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Financial Covenants and Fire Sales in Closed-End Funds

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Abstract. Closed-end funds are thought to have negligible fire sale risk as they have stable funding. However, I show that embedded covenants can generate price pressure in collateralized loan obligation (CLO) funds, even though such funds are closed end. Loans held by constrained CLOs report significantly lower cumulative returns than loans held by unconstrained CLOs. This can be explained by contractual arbitrage, a practice by which CLOs exploit loopholes in the design of covenants to mechanically loosen their covenants and avoid covenant breaches. Covenant breaches are associated with significant pecuniary and nonpecuniary costs, affecting CLO compensation, reputation, and career prospects. I show that when covenants breaches are imminent, managers fire sell distressed loans. Hence, I demonstrate a channel by which closed-end funds can also create fire sale risk, akin to their open-end counterparts.

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Keywords: closed-end funds • covenants • fire sales • CLOs • leveraged loans

1. Introduction

This paper investigates fire sale risk originating from the collateralized loan obligation (CLO) market, a segment of closed-end funds. A large body of empirical work has documented the negative effects of fire sales in open-end funds (Coval and Stafford 2007, Mitchell et al. 2007, Jotikasthira et al. 2012, Choi et al. 2020), however, there is a paucity of work that examines fire sale risk in closed-end funds. Closed-end funds are perceived to be impervious to fire sales as capital is locked-in for the duration that the fund is in operation, providing a stable source of funding that does not rely on investor flow. However, I show that even in the absence of investor withdrawals, fire sale risk can materialize through other means. Specifically, I show that covenants intrinsic to CLO managerial contracts can generate fire sale risk in the leveraged loan market.

Open-ending is viewed as an optimal solution to the agency problem (Fama and Jensen 1983a). The control function of fully redeemable claims serves as a disciplining device for open-end managers. Fama and Jensen (1983b, p. 317) argue that "the decision of the claim holder to withdraw resources is a form of partial takeover or liquidation which deprives management of control over assets." Closed-end fund investors do not have the same opportunities for recourse when confronted with managerial mismanagement. Empirically, closed-end shares have been shown to trade at a discount relative to net asset value, partly because of agency costs.[1] CLOs are an example of closed-end funds which face the same agency problem. However, the agency problem in CLOs is addressed through a different means, namely, covenants. Covenants are designed to provide recourse in the event of a breach. Thus, this work demonstrates that the remediation designed to address the agency problem in closed-end funds creates fire sale risk as in open-end funds.

Covenants intrinsic to CLO managerial contracts are designed to align managerial incentives and mitigate agency costs. The covenants are primarily of two forms: quality and coverage. Quality covenants aim to ensure that CLOs are sufficiently diversified and have limited exposure to various qualitative dimensions of portfolio risk. Coverage covenants aim to ensure that CLOs have adequate liquidity and capital to finance their obligations. That is, the coverage covenants stipulate a specific level of coverage and subordination relative to the triggers associated with each tranche. If the coverage covenants are breached, proceeds are diverted from junior tranches toward paying down liabilities in descending order of seniority or toward the purchase of value-increasing collateral. Coverage covenants effectively allocate control rights in various states of the world. The diversion of proceeds is punitive to CLO managers in multiple ways; diversion may cause a manager to suffer pecuniary losses, in addition to losses in social capital with regard to career prospects and reputation.

Coverage covenants serve as disciplining devices that ensure that managers adequately screen and monitor their portfolios. Hence, they are the focus of this study. As regulatory bodies have limited supervisory authority to directly address the risks originating from CLOs, understanding how the self-governing charter operates is critical for assessing the potential risks therein.[2] Investigating latent risks in the leveraged loan market is essential for unearthing novel mechanisms of transmission and the amplification of shocks, especially among the riskier segment of firms.

Despite their objective of mitigating agency frictions, covenants can kindle price pressure and fire sale risk, imposing potentially large social costs. Under ordinary circumstances, CLOs are immune to market fluctuations as loans are marked at par value in the calculation of the coverage covenants. However, if a loan experiences distress, it is subject to alternative accounting rules that can tighten the covenants. That is, if a loan experiences default, is a discount obligation, or puts the CLO in excess of its stipulated CCC/Caa1+ loan rating limit, the loan is marked to the lower of its market value or assumed rating agency recovery value, the purchase price until the loan trades above a specified threshold (typically 90¢/$) for more than 30 days or the lowest market value among the CCC/Caa1+ loans, respectively. In these circumstances, CLO managers can mechanically loosen their covenants by selling loans that exhibit higher market values than accounted values. The differences in the valuations directly accrue to the par value of the underlying leveraged loans, loosening the covenants. I introduce and refer to this mechanism as *contractual arbitrage*. Hence, the nonlinear nature of covenants can induce CLO sales of riskier loans and impose externalities on asset prices. I provide supporting evidence that the market prices of distressed loans are frequently larger than their accounted values, thereby allowing CLOs to exploit these differences in valuation through loan sales and loosen their covenants. I further establish a negative relation between a CLO's share of risky loans and its distance to its most stringent coverage covenant threshold. This relation is economically meaningful and statistically significant.

Understanding the financial stability risks arising from the CLO market is important given its growing importance in credit intermediation.[3] CLOs provide long-term stable funding to constrained corporate borrowers. They purchased 75% of new institutional leveraged loans issued in 2019 (Leveraged Commentary and Data 2019). Evidence from the Great Financial Crisis would suggest that, unlike their collateralized debt obligation and collateralized bond obligation counterparts, CLOs are resilient, as they emerged as unscathed survivors of the crisis and did not require an overhaul in their design. However, I argue that the perceived safety of the CLO market is a result of active management, informed by the covenants that CLO managers comply with on a regular basis. I contend that covenants are effective in mitigating agency frictions, although they cannot completely eliminate them, as covenants provide a mechanism through which fire sale risk can transpire.

I analyze the trading behavior, price impact, and underlying incentives of CLO managers using a comprehensive database on CLO holdings, transactions, test results, tranches, and equity distributions. The database uses data from more than 35,000 trustee reports and prospectuses and covers more than 1,200 CLOs in the United States, covering up to 76% of the entire CLO market. The sample period for this study is from 2009 to 2019.

Unlike other static securitizations, CLOs actively manage their portfolios. On average, a CLO's annual turnover is 48% and annual rebalancing is 6.5%. Moreover, discrepancies in characteristics between the CLO and leveraged loan markets indicate that CLO managers both select and monitor their portfolios. At issuance, the composition of leveraged loans differs from the composition of CLO portfolios, and the realized default rate of CLOs is significantly lower than the realized default rate of leveraged loans. These differences motivate the study of CLO managerial behavior regarding defaulted loans.

I use data on loan defaults to identify the trading and price effects originating from CLO covenants. The sample of loan defaults is restricted to the issuers' initial or first loan default event; all subsequent default events associated with an issuer are dropped. I exclude the subsequent default events, as they may confound identification of preemptive sales and price pressure; with subsequent default events, changes that result from a tightening of CLO covenants cannot be readily distinguished from changes in issuer fundamental characteristics. The sample period for this study is from 2009 through 2019.

The central hypothesis of this paper is that fire sales occur when distressed loans are concentrated among constrained CLOs. I begin by documenting a significant positive relation between distressed loan sales and CLO covenant tightness. As the percentage change in the distance to the covenant threshold increases, the probability of a distressed loan sale decreases. I further consider possible nonlinearities in the relation between covenant tightness and the likelihood of a distressed loan sale and find that CLOs which experience a relative tightening in their covenants are more likely to sell distressed loans. In aggregate, CLOs become net sellers of distressed loans, several months before default, indicating that CLOs preemptively divest themselves of distressed loans. However, constrained CLOs sell a larger volume of distressed loans relative to unconstrained CLOs. Hence, the degree of covenant tightness critically determines the magnitude of sales.

CLO sales in the secondary loan market impose price effects around default. A key challenge in studying price effects is disentangling the motives, namely price pressure from information revelation. Evidence of price reversals following forced sales lends credence to the price pressure hypothesis; if expectations of terminal values are unchanged, reversal reflects deviations between fire sale prices and fundamental values. In contrast, if information informs CLO sales, the secondary loan price is expected to fall and not exhibit any drift.

The baseline empirical design compares the price effects of loans held by constrained and unconstrained CLOs, exploiting variation in issuers' exposures to CLO covenant tightness. CLO holdings are overlapping. On average, an issuer's loans are held across 125 CLOs. According to the FSB, 90% of CLOs are exposed to at least one of the top 50 borrowers and more than 80% of CLOs are exposed to the top five borrowers (Federal Stability Board 2019). Hence, a comparison of the price effects of loans held by constrained and unconstrained CLOs should reflect differences in intermediary constraint rather than information about an individual loan. Nonetheless, I use high-dimensional fixed effects to allay information-related concerns and run two falsification tests, the results of which indicate that the price effects are driven by price pressure originating from CLOs.

Fire sale costs are significant. In the month after default, loans held by constrained CLOs experience a cumulative average abnormal return of −14.04% compared with −4.27% for loans held by unconstrained CLOs.[4] Following default, the discrepancy narrows. Ten months after default, loans held by constrained CLOs experience a cumulative average abnormal return of −3.65%, whereas loans held by unconstrained CLOs experience a cumulative average abnormal return of 0%. As explained earlier, evidence of a price drop before default, and subsequent reversal may indicate that the price effects are driven by price pressure. I rule out alternative channels by conducting event studies of the price changes of other security markets in which CLOs are not active, namely stocks, corporate bonds, and nonterm loans, around default. The absence of significant abnormal returns in these analyses, reflects the salience of CLO intermediaries in generating price pressure in the secondary loan market. As the CLO covenant-induced forced sales are predictable, the dislocation in prices can create trading opportunities for potential liquidity providers.

Theoretically, Shleifer and Vishny (1992) argue that when a firm experiences financial distress and is forced to sell specialized assets, the most natural buyers are the firm's industry peers who are also likely to experience similar levels of financial distress. Therefore, the potential buyers of such assets are likely industry outsiders who have lower valuations for the assets. If financial distress is widespread, sellers may be forced to sell at further discounts. I compare the price effects when there is a scarcity of potential buyers to when there is not by comparing the cumulative average abnormal return during the Great Financial Crisis of 2008 (GFC) to the entire sample period. During crisis periods, markets are illiquid and financial constraints bind. Hence, the pool of healthy buyers is limited. The cumulative average abnormal return experienced during the GFC is −9.57%, which is almost twice as large as the cumulative average abnormal return experienced throughout the entire sample period of −4.64%. Reversal takes longer during the GFC, relative to the whole sample period, indicating that market illiquidity can prolong price recovery and amplify fire sale costs.

By revealed preferences, the costs associated with holding onto distressed loans are larger than the costs associated with preemptive sales. I explore these costs and find that covenant breaches are punitive to managers. A covenant breach may reduce the equity distribution by more than 65% of the average, significantly reducing managerial compensation. In nonpecuniary terms, covenant breaches have detrimental effects on managers' reputation and career prospects. Upon breaching a covenant, I find that managers are less likely to launch new deals, face more stringent covenants, and administer smaller portfolios. Hence, the effective costs of covenant breaches can be larger than the costs of fire sales and, therefore, incentivize managerial compliance.

The aim of covenants is to mitigate agency costs (Aghion and Bolton 1992, Smith and Warner 1979). Overall, these findings demonstrate that while covenants may limit managerial risk taking, they may also kindle fire sale risk, imposing externalities on asset prices. Thus, this work implies that differences in the organizational structure between closed-end and open-end funds may not fully address both the underlying agency problems and fire sale risk.

1.1. Related Literature

This paper makes contributions to two distinct strands of the literature. First, this paper adds to the fire sale literature by demonstrating that fire sale risk and price pressure can transpire in funds with a closed-end fund structure. Second, this paper contributes to the growing literature that examines the fragility of nonbank financial intermediaries and their effects on financial markets.

First, this paper adds to the fire sale literature. Several papers have shown that fire sale risk may materialize in open-end funds (Coval and Stafford 2007, Mitchell et al. 2007, Ellul et al. 2011, Jotikasthira et al. 2012, Choi et al. 2020). In contrast, I provide evidence of fire sale risk in funds with a closed-end fund structure. The distinction between closed-end and open-end funds is important. The open-ending of funds is viewed as a solution to the agency problem, as open-end funds are highly transparent, allowing investors to monitor investment decisions and withdraw capital on demand. However, the redeemable nature of investor claims also makes open-end funds susceptible to fire sales. In contrast, closed-end funds are perceived to be immune to fire sales because of stable funding, albeit susceptible to greater agency frictions.[5] I show that covenants, a set of tools used to address the agency problem within the closed-end fund structure, can generate fire sale risk and impose externalities on asset prices. Thus, this work shows that covenants can create fire sale problems in closed-end funds akin to open-end funds.

Second, this paper contributes to the growing literature, examining the fragility of nonbank financial intermediaries and their impact on financial markets. This line of research informs the discussion on the design of contingent financial contracts, considering their effects on incentives and systemic risk. Several papers study how the participation of nonbank intermediaries affects various aspects of debt contracts and covenants (Ivashina and Sun 2011, Shivdasani and Wang 2011, Nadauld and Weisbach 2012, Becker and Ivashina 2016, Bozanic et al. 2018, Ivashina and Vallee 2020). In particular, an emerging literature has analyzed managerial skill, security performance, market efficiency, and portfolio effects in the CLO market (Liebscher and Mählmann 2017; Loumioti and Vasvari 2019a, b; Peristiani and Santos 2019; Cordell et al. 2021; Fabozzi et al. 2021). Complementing these papers, I focus on how CLO covenants affect the market prices of leveraged loans through their impact on managerial incentives. The closest paper to this paper is independent and contemporaneous work produced by Elkamhi and Nozawa (2020). Both papers study how fire sale risk can materialize in the leveraged loan market around adverse credit events. I focus on the role of covenants as a latent source of amplification in the transmission of shocks. I explain that CLOs can mechanically loosen their covenants by selling distressed loans that exhibit higher market values than accounted values and building par. Hence, this paper introduces a new mechanism, contractual arbitrage, to explain CLO fire sales. In support of this mechanism, I document a negative relation between a CLO's share of risky loans and its distance to the covenant threshold, in both levels and changes, and show that there is a positive relation between a CLO's share of risky loans and the likelihood of a covenant breach. Furthermore, I explore the costs of covenant breaches and find that such events can impose pecuniary and nonpecuniary costs to CLO managers; upon breaching a covenant, managers are compensated less, are less likely to launch new deals, face more stringent covenants, and administer smaller portfolios. Hence, this paper adds to the existing literature by contributing a novel channel that influences price pressure, deepening our understanding of the origins of financial fragility.

This paper joins Kundu (2022b) in demonstrating how fire sale risk can transpire in closed-end funds due to covenants, which are designed to address agency frictions in closed-end funds. This paper is distinct from Kundu (2022b) as it documents the primary impact of financial distress on CLOs. Specifically, this paper demonstrates that if a firm experiences distress, constrained CLOs sell that firm's loans, exerting price pressure in the secondary loan market for those loans. In contrast, Kundu (2022b) highlights the *spillovers* of idiosyncratic shocks to other firms.

The roadmap for the paper is as follows. The data are described is described in Section 2. The institutional setting and contractual arbitrage are introduced in Section 3. The main results on preemptive sales, price pressure, and costs of fire sales are presented in Section 4. Last, I conclude in Section 5.

2. Data

The overarching objective of this project is to study the mechanism through which CLO contracts impose externalities on asset prices. An empirical challenge of studying fire sales and their associated price effects is the lack of data on realized prices; typically, researchers must rely on quoted prices that are updated infrequently. Moreover, assessing fire sale costs requires disentangling firm financial distress from intermediary distress that is challenging with aggregate data. The availability of granular data makes the CLO setting an ideal testing ground to study fire sales in closed-end funds.

The primary data set used in this study is the Credit-Flux CLO-i Database. The database uses data from more than 35,000 trustee reports and prospectuses and covers more than 1,200 CLOs. It contains detailed information on transactions, prices, holdings, test results, tranches, and equity distributions. The richness of the data allows for the observation of trade prices, before and after default is realized. In terms of coverage, the CLO-i database covered between 67% and 76% of the entire CLO market in 2019. The sample period for this study is from 2009 to 2019.

Table 1 presents summary statistics at the CLO, issuer, and loan levels. The average (median) size of a CLO is $424 million ($407 million), with a standard deviation of $204 million. The 25th and 75th percentile values are $321 million and $504 million, respectively. The average (median) number of loans per CLO is 299 (269) loans, with a standard deviation of 201 loans. The 25th and 75th percentile values are 169 and 381 loans per CLO, respectively. The mean (median) annual equity distribution is 17% (15%), with a standard deviation of 16%. The 25th and 75th percentile values are 8% and 21%, respectively. The average (median) share of risky loans is 7% (6%), with a standard deviation of 7%. Risky loans consist of defaulted loans and loans rated CCC/Caa1+. The 25^{t}h and 75th percentile values are 3% and 9%, respectively. On average, an issuer's debt is held across 125 CLOs and totals to $239 million. The average loan interest rate of 5%, and tenor is 56 months.

CLO portfolios are typically constrained by eight covenants: interest diversion (ID), junior overcollateralization (Junior OC), senior overcollateralization (Senior OC), junior interest coverage (Junior IC), senior interest coverage (Senior IC), weighted average rating factor (WARF), weighted average spread (WAS), and weighted average life (WA Life). As shown in Table 1, the average WARF of a CLO is 2,716, corresponding to a Moody's credit rating between B1 and B2.[6] The average WAS is 3.75%, and the average WA Life is five years.

I present summary statistics on the distances to the quality and coverage covenant thresholds in Table 2. The distance to the covenant threshold is measured as the ratio of the reported covenant value to the covenant threshold. Among the coverage covenants, CLOs operate closest to the capital covenants followed by the liquidity covenants. On average, CLOs operate within 3% of the ID threshold, which is a smaller buffer than the Junior and Senior OC covenants by design. In contrast to the coverage covenants, violation of the quality covenants is not punitive insofar as quality covenant breaches do not directly result in the diversion of interest or principal proceeds. Hence, CLOs may operate below the quality covenant thresholds.

Table 1. Summary Statistics

	N	Q1	Median	Q3	Mean	Standard deviation
CLO characteristics						
Size (millions)	85,654	321.0966	406.5974	504.7332	423.7677	204.8988
No. of loans/CLO	85,654	169.0000	269.0000	381.0000	299.0720	201.6396
Monthly turnover	67,092	0.0219	0.0424	0.0713	0.0558	0.0553
Annual turnover	7,005	0.2002	0.4345	0.6666	0.4756	0.4393
Monthly rebalancing	67,094	−0.0080	0.0087	0.02804	0.0038	0.1026
Annual rebalancing	6,859	−0.0494	0.0645	0.2188	0.0642	0.3089
Annual equity distribution	36,639	8.2400	14.7600	21.2900	16.8099	15.8831
Monthly industry HHI	85,654	0.0639	0.0714	0.0816	0.0900	0.1008
Risky %	83,898	3.2182	5.6487	8.5749	7.1849	6.6580
Weighted average rating factor	79,802	2,597	2,778	2,915	2,716	667.4960
Weighted average spread	82,764	3.2862	3.5800	4.0023	3.7538	0.8506
Weighted average life (years)	73,533	4.0200	4.7800	5.1550	5.0648	5.3681
Monthly transaction volume (millions)	82,800	7.3167	17.1356	31.4894	25.2429	40.7461
Monthly net purchase volume (millions)	82,800	0.3284	5.4117	12.3131	9.0709	36.1311
Issuer characteristics						
Holdings across CLOs (millions)	2,199	6.6032	105.3147	311.6104	239.2612	414.7171
No. of CLOs/issuer	2,204	2.0000	78.0000	198.5000	124.7087	150.6715
Monthly transaction volume (millions)	125,255	2.1902	5.7968	14.2711	16.6869	49.9975
Monthly net purchase volume (millions)	125,255	−1.9444	1.0000	5.0000	5.9963	38.3162
Loan characteristics						
Loan holdings (millions)	25,614,672	0.3244	0.9744	1.9950	1.4171	1.4885
Interest rate	25,417,062	3.7900	4.7500	5.8300	4.9111	1.7918
Tenor (months)	25,486,963	43.0000	58.0000	71.0000	56.0011	18.6275
Transaction amount (millions)	2,137,456	0.2500	0.5651	1.2500	0.9779	1.0884
Transaction price	2,131,172	98.2500	99.5000	100.0000	96.9158	10.9897

Notes. The table reports the summary statistics at varying levels of granularity: CLO, issuer, and loan levels. The variables are listed in the first column. Turnover is defined as the ratio of the total amount transacted to the portfolio balance in the previous period. Rebalancing is defined as the ratio of the difference between the number of loans purchased and sold, and the number of loans held in the portfolio in the previous quarter. The equity distribution is the ratio of the interest payment to par value of equity. The industry HHI reflects the Herfindahl-Hirschman Index, measured as the sum of squared industry shares. Risky % indicates the share of defaulted loans and loans rated CCC/Caa1+ in a CLO. Transaction volume refers to the total amount of purchases and sales. Net Purchase Volume refers to the total net purchase. Tenor is defined as the remaining maturity. The second column indicates the number of observations. The third column indicates the value at the 25th percentile. The fourth column indicates denotes the median value. The fifth column indicates denotes the value at the 75th percentile. The sixth column denotes the mean. The seventh column indicates the standard deviation.

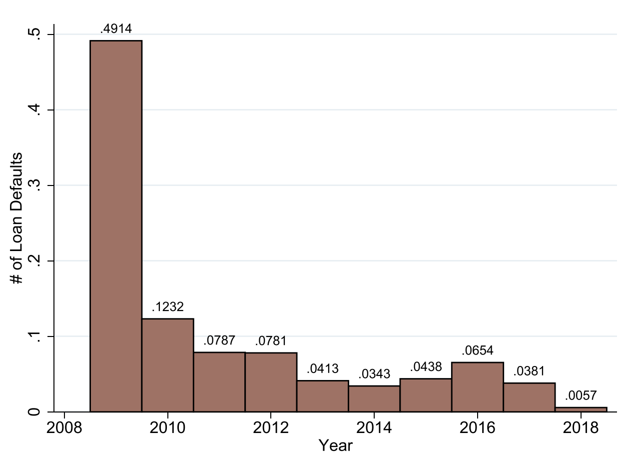
Table 2. Summary Statistics: Distance to CLO Covenant Thresholds

	N	Q1	Median	Q3	Mean	Standard deviation
Interest diversion	29,262	1.0253	1.0335	1.0385	1.0309	0.0313
Junior OC	78,533	1.0280	1.0424	1.0545	1.0431	0.1167
Senior OC	80,553	1.0721	1.0823	1.1122	1.1963	0.4105
Junior IC	68,346	1.6047	2.0898	3.4340	2.6647	1.4912
Senior IC	72,577	1.7101	2.4689	4.6287	3.9996	4.4748
WARF	79,802	0.9033	0.9626	1.0147	0.9901	0.1710
WAS	82,764	1.0294	1.1045	1.2877	1.1804	0.2501
WA life	72,702	0.6400	0.7908	0.9909	1.0436	1.2183

Notes. The table reports the summary statistics of the distance to the CLO covenant threshold, measured as the ratio of covenant result to the covenant threshold, by covenant. The covenants are listed in the first column. OC, overcollateralization covenant; IC, interest coverage covenant; WARF, weighted average rating factor; WAS, weighted average spread; WA Life, weighted average life. The second column indicates the number of observations. The third column indicates the value at the 25th percentile. The fourth column indicates denotes the median value. The fifth column indicates denotes the value at the 75th percentile. The sixth column denotes the mean. The seventh column indicates the standard deviation. The frequency of observations is monthly.

I identify loan defaults directly from the CLO-i database. A loan is flagged as defaulted in the CLO-i database if the CLO is required to treat it as defaulted. Loan defaults encompass missed interest payments, chapter 7/11 filings, and downgrades to CCC/Caa1+. Often, loan downgrades are preceded by loan delinquencies. Similar to defaults in the legal sense, downgrades to CCC/Caa1+ are treated as default events as they can trigger alternate accounting rules. This is because managers typically have a stipulated limit to the amount of CCC/Caa1+ loans they can hold to maintain the credit quality of the overall portfolio and ensure due diligence. A downgrade to CCC/Caa1+ may indicate a greater likelihood of bankruptcy default and higher potential trading losses. This can increase the risk of OC/ID covenant breaches. While defaults, in the legal sense, differ from downgrades to CCC/Caa1+, CLO managerial contracts functionally treat them similarly to align managerial incentives with the debt investors.

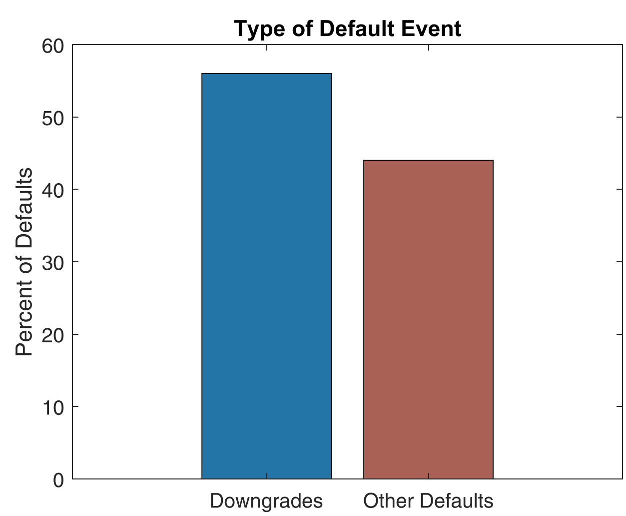
Figure 1. (Color online) Distribution of Initial Default Events



Notes. The histogram plots the frequency of initial loan defaults by year. An initial loan default refers to an issuer's first loan default, recorded by a CLO. The *x* axis indicates the year. The *y* axis indicates the frequency distribution of the number of initial loan defaults.

The sample of loan defaults is restricted to the issuers' initial or first loan default event; all subsequent default events associated with an issuer are dropped. I exclude the subsequent default events, as they may confound identification of preemptive sales and price pressure resulting from a tightening of CLO covenants with fundamental changes in issuer characteristics. There are a total of 1,575 initial default events across the sample period. Figure 1 presents the distribution of initial default events throughout the sample period. Almost half of the initial defaults in the sample period occurred in 2009. The last year in which initial defaults were reported is 2018. The initial loan defaults are disaggregated by default type in Figure 2. I distinguish downgrades from other default events by examining whether

Figure 2. (Color online) Initial Loan Defaults



Notes. The figure presents the type of initial loan default event. An initial loan default refers to an issuer's first loan default, recorded by a CLO. The default event types are disaggregated into downgrades and other default events. The *x* axis indicates the type. The *y* axis indicates the share of default type. Fifty-six percent of initial loan defaults are downgrades; 44% of initial loan defaults encapsulate other adverse credit events.

there is any change in the median S&P or Moody's credit rating between the 12 months before the initial default event and after. Fifty-six percent of default events are downgrades, whereas 44% represent other default events. I investigate whether price pressure differs based on the type of default event in Section 4.3.1.

To analyze price pressure and information effects in the CLO market, I make use of several additional data series including: the 10-Year Treasury Constant Maturity Rate, ICE BofA U.S. High Yield Index Effective Yield, ICE BofA U.S. Corporate Index Effective Yield, S&P 500 Index Return, S&P/LSTA Leveraged Loan Index, and issuer specific stock returns.

3. Collateral and Covenants

In this section, I first provide a condensed summary of covenants. I then describe the practice of contractual arbitrage: the mechanism behind fire sales. Last, I provide empirical evidence in support of contractual arbitrage and document a negative relation between the share of risky loans and covenant tightness.

3.1. Summary of CLO Covenants

Covenants can be classified as quality covenants or coverage covenants. Quality covenants are maintain-or-improve constraints that do not directly prescribe any action on the manager in the event that they are triggered. The WAS, WA Life, and WARF are examples of quality covenants that stipulate that the underlying collateral has sufficient interest proceeds to pay interest on rated notes and equity, is amortizing (limiting portfolios with a high WA Life exposed to downturn and default), and the average loan rating of the portfolio is above a specified threshold, respectively. Coverage covenants ensure that there is a specific level of coverage and subordination relative to the covenant triggers for each tranche. Coverage covenants serve as disciplining devices that ensure that CLO managers adequately screen and monitor their portfolios. If triggered, they may divert proceeds from junior tranches toward paying down liabilities in descending order of seniority or toward the purchase of value-increasing collateral. Diversion is punitive for a CLO manager in several ways. A manager may suffer pecuniary losses, in addition to losses in social capital regarding career prospects and reputation. These are examined in Section 4.4.

There are three types of coverage covenants: OC covenants, ID covenants, and IC covenants.

$$OC/ID = \frac{\text{Par value of collateral} + \text{Defaulted collateral value}}{\text{Principal balance of tranche and all senior tranches}} + \frac{\text{Purchase price of discounted collateral-'CCC/Caa1' excess adjustment}}{\text{Principal balance of tranche and all senior tranches}} \tag{1}$$

$$IC = \frac{\text{Interest from collateral}}{\text{Interest due on tranche and senior tranches}} \tag{2}$$

The OC and ID covenants are *capital covenants* and are measured similarly. The ID covenant has a lower threshold than any of the OC covenants. If it is breached, proceeds are diverted toward the purchase of high-quality, value-increasing loans. If an OC covenant is breached, managers must pay down their liabilities in order of seniority. The IC covenants are *liquidity covenants* that ensure that there is a specific level of coverage for interest due on tranches relative to the triggers. Similar to OC breaches, in the event of IC breaches, principal and interest are diverted toward paying down liabilities until the CLO is in compliance with the failed covenants.

The measurement of the covenants is of noteworthy importance. As shown in Equations (1) and (2), CLOs are immune to fluctuations in the market prices of loans, as loans are typically marked at par value, barring distressed loans. If an asset experiences default, is a discount obligation or puts the CLO in excess of its CCC/Caa1+ concentration limit, the asset is marked to the lower of market value or assumed rating agency recovery rate or ultimate recovery value, the purchase price until the loan trades above a threshold (typically 90¢/$) for more than 30 days, or the lowest market value among the CCC/Caa1+ loans, respectively. Thus, the accounted values of distressed loans can deviate from their market values.

CLOs are sensitive to the credit quality of the underlying portfolios. For example, downgrades to CCC/Caa1+ can tighten the OC/ID covenants by increasing the share of excess CCC/Caa1+ loans. Defaults increase the risk of trading losses and can similarly tighten the covenants. Hence, when loans experience distress, CLOs experience a tightening of their covenants as the loans are no longer accounted at par. Specifically, CLO managers may mechanically loosen their covenants by selling loans that exhibit higher market values than accounted values. These differences in the valuations directly accrue to the par value of the CLO, loosening the covenants. Hence, the nonlinear nature of covenants can induce CLO sales of distressed loans.

3.2. Contractual Arbitrage

This section explores the underlying mechanism behind CLO distressed sales. I argue that CLO managers sell distressed loans to generate slack in their covenants. When managers sell loans with higher market values than accounted values, these differences directly accrue to the par value of the portfolio, loosening the covenants. This simple explanation reconciles several empirical findings and provides a motive behind distressed sales.

For illustration, consider how distressed loan sales can loosen CLO covenants. Before experiencing any distress, a CLO's capital covenant is

$$Cov^{orig} = \frac{A}{L}, \tag{3}$$

where A denotes the total value of loans (leveraged loans) and L denotes the total value of liabilities (notes).

If loans that are marked at par in a CLO portfolio are projected to experience default in the future, a CLO manager faces a choice: sell the loans before default or hold onto them through default. If the manager holds on to this projected share of defaulted loans, μ, through default, the CLO's capital covenant will be

$$Cov_1^{Keep} = \frac{(1-\mu)A + \mu\theta A}{L}, \tag{4}$$

where θ represents the lower of the market value, and ultimate recovery value after default.

Instead, if the manager preemptively sells the projected share of defaulted loans at price γ, the CLO's capital covenant will be

$$Cov_1^{\text{Sell}} = \frac{(1-\mu)A + \mu\gamma A}{L}, \tag{5}$$

where γ represents the prevailing market value.

The manager is incentivized to sell the projected share preemptively, as long as $\gamma \geq \theta$. The prevailing market value, prior to default, is likely higher than the lower of the market value or ultimate recovery value at default. Preemptive sales mitigate the possibility and associated costs of future covenant breaches. This condition remains the same for the other categories of distress.

This simple exercise demonstrates how the accounting rules inherent in covenants can induce CLO managers to preemptively sell distressed loans. The sharp changes in the accounting rules are a source of fragility in the market, as CLO managers can mechanically loosen their capital covenants by exploiting the differences between loans' market values and accounted values to build par.[7]

I provide empirical evidence in support of the contractual arbitrage hypothesis. For managers to avail of contractual arbitrage, the prevailing market value of a distressed loan should be higher than the accounted value. I examine the distribution of reported loan prices in the holdings data to study how frequently a distressed loan has a greater market value than accounted value. Figure 3 presents the cumulative distribution function (CDF) and probability density function (PDF) of defaulted loan prices. Additionally, I tabulate the complementary cumulative distribution (CCD) for various thresholds from 20 through 90. As Chen et al. (2019) point out, the recovery rates for leveraged and nonleveraged loans are distinct as they have different risk factors. Using various modeling techniques, Chen et al. (2019) find that the overall recovery rate associated with leveraged loans is 59.5%. According to Figure 3, almost 40% of defaulted loans report a market price above 60¢/$. Hence, defaulted loans frequently exhibit higher market values than recovery values. Moreover, in Online Appendix Figure B.1, I conduct a similar exercise for CCC/Caa1+ loans to study the distribution of loan prices for CCC/Caa1+ loans with the lowest price in each CLO reporting period. The average price of the lowest priced CCC/Caa1+ loans is 64¢/$with a standard deviation of 18 ¢/$. The CDF and PDFs indicate that a substantial mass of CCC/Caa1+ loans trade at market prices well above this mean; according to the PDF, the mean is 87¢/$. Hence, the market prices of CCC/Caa1+ loans are also likely larger than the lowest priced CCC/Caa1+ loans of CLOs that they are held in.

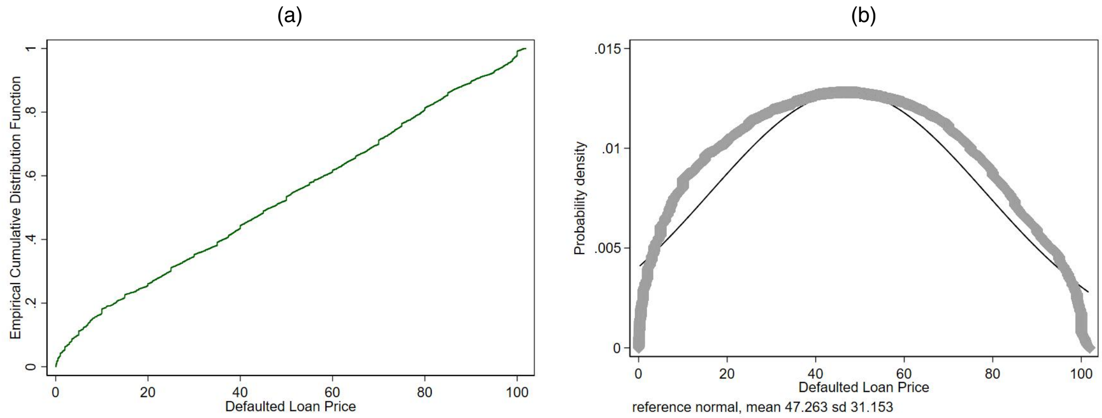
Market prices can often diverge from the ultimate recovery rate. The ultimate recovery rate for assets is determined prior to default based on the type of debt and its seniority, among other characteristics (Creditflux 2020). This forecasted rate is not necessarily equivalent to the realized ex post recovery rate. Hence, the assumed rating agency recovery rate may be an imperfect assessment of the actual recovery rate.[8] The discrepancy between the market prices and the assumed rating agency recovery values may result in CLO distressed loan sales per contractual arbitrage.

3.3. Risky Loans and Covenant Tightness

The key mechanism through which distressed loans affect CLO sales is through covenants. This section empirically tests this conjecture. First, I document that there is a negative relation between a CLO's share of risky loans in a given period and its distance to the covenant threshold in the subsequent period. Second, I document that changes in the holdings of risky loans directly affect changes in the distance to the covenant threshold. Third, I document that there is a strong positive relation between a CLO's likelihood of breaching a covenant and its share of risky loans.

As CLOs operate closest to the capital covenant thresholds among the coverage covenants, these covenants are the primary focus of my analysis. The ID covenant is not observed in many CLOs. Therefore, I identify the most stringent capital covenant as the capital covenant with the lowest threshold. Although the distances to the covenant thresholds vary over time, the thresholds hardly vary. Therefore, each CLO has effectively one "binding" capital covenant

Figure 3. (Color online) Distributions of Defaulted Loan Prices



Recovery Price	P(Price ≥ Recovery)
20	74%
30	65%
40	56%
50	47%
60	38%
70	29%
80	19%
90	10%

Notes. The figure presents the cumulative distribution function (CDF) and probability density function (PDF) of defaulted loan prices. (a) CDF of defaulted loan prices. (b) PDF of defaulted loan prices. The table presents the complementary cumulative distribution (CCD) for defaulted loan prices. That is, the right column presents the probability that the defaulted loan price is greater than the ultimate recovery value, indicated in the left column.

that is breached before the other capital covenants are breached.

Table 3 reports the relation between covenant tightness and risky loans. Risky loans consist of defaulted loans and loans rated CCC/Caa1+. Panel A examines the relation between a CLO's distance to the most stringent capital covenant ("the covenant") threshold at time $t + 1$ and its share of risky loans at time t. Panel B examines the relation between a CLO's change in the distance to the covenant threshold and the change in its share of risky loans. I use a within CLO × year estimator. CLO × year fixed effects account for the time-varying heterogeneity associated with CLO taste, style, sophistication, risk aversion, reputation, and common factors. I include additional CLO controls, consisting of CLO size, age, and maturity.

I do not include any fixed effects in column 1. In columns 2–4, I successively add CLO, year, and CLO × year fixed effects. All specifications include CLO controls. Panel A indicates that a one standard deviation increase in a CLO's share of risky loans decreases a CLO's distance to the covenant threshold by 0.42%–1.25%. This relation is economically meaningful as CLOs typically operate with a 3% buffer of their most stringent capital covenant. Moreover, the estimates are stable and statistically significant at the 1% level in the most conservative specification. Panel B indicates that a one standard deviation change in the share of risky loans reduces the change in the distance to the covenant threshold by 0.058 to 0.080 standard deviations: a significant change relative to the mean (see table notes for summary statistics). Overall, the findings indicate that a CLO's share of risky loans and its distance from the covenant threshold are inversely related. Accordingly, a higher proportion of risky loans is associated with tighter capital covenants, increasing the incidence of covenant breach.

Next, I investigate the link between a CLO's share of risky loans and the incidence of covenant breaches.

Table 3. Covenant Tightness and Risky Loans

ln(Distance to Cov. Thresh.)$_{t+1}$			(1)	(2)	(3)	(4)
Panel A: CLO covenant constraint$_{t+1}$ and share of risky loans$_t$						
Risky Share$_t$			−0.0042*	−0.0101***	−0.0125***	−0.0071***
			(0.0024)	(0.0026)	(0.0031)	(0.0019)
CLO controls			✓	✓	✓	✓
CLO fixed effects				✓	✓	
Year fixed effects					✓	
CLO-year fixed effects						✓
N			39,658	71,538	71,538	71,538
R^2			0.0217	0.3343	0.3388	0.6355
Panel B: Δ CLO covenant constraint$_t$ and Δ share of risky loans$_t$						
ΔRisky Share$_t$			−0.0584***	−0.0798***	−0.0743***	−0.0771***
			(0.0137)	(0.0178)	(0.0151)	(0.0155)
CLO controls			✓	✓	✓	✓
CLO fixed effects				✓	✓	
Year fixed effects					✓	
CLO-year fixed effects					✓	
N			39,400	70,817	70,817	70,817
R^2			0.0251	0.1025	0.1088	0.1907
Panel C: Summary statistics						
	N	Q1	Median	Q3	Mean	Standard deviation
ΔRisky Share	72,560	−0.2967	0.0000	0.4406	0.0790	1.5640
Δln(Distance to Cov. Thresh.)	72,732	−0.0006	0.0001	0.0009	0.0010	0.0091

Notes. Standard errors are two-way clustered by CLO and month-year in parentheses. The table presents the relation, in levels and changes, between the share of risky loans in a CLO portfolio and the degree of covenant tightness. The share of risky loans is defined as the sum of the share of defaulted loans and CCC/Caa1+ loans. Panel A presents the relation between the natural log-transformed value of a CLO's distance to the most stringent capital covenant threshold and its share of risky loans. Panel B presents the relation between the monthly change in the natural log-transformed value of a CLO's distance to the most stringent capital covenant threshold and the monthly change in the share of risky loans. The regression specification of Panel A is the following: $ln(\text{Distance to Cov. Thresh.})_{c,t+1} = \alpha + \beta \times \text{Risky Share}_{c,t} + \text{CLO Controls}_{c,t} + \theta_{c,y} + \epsilon_{c,t}$. The regression specification of Panel B is the following: $\Delta ln(\text{Distance to Cov. Thresh.})_{c,t} = \alpha + \beta \times \Delta\text{Risky Share}_{c,t} + \text{CLO Controls}_{c,t} + \theta_{c,y} + \epsilon_{c,t}$. where c denotes the CLO, t indexes the month-year, and y denotes the year. The change in risky loans reports a mean (sd) of 0.0790 (1.5640). The 25th, 50th, and 75th percentile values are −0.2967, 0.0000, and 0.4406. The change in the distance to the covenant threshold reports a mean (sd) of 0.0010 (0.0091). The 25th, 50th, and 75th percentile values are −0.0006, 0.0001, and 0.0009. CLO controls consist of CLO size, age, and maturity. The independent variables are standardized in both panels. The dependent variable is standardized in Panel B for ease of interpretation. Standard errors are two-way clustered by CLO and month-year.

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Figure 4 presents a time series plot of the average covenant breach rate and share of risky loans across all CLOs by quarter-year. The figure indicates that the correlation between the share of risky loans and the covenant breach rate is 0.90. Moreover, the covenant breach rate and share of risky loans rise during recessionary periods, albeit with a lag; in 2009, almost 60% of covenants reported a breach. As shown in an extended time series plot in Online Appendix Figure B.2, 20% of covenants reported a breach during the COVID-19 contraction.

I codify the relation between a CLO's likelihood of breaching a covenant and its share of risky loans in Table 4. The dependent variable takes a value of one if the CLO breaches the covenant threshold and zero otherwise. Like in Table 3, I use a within CLO × year estimator. Column 1 does not include any fixed effects. Columns 2–4 include CLO, year, and CLO × year fixed effects, respectively. All columns include size, age, and maturity controls. The point estimates indicate that a one standard deviation increase in a CLO's share of risky loans increases the likelihood of a covenant breach by 3.04%–7.75%. These estimates are statistically significant at the 1% level and economically meaningful. On average, 11.11% of reported covenant values report a breach (see table notes for summary statistics).

4. Results

This section presents the main results of the paper. First, I motivate the main analysis by examining CLO trading behavior, documenting that CLO managers actively manage their portfolios in the secondary loan market. Second, I show that CLO managers preemptively sell distressed loans. Third, I document that, on

Table 4. Covenant Breaches and Risky Loans

$\mathbb{1}_{Fail,t+1}$	(1)	(2)	(3)	(4)
Risky Share$_t$	0.0394***	0.0775***	0.0423***	0.0304***
	(0.0090)	(0.0097)	(0.0080)	(0.0071)
CLO controls	✓	✓	✓	✓
CLO fixed effects		✓	✓	
Year fixed effects			✓	
CLO-year fixed effects				✓
N	39,887	72,666	72,666	72,666
R^2	0.0666	0.4870	0.5099	0.7698

Summary statistics

	N	Q1	Median	Q3	Mean	Standard deviation
$\mathbb{1}_{\text{Fail}}$	85,745	0.0000	0.0000	0.0000	0.1111	0.3142

Notes. Standard errors are two-way clustered by CLO and month-year in parentheses. The table presents the relation between the share of risky loans and likelihood of a covenant breach. The share of risky loans is defined as the sum of the share of defaulted loans and CCC/Caa1+ loans. The dependent variable takes the value of one if the CLO breaches the most stringent capital covenant and zero otherwise. The independent variable is the share of risky loans. The regression specification is the following:

$$\mathbb{1}_{Fail,c,t+1} = \alpha + \beta \times \text{Risky Share}_{c,t} + \text{CLO Controls}_{c,t} + \theta_{c,y} + \epsilon_{c,t}$$

where c denotes the CLO, t indexes the month-year, and y denotes the year. CLO controls consist of CLO size, age, and maturity. The independent variables are standardized in both panels. Standard errors are two-way clustered by CLO and month-year. The dependent variable reports a mean (sd) of 0.1111 (0.3142).

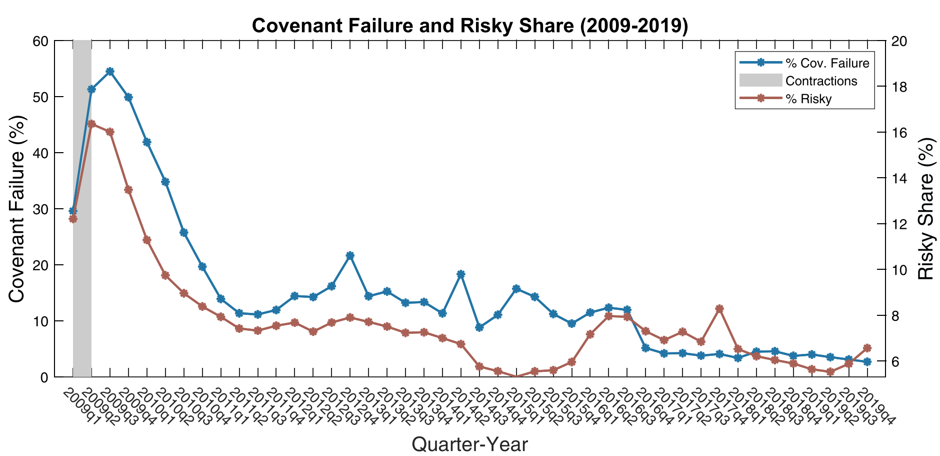
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

the extensive margin, CLOs operating with tighter covenants are more likely to sell distressed loans than CLOs with looser covenants. Fourth, I show that, on the intensive margin, loans that are held primarily by CLOs with tighter covenants experience a greater volume of sales relative to loans that are held primarily by CLOs with looser covenants. Fifth, I show that these differences in sales manifest as differences in price effects. There is a significant discrepancy in the cumulative average abnormal return experienced by loans held by constrained and unconstrained CLOs. Sixth, I compare the price effects during the GFC to the entire sample period and show that market illiquidity can prolong price recovery and amplify fire sale costs. Last, I show that covenant breaches can impose large pecuniary and nonpecuniary costs, hence, the costs associated with holding onto distressed loans can be larger than the costs associated with preemptive sales.

4.1. Motivation

In this section, I motivate the main analysis by examining CLO trading behavior. Unlike other static securitizations, CLO managers actively manage their portfolios in the secondary loan market. I begin by documenting portfolio

Figure 4. (Color online) Covenant Breach and Risky Share (2009–2019)



Notes. The figure presents a time-series plot of the mean covenant breach and share of risky loans across all CLOs by quarter-year. A CLO breaches the most stringent capital covenant (*Failure* = 1) if its reported value is below the stipulated threshold. The *Failure* indicators are averaged across all CLOs by quarter-year. The portfolio share of risky loans are averaged across all CLOs by quarter-year. The share of risky loans is defined as the sum of the share of defaulted loans and CCC/Caa1+ loans. Contractions/recessions are shown in gray and defined according to NBER.

changes including turnover, transaction volumes, and rebalancing. I then compare the industry and lien distributions of loans held in CLO portfolios to the overall leveraged loan market and the default rates. Overall, the empirical findings suggest that CLO managers screen and monitor their investments throughout the duration of a CLO's life.

CLO turnover, transaction volumes, and rebalancing are reported in Table 1. Turnover is defined as the ratio of the total amount transacted in a given period to the portfolio balance in the previous period. On average, a CLO's monthly turnover is 5.58%, and its annual turnover is 47.56%. The average CLO monthly transaction volume is $25 million or 5.89% of the CLO size, consistent with the mean monthly turnover figure. At the issuer level, the average monthly transaction volume is $17 million or 7.11% of an issuer's total CLO debt. Net purchases constitute roughly 36% of the transaction volume; the average monthly net purchase volume is $9 million at the CLO level and the average monthly net purchase volume is $6 million at the issuer level. The average transaction amount at the loan level is $0.98 million or 69% of the loan amount and trades at 97¢/$. Next, I assess the extent of CLO portfolio rebalancing. Rebalancing is defined as the ratio of the difference between the number of loans purchased and sold and the total number of loans held in the portfolio in the previous quarter. CLOs may rebalance their portfolios to align their portfolio allocation with their target allocation. On average, monthly rebalancing is 0.38%, whereas annual rebalancing is 6.42%. Moreover, the average (median) monthly industry Herfindahl-Hirschman index (HHI) is 0.09 (0.07), with a standard deviation of 0.10.[9] Thus, CLO portfolios are diversified across industries and exhibit significant churn in their portfolio composition.

Discrepancies between the CLO distribution of loans at inception ("closing date") and the underlying leveraged loan market indicate that CLOs are screened and/or monitored. Online Appendix Figure B.3 shows two dimensions through which CLO managers screen their portfolios: industry and lien. Online Appendix Figure B.3a presents histograms, exhibiting the industry distribution of leveraged loans held in CLOs and the overall leveraged loan market. The figure shows that CLO managers hold a disproportionately smaller amount of loans in the oil and gas industry and larger amount in the telecommunications industry relative to the overall industry distribution of leveraged loans.[10] Online Appendix Figure B.3b presents histograms, exhibiting the lien distribution of leveraged loans held in CLOs and the overall leveraged loan market. The figure shows that CLO managers typically hold onto a smaller share of second-lien loans relative to the overall leveraged loan issuance. These two pieces of evidence indicate that CLO managers are not passive purchasers of leveraged loans. Rather, managers screen their portfolios.

CLO managers also monitor the quality of their investments. I compute each CLO's projected default rate based on its initial holdings at the closing or settlement date.[11] The projected default rate reflects the portion of the portfolio that would experience default if the CLO was unable to make any trades. I find that ~16% of CLO portfolios would experience default, if CLO managers were unable to make trades. This default percentage exceeds the realized default rate of leveraged loans and far exceeds the CLO realized default rate on leveraged loans. Online Appendix Figure B.4 presents the trailing 12-month default rate for leveraged loans in the leveraged loan market and leveraged loans held in CLOs from 2015 through July 2021. Based on Thomson Reuters estimates, the default rate of leveraged loans in the leveraged loan market was 1.75% at the end of 2018. The S&P (not shown) places a higher estimate of the default rate for leveraged loans, at 3.26% at the end of 2018. Regardless of the exact percentage, CLOs have reported a significantly lower default rate on leveraged loans as compared with the overall market throughout the sample period. The default rate on leveraged loans held in CLOs tracks the default rate on the overall leveraged loan market, albeit, at a significantly lower level. For comparison, at the end of 2018, the default rate reported on leveraged loans held in CLO portfolios was 0.46%. This finding suggests that managers may make risky investments, ex ante, and sell out of risky positions before the positions bear losses. The discrepancy in the projected and realized default rates motivates the study of managerial incentives, and in particular, the role of covenants in mitigating agency frictions.

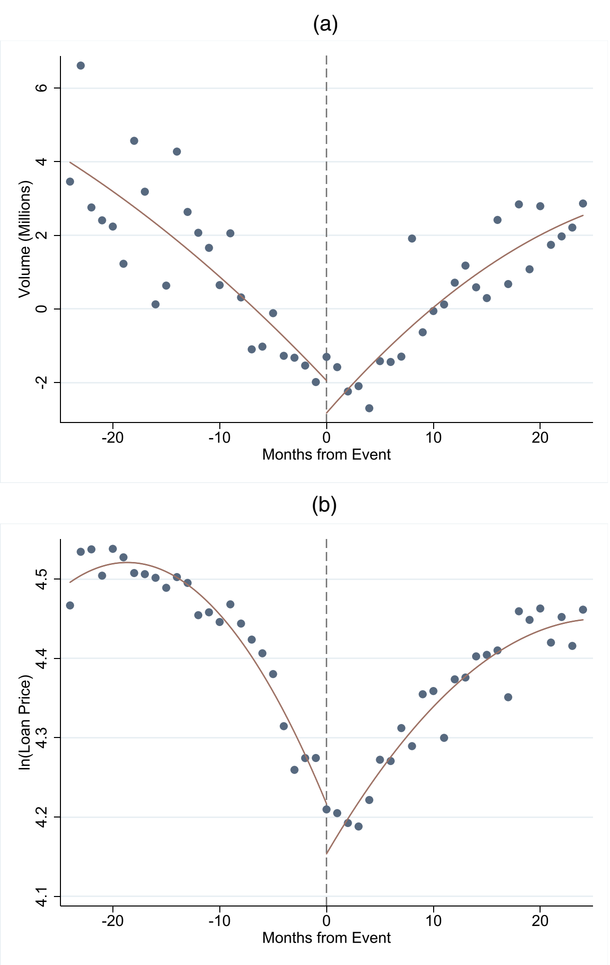
Overall, the results suggest that CLO managers are active traders in the secondary loan market. The subsequent analyses establishes that covenants are a key determinant of CLO managerial trading behavior.

4.2. Managers Preemptively Sell Distressed Loans

This section examines the trading behavior of CLO managers around the initial loan default. I provide evidence of preemptive sales of distressed loans. There is a significant decline and reversal in the transaction amount and transaction price in the months surrounding default. I establish a link between the monthly net purchase amount and covenant tightness. CLOs that operate closer to the covenant threshold sell distressed loans more aggressively than CLOs that operate farther away from the covenant threshold. Loans held by constrained CLOs experience a greater volume of sales relative to loans held by unconstrained CLOs. Cumulatively, the total volume of loans sold in the months surrounding default represent a substantial share of issuer debt held across CLOs.

I begin by observing the net transaction amount and transaction price in the months surrounding the issuers initial default event. "Initial default" refers to a distressed issuer's first instance of default. The binscatter diagrams in Figure 2 illustrate the relation between net transaction amount and months from default (Figure 5(a)) and the natural log-transformed transaction price and months from default (Figure 5(b)). Figure 5(a) exhibits a monotonic decline in the net transaction amount in the months prior to default, and subsequent reversal in the months after default. That is, CLOs are net purchases of distressed debt until approximately one year before default. After this point, CLOs become net sellers of distressed debt in aggregate. The magnitude of CLO sales increases through the default date. After default, CLOs gradually reduce the amount of net sales and become net purchasers, approximately, one year after the default. Figure 5(b) exhibits a similar pattern for the price. Distressed loans trade at approximately 90¢/$, two years prior to default. The transaction price falls to approximately 65¢/$ in the month of default and reverts back toward the predistressed price in the subsequent months.

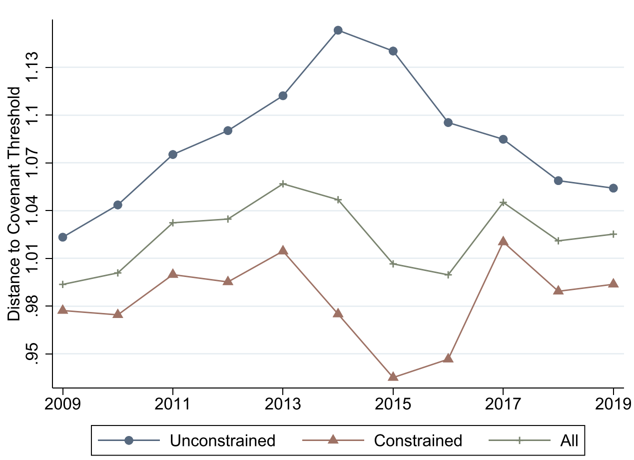
Figure 5. (Color online) Binscatter Diagrams: Transaction Amount, Price, and Months from Default



Notes. (a) Transaction amount. (b) Transaction price. The figure plots the binscatter of the transaction amount and transaction price around the initial loan default event. An initial loan default refers to an issuer's first loan default, recorded by a CLO. The x axis plots the months from the event. The y axis plots the transaction amount in (a) and the natural log of the transaction price in (b).

I investigate the heterogeneity in the transaction behavior of CLOs, based on covenant tightness, around default. The distance to the covenant threshold is the ratio of the realized covenant value to the covenant threshold. For each CLO, a time series average of the distance to the covenant threshold is computed. The median of these distances determines the cutoff for constrained and unconstrained CLOs. *Constrained* (*unconstrained*) CLOs are those with below (above) median distance to the covenant threshold. There is significant heterogeneity in the distances to the covenant thresholds across CLOs over time. Figure 6 plots the distance to the covenant threshold for constrained, unconstrained, and all CLOs. In 2009, unconstrained CLOs operated, on average, 2.3% above the covenant threshold, whereas constrained CLOs operated, on average, 2.3% below the covenant threshold. In subsequent years, unconstrained CLOs operate between 4.3%-14.5% above the covenant threshold. In contrast, CLOs belonging to the constrained group breached the covenant in most years throughout the sample period. Across all CLOs, the average distance to the covenant threshold fell below one during the peak of the oil and gas price plunge in 2015–2016.

Figure 6. (Color online) Distance to Threshold: Constrained and Unconstrained CLOs over Time



Notes. The figure plots the mean distance to the most stringent capital covenant threshold for constrained, unconstrained, and all CLOs. The distance to the most stringent capital covenant threshold is measured as the as the ratio of the covenant result to the covenant threshold. *Constrained* (*Unconstrained*) CLOs are those with below (above) median distance to the most stringent capital covenant threshold over the sample period. The distance to the most stringent capital covenant threshold for constrained CLOs is represented by the line with the dotted marker. The distance to the most stringent capital covenant threshold for unconstrained CLOs is represented by the line with the triangle marker. The distance to the most stringent capital covenant threshold for all CLOs is shown by the line with the plus marker. The x axis plots the year. The y axis plots the distance to the most stringent capital covenant threshold.

The central hypothesis of this paper is that fire sales occur when distressed loans are concentrated among constrained CLOs. To this end, I investigate the relation between the probability of a distressed loan sale and CLO covenant tightness, using transactions data. I present the results, using a linear probability model in Table 5. The six columns of Table 5 report the coefficient estimates associated with different linear probability model specifications. The dependent variable, $\mathbb{1}_{Sale}$, takes a value of one if the transaction constitutes a sale and zero if it is a purchase. The independent variable of interest in columns 1, 3, and 5 is the change in the natural log-transformed distance to the covenant threshold reported in the previous period. I consider potential nonlinearities in the relation between a CLO's distance to the covenant threshold and the likelihood of a distressed loan sale in columns 2, 4, and 6. The independent variables of interest in columns 2, 4, and 6 are indicator variables that specify which quartile the change in a CLO's distance to the covenant threshold belongs to in the previous period.

In columns 1 through 8, I sequentially add fixed effects. Columns 1 and 2 do not include any fixed effects. Columns 3 and 4 include issuer and year fixed effects to account for the time-invariant heterogeneity across issuers and control for macroeconomic shocks. Columns 5 and 6 use a within issuer × year estimator to account for changes in firm fundamental characteristics. Columns 7 and 8 further include CLO × year fixed effects, which account for the time-varying heterogeneity associated with CLO taste, style, sophistication, risk aversion, reputation, and common factors. CLO, issuer, and loan controls are included in columns 5 through 8. CLO controls include CLO size, age, and maturity. Issuer and loan controls include the total issuer debt held across CLOs, median loan tenor, rating, and industry.

Table 5. Linear Probability Model: Distressed Loan Sales and Covenant Tightness

$\mathbb{1}_{Sale,t}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δln(Distance to Cov. Threshold)$_{t-1}$	−0.0596***		−0.0557***		−0.0384***		−0.0309**	
	(0.0182)		(0.0163)		(0.0133)		(0.0141)	
$\mathbb{1}_{\text{Cov. Dist}\leq 25^{\text{th}}\text{pct}}$		0.0143**		0.0122**		0.0132**		0.0130**
		(0.0068)		(0.0059)		(0.0056)		(0.0052)
$\mathbb{1}_{25^{th}pct<\text{Cov. Dist}\leq 50^{\text{th}}\text{pct}}$		−0.0150**		−0.0111**		0.0047		0.0114**
		(0.0068)		(0.0053)		(0.0051)		(0.0051)
$\mathbb{1}_{50^{th}pct<\text{Cov. Dist}\leq 75^{\text{th}}\text{pct}}$		−0.0572***		−0.0462***		−0.0062		−0.0004
		(0.0061)		(0.0050)		(0.0049)		(0.0048)
CLO controls					✓	✓	✓	✓
Loan controls					✓	✓	✓	✓
CLO × year fixed effects							✓	✓
Issuer × year fixed effects					✓	✓	✓	✓
Issuer fixed effects			✓	✓				
Rating fixed effects					✓	✓	✓	✓
Industry fixed effects					✓	✓	✓	✓
Year fixed effects			✓	✓				
N	316,839	316,839	316,757	316,757	267,682	267,682	267,298	267,298
R^2	0.0001	0.0029	0.0750	0.0767	0.2438	0.2439	0.3352	0.3353

Summary statistics

	N	Q1	Median	Q3	Mean	Standard deviation
$\mathbb{1}_{Sale}$	355,386	0.0000	0.0000	1.0000	0.4616	0.4985

Notes. Standard errors are two-way clustered by CLO-issuer and trade date in parentheses. This table presents the relation between the likelihood that a CLO sells a defaulted loan and the change in the distance to the CLO's most stringent capital covenant threshold. The dependent variable, $\mathbb{1}_{Sale}$ takes a value of one if the defaulted loan is sold and zero otherwise. The independent variable of interest in columns 1, 3, and 5 is the change in the natural-log transformed distance to the most stringent capital covenant threshold, reported in the previous period. The independent variables of interest in columns 2, 4, and 6 are indicator variables that specify which quartile the change in CLO's distance to the most stringent capital covenant threshold lies in. The regression specifications are

$$\mathbb{1}_{Sale,c,l,t} = \alpha + \beta \times \Delta ln(\text{Distance to ID Threshold})_{c,m} + X_{c,m} + Z_{i,m} + \theta_{c,y} + \phi_{i,y} + \epsilon_{c,l,t}$$

and

$$\begin{aligned}\mathbb{1}_{Sale,c,l,t} = {} & \alpha + \beta_1 \times \mathbb{1}_{\text{Cov. Dist}\leq 25^{th}pct,c,m} + \beta_2 \times \mathbb{1}_{25^{th}pct<\text{Cov. Dist}\leq 50^{th,c,m}pct} + \beta_3 \times \mathbb{1}_{50^{th}pct<\text{Cov. Dist}\leq 75^{th}pct,c,m} \\ & + X_{c,m} + Z_{l,m} + \theta_{c,y} + \phi_{i,y} + \epsilon_{c,l,t},\end{aligned}$$

where c denotes the CLO, l denotes the security (loan), i denotes the issuer, t denotes the trade date, m denotes the previous month-year, and y denotes the year. CLO controls, X, consist of CLO size, age, and maturity. Issuer controls, Z, consist of total issuer debt held across CLOs, median loan tenor, rating, and industry. Standard errors are two-way clustered by CLO-issuer and trade date. The dependent variable reports a mean (sd) of 0.4616 (0.4985).

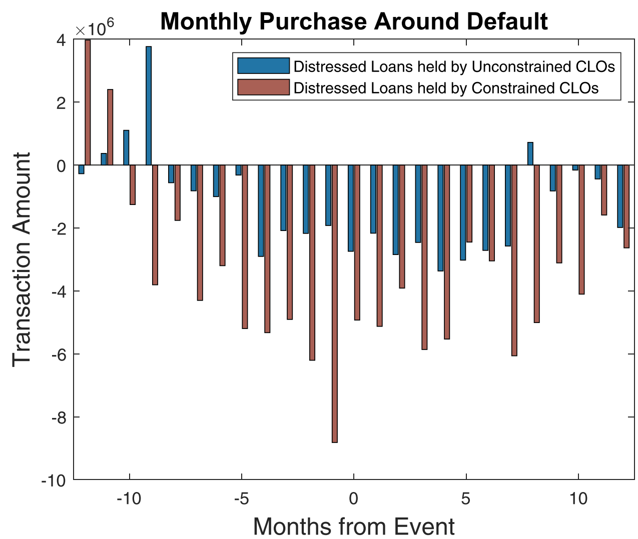
$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

CLOs that experience a tightening of their capital covenants sell distressed loans more aggressively than CLOs with looser capital covenants. I document a negative relation between the distance to the covenant and the likelihood of a distressed loan sale. That is, a loosening of the covenant reduces the likelihood of a distressed loan sale relative to a loan purchase. However, this baseline estimation does not capture nonlinearities in the relationship between the changes in the distance to the covenant threshold and the likelihood of a distressed loan sale, nor does it capture asymmetries in positive/negative covenant changes. It is hypothesized that a tightening of the covenant affects the likelihood of a loan sale more than a loosening. Columns 2, 4, 6, and 8 provide evidence of consistent with this hypothesis. Specifically, CLOs in the first quartile of changes in the distance to the covenant threshold are more likely to sell distressed loans by 3% of the mean, relative to CLOs in the fourth quartile. These effects are economically meaningful, statistically significant, and stable across all specifications. Online Appendix Table B.1 considers only covenant tightenings (negative changes in the distance to the covenant threshold) and reports the estimates of the linear relationship to be more than two times as large as the baseline estimates reported in Table 5. Furthermore, Online Appendix Figure B.5 uses holdings data to examine portfolio changes, reduction, elimination, expansion, and maintenance of distressