.36)	(6.27)	(5.12)
$\text{I}(\text{Performance}_{t-1} < 0)$	-0.512	-0.172***	0.025	0.010	-0.222***	-0.199*
	(-1.49)	(-3.01)	(0.13)	(0.04)	(-4.31)	(-1.88)
$\text{Performance}_{t-1} \times \text{I}(\text{Performance}_{t-1} < 0)$	0.018	0.025***	0.035**	-7.791**	0.596*	-0.226
	(0.32)	(4.41)	(2.28)	(-2.41)	(1.83)	(-0.31)
Lagged Flow	0.214***	0.144***	0.085***	0.153***	0.102***	0.036***
	(10.84)	(23.30)	(6.36)	(6.21)	(15.67)	(2.67)
Log(TNA)	-0.158	0.289***	0.383***	0.256*	0.368***	0.528***
	(-0.96)	(8.37)	(4.39)	(1.76)	(10.24)	(5.72)
Log(Age)	-5.929***	-3.954***	-4.999***	-5.398***	-3.383***	-4.544***
	(-11.16)	(-34.20)	(-18.21)	(-9.57)	(-26.82)	(-15.34)
Expense Ratio	-3.681	-0.638**	-0.120	0.666	-0.790***	-0.344
	(-1.45)	(-2.39)	(-0.23)	(0.31)	(-3.16)	(-0.74)
I(Rear Load)	0.817	0.104	0.191	1.300**	-0.046	-0.012
	(1.28)	(0.73)	(0.82)	(2.02)	(-0.36)	(-0.06)
Share Class FEs	Yes	Yes	Yes	Yes	Yes	Yes
Month FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,231	422,327	106,388	27,512	398,931	100,785
R-squared	0.22	0.07	0.08	0.18	0.04	0.06

Table A2. Effects of Flow on Monthly Excess Percentage Returns in Illiquid Periods

This table repeats Table 2, except that the sample period is from January 2003 to December 2019. The unit of observation is fund-month. Standard errors are clustered at the fund level and *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Loan Funds			Bond Funds			High Yield Funds		
	VIX	HYBB	TIGHTEN	VIX	HYBB	TIGHTEN	VIX	HYBB	TIGHTEN
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flow	0.292***	0.427***	0.324**	-0.030	0.068	0.379	-0.906	-0.844	-0.662
	(2.99)	(2.96)	(2.44)	(-0.08)	(0.19)	(1.05)	(-1.10)	(-0.97)	(-0.84)
Flow × I(Illiquid Period)	0.668*	0.192	0.614	2.289***	1.964***	1.320***	1.959**	1.696**	1.508*
	(1.76)	(0.54)	(1.56)	(5.70)	(4.91)	(3.30)	(2.31)	(2.03)	(1.79)
I(Illiquid Period)	-0.328**	-0.307*	-0.454***	-0.174***	-0.169***	-0.204***	0.121	0.129	-0.250***
	(-2.28)	(-1.92)	(-3.33)	(-3.50)	(-3.42)	(-5.00)	(1.47)	(1.57)	(-3.81)
Alpha [t-12 : t-1]	-3.509	-3.396	-4.257	-18.303***	-18.103***	-18.006***	18.740**	18.843**	18.564**
	(-0.51)	(-0.50)	(-0.64)	(-4.16)	(-4.09)	(-4.10)	(2.11)	(2.10)	(2.11)
Lagged Flow	0.003	0.006	0.004	0.112	0.118	0.113	-0.113	-0.134	-0.148
	(0.02)	(0.03)	(0.02)	(1.25)	(1.30)	(1.27)	(-0.72)	(-0.87)	(-0.96)
Log(TNA)	-0.006	-0.007	-0.006	0.017***	0.016***	0.016***	0.007	0.007	0.008
	(-0.48)	(-0.51)	(-0.49)	(4.99)	(4.93)	(4.93)	(1.12)	(1.09)	(1.13)
Log(Age)	0.009	0.011	0.010	-0.023***	-0.023***	-0.022**	-0.006	-0.006	-0.006
	(0.31)	(0.36)	(0.33)	(-2.69)	(-2.61)	(-2.54)	(-0.31)	(-0.31)	(-0.31)
Expense Ratio	5.562	5.321	5.328	7.315***	7.287***	7.414***	-5.087**	-5.238**	-5.303**
	(1.12)	(1.09)	(1.08)	(4.14)	(4.13)	(4.19)	(-2.09)	(-2.19)	(-2.22)
I(Rear Load)	0.008	0.007	0.007	0.029**	0.030**	0.029**	0.018	0.018	0.018
	(0.32)	(0.28)	(0.27)	(2.20)	(2.23)	(2.21)	(0.93)	(0.92)	(0.92)
Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,220	6,220	6,220	123,182	123,182	123,182	28,166	28,166	28,166
R-squared	0.18	0.18	0.18	0.28	0.28	0.28	0.14	0.14	0.14

Appendix B: Fire-Sale Spillover Effects.

FHLS (2021) find that a mutual fund's performance in fixed income markets is adversely affected by outflows of its peer funds. We assess fire-sale spillover effects for loan funds by estimating the relationship between monthly returns (flows) and peer flow pressure. We use the same measure of peer flow pressure as FHLS (2021). For, each fund *j* in month *t*, we take the weighted sum of price pressure from *other* funds' flow-related trading in each loan (bond) it holds,

$$Peer\ Flow\ Pressure_{j,t} = \sum_{l} Flow\ Pressure_{l,t}^{j \neq i} * \ \omega_{j,l,t-1} \qquad (A1)$$

where $Flow\ Pressure_{l,t}^{j \neq i}$ is calculated by using the holdings and flow information of other funds (i.e., $i \neq j$) and $\omega_{j,l,t-1}$ is the portfolio percentage share holdings of each fund *j* in loan *l* in month *t*-1. To examine potential asymmetric effects of peer flow pressure, we also calculate peer buy (sell) pressure as follows:

$$Peer\ Buy\ (Sell)\ Pressure_{j,t} = \sum_{l} \frac{Flow\ Induced\ Buys\ (Sales)_{l,t}^{j \neq i}}{Mutual\ Fund\ Trade\ Volume_{l,t}} * \omega_{j,l,t-1} \qquad (A2)$$

For comparison purposes, we also standardize flow pressure and peer flow pressure measures for loan and high yield funds. We identify high yield bonds through matching CRSP holdings to the TRACE database and require the "grade" variable to be "H," which indicates high yield bonds.

The peer flow pressure is the weighed sum of peers' flow pressure with the weights based on the asset allocation of a given fund. Funds with greater peer flow pressure hold a larger proportion of their portfolio subject to net flow pressure. We examine the relationship between fund performance and peer flow pressure by estimating the following regression:

$$Y_{i,t} = \alpha + \beta_1\ Peer\ Flow\ Pressure_{i,t} + \mu_i + \theta_t + \varepsilon_{i,t} \quad (A3)$$

where $Y_{i,t}$ is a measure of fund *i*'s performance at time and μ_i and θ_t are fund and time fixed effects.

In Table B1, we report estimates of equation (A3) separately for loan and high yield bond funds as well as estimates based on a pooled sample of funds. In Panel A, we report estimates of the relationship between fund returns and peer flow pressure while in Panel B we report estimates of the relationship between investor flows and peer flow pressure.

Consistent with the findings of FHLS (2021), we find that for both loan funds and high yield bond funds a positive and highly significant relationship between fund returns and peer flow pressure. As shown, peer buy pressure is associated with an increase in fund performance while peer sell pressure depresses fund returns. However, the impact of flow pressure on fund returns is significantly less for loan funds than for high yield bond funds. Comparing the coefficient estimates reported in columns (2) and (4), we see that the impact of sell pressure on loan fund returns is about half the impact on high yield bond funds. In terms of economic magnitude, a one standard-deviation increase in sell pressure reduces loan fund returns by about 24 basis points (about 77 percent of the average monthly return) while for high yield funds it is associated with a 58-basis point decline in returns (about 107 percent of the average monthly returns).

We test for differences in spillover effects by pooling loan and high yield funds and then interacting the fund pressure measures with a dummy variable that indicates whether the fund is a loan fund or not. As shown in column (5), the coefficient on the interaction variable is negative and significant at the 1% level. More importantly, focusing on peer sell pressure, we find that the effect of sell pressure is significantly less for loan funds than for high yield bond funds. Thus, while both loan and high yield bond funds experience significant spillover effects, the effects and the associated fire-sale discounts are significantly less for loan funds than bond funds.

Panel B of Table B1 provides estimates of the impact of peer flow pressure on own fund flows. Consistent with the findings of FHLS (2021), we find a strong positive relation between fund flows and peer flow pressure for both loan and high yield funds. Like the return analysis, loan funds appear to be more resilient than high yield funds. Overall, the findings reported in Table B1 suggest that loan funds are less exposed to strategic complementarities than high yield bond funds.

Table B1. Fire-Sale Spillover for Loan and High Yield Bond Funds

This table presents regression estimates of the relationship between peer flow pressure and monthly fund returns in Panel A and fund flows in Panel B. The unit of observation is fund-month. The sample includes loan and high yield mutual funds from January 2010 to December 2020. The sample is partitioned into loan funds in columns (1) and (2) and high yield funds in columns (3) and (4). We require that security holdings information be available in two consecutive months. Monthly fund returns are taken from the CRSP Mutual Fund database and the peer flow pressure measures are calculated according to equation (A1). We standardize the peer flow pressure measures to aid interpretation. *I(Loan Fund)* is an indicator equal to one for loan funds and zero otherwise. T-statistics are in parentheses. Standard errors are clustered at the fund level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Monthly Fund Returns (%)

	Loan Funds		High Yield Funds		Loan and High Yield Funds	
	(1)	(2)	(3)	(4)	(5)	(6)
Peer Flow Pressure Sd	0.10***		0.35***		0.34***	
	(3.02)		(9.26)		(9.33)	
Peer Buy Pressure Sd		-0.05***		0.27***		0.28***
		(-4.62)		(8.90)		(9.09)
Peer Sell Pressure Sd		-0.12***		-0.25***		-0.24***
		(-3.09)		(-7.51)		(-7.55)
Peer Flow Pressure Sd × I(Loan Fund)					-0.23***	
					(-4.80)	
Peer Buy Pressure Sd × I(Loan Fund)						-0.33***
						(-9.98)
Peer Sell Pressure Sd × I(Loan Fund)						0.11**
						(2.36)
Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,201	3,201	10,000	10,000	13,201	13,201
R-squared	0.04	0.04	0.11	0.11	0.09	0.10

Panel B. Monthly Fund Flows (%)

	Loan Funds		High Yield Funds		Loan and High Yield Funds	
	(1)	(2)	(3)	(4)	(5)	(6)
Peer Flow Pressure Sd	0.28**		0.40***		0.51***	
	(2.42)		(6.08)		(7.07)	
Peer Buy Pressure Sd		0.01		0.12**		0.16***
		(0.13)		(2.14)		(2.77)
Peer Sell Pressure Sd		-0.29**		-0.41***		-0.52***
		(-2.44)		(-5.51)		(-6.22)
Peer Flow Pressure Sd × I(Loan Fund)					-0.27**	
					(-2.01)	
Peer Buy Pressure Sd × I(Loan Fund)						-0.06
						(-0.44)
Peer Sell Pressure Sd × I(Loan Fund)						0.28*
						(1.95)
Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,201	3,201	10,000	10,000	13,201	13,201
R-squared	0.26	0.26	0.10	0.10	0.11	0.12

Appendix B2. Incentives of CLO Managers to Fire Sell Downgraded Loans versus Build Par Through Transactions.

Elkamhi and Nozawa (2022) examine whether CLOs constrained by a low overcollateralization (OC) ratio are forced to sell loans downgraded to a CCC rating. Specifically, they inspect two choices for a CLO to improve its OC ratio: 1) Sell a loan carried at par value (i.e. a par eligible loan) to pay down the debt. That is, the CLO sells a loan that is held at the book value of 100 and uses the proceeds to repay the senior tranche, and 2) Sell a loan carried at market value (i.e. a par-ineligible loan) to pay down the debt. That is, the CLO sells a loan valued at market price $P < 100$ and repays the senior tranche. We expand the choice set by examining a third choice: 3) Sell a par-ineligible loan, use the proceeds to purchase a par eligible loan, and do not pay down the debt.

Denote OC^{pre} as the current OC ratio before transactions. Elkamhi and Nozawa (2022) show that in order to improve the OC ratio after transactions, choice 1 requires $OC^{pre} > \frac{100}{P}$; choice 2 requires $OC^{pre} > 1$. Since the threshold for the OC ratio test is set above 100%, choice 2 is the optimal choice for most CLOs.

We show that choice 3 dominates choice 2 if and only if the purchase price of the new loan falls below a cutoff price P^*. While the cutoff price is determined by assets under management, the current OC ratio, and transaction principal amount, the condition is satisfied for most cases. As an example, Figure B1 below shows the various cutoff prices depending on the parameter values when $OC^{pre} = 1.08$. A typical example of a CLO portfolio with \$500 million in assets and a transaction amount of \$2.5 million is associated with a cutoff price of 92.56. This means that for a new loan priced below 92.56, this CLO could improve the OC ratio by building bar with transacting loans and avoiding paying down the debt tranche. Notice that when $OC^{pre} = 1.08$, the possible cutoff prices are around 92 for all combinations of reasonable assets and transaction principal amount levels, so par building would be a likely strategy for CLOs. Note that a higher OC^{pre} would push down the cutoff price but also diminish the need to improve the OC ratio. Figure B3 shows when $OC^{pre} = 1.1$, a similar picture is observed where the cutoff price is around 90.

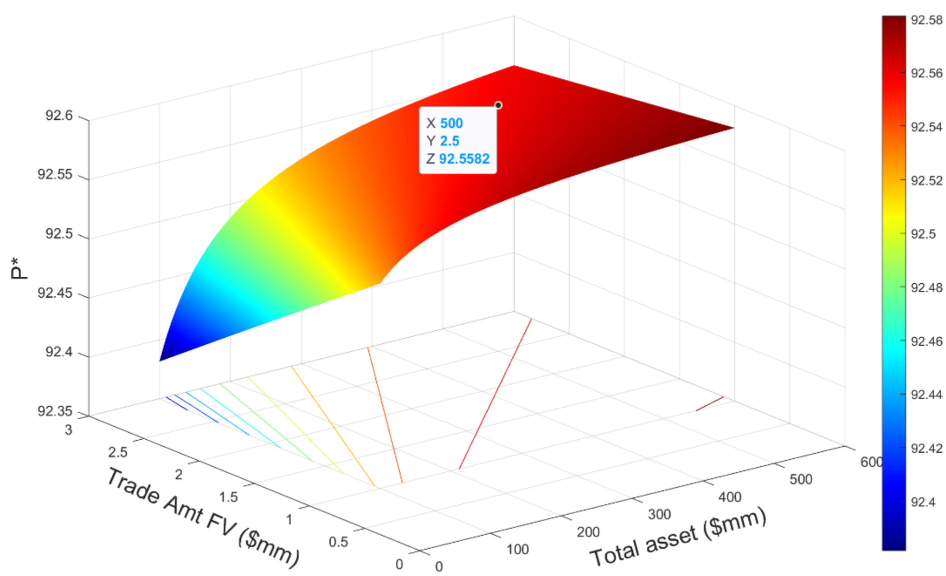


Figure B1. Heat map of the cutoff price P^* when $OC^{pre} = 1.08$

To formally show these results, consider a CLO whose asset value is A and the outstanding amount of senior tranche is D, as in Elkamhi and Nozawa (2022). Then the initial senior OC ratio is $OC^{pre} = \frac{A}{D}$. Consider the following three choices, whereas the first two choices are examined in Elkamhi and Nozawa (2022).

1) The CLO sells a loan held at book value of 100 and uses the proceeds to repay the senior tranche.
   After the transaction, $OC^{post1} = \frac{A-100}{D-P}$
   $OC^{post1} > OC^{pre}$ holds if and only if $OC^{pre} > \frac{100}{P}$

2) The CLO sells a loan held at a market price of $P < 100$ and uses the proceeds to repay the senior tranche.
   After the transaction, $OC^{post2} = \frac{A-P}{D-P}$
   $OC^{post2} > OC^{pre}$ holds if and only if $OC^{pre} > 1$

3) The CLO sells a loan held at a market price of $P < 100$, uses the proceeds to purchase a new loan at the same price to build par, and does not repay the senior tranche.
   After the transaction, $OC^{post3} = \frac{A-P+100}{D}$

Note that $OC^{post3} > OC^{pre}$ is always true because $P < 100$.
We now examine the conditions for $OC^{post3} > OC^{post2}$ to hold.

$$\frac{A-P+100}{D} > \frac{A-P}{D-P} \quad (1)$$

$$\text{iff } D(A-P+100) - P(A-P+100) > D(A-P)$$

$$\text{iff } P^2 - P \cdot (A+100) + 100 \cdot D > 0 \quad (2)$$

$$\text{Denote } f(P) \equiv P^2 - P \cdot (A+100) + 100 \cdot D$$

$$\text{Then (2) is equivalent to } f(P) > 0 \quad (3)$$

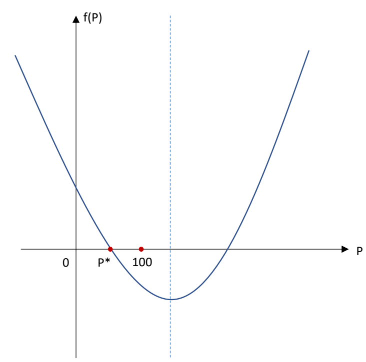


Figure B2. Illustration of the function f(P)

Note that if $D \geq A$, then $f(100) \geq 0$. Since $P < 100$, $f(P) > 0$ will always hold. Therefore, choice 3 dominates choice 2.

If $D < A$, which is the condition for choice 2, then $f(100) < 0$. Since $f(0) = 100 \cdot D > 0$, the cutoff price P^*, which enables $f(P^*) = 0$, will lie between 0 and 100. So $f(P) > 0$ if and only if $P < P^*$. That is, as long as the purchase price $P < P^*$, choice 3 dominates choice 2.

Solving the quadratic function, we obtain $P^* = \frac{(A+100) - \sqrt{(A+100)^2 - 400 \cdot D}}{2}$.

Figure B2 is illustrates $f(P)$ and P^* graphically.

To generalize the comparison of OC^{post3} and OC^{post2}, denote V as the total principal value of the transaction amount and p as the price expressed in a fraction of par so that $p \cdot V$ denotes the transaction price. Then we obtain

$$OC^{post3} = \frac{A - p \cdot V + V}{D}$$

$$OC^{post2} = \frac{A - p \cdot V}{D - p \cdot V}$$

$$OC^{post3} > OC^{post2} \text{ iff } g(p) \equiv p^2 \cdot V - (V + A) \cdot p + D > 0$$

The cutoff price would be $P^* = p^* \cdot V = \frac{(A+V) - \sqrt{(A+V)^2 - 4VD}}{2} = \frac{(A+V) - \sqrt{(A+V)^2 - 4V \cdot \frac{A}{OC^{pre}}}}{2}$.

We note that P^* monotonically decreases in OC^{pre}.

Again, choice 3 is the optimal choice as long as $P < P^*$, where P^* is determined by total assets A, current OC ratio OC^{pre}, and transaction amount V. We illustrate the dynamic levels of P^* using heat maps. As mentioned above, Figure A1 presents a heat map when $OC^{pre} = \frac{A}{D} = 1.08$, the cutoff prices are around 92 for all combinations of an empirically reasonable range of total assets and transaction principal amount levels. Similarly, Figure A3 below shows that when $OC^{pre} = 1.1$, cutoff prices are around 90.

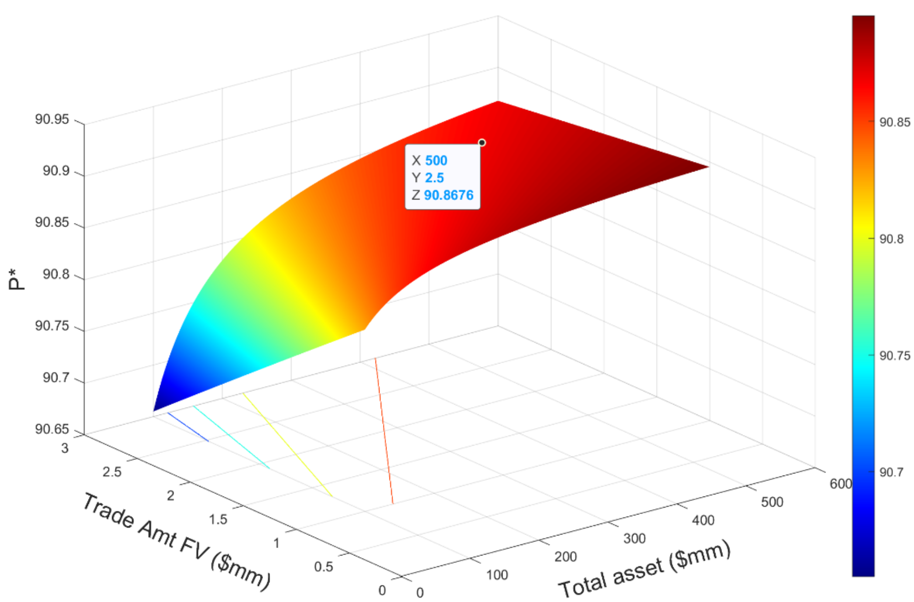


Figure B3. Heat map of the cutoff price P^* when $OC^{pre} = 1.1$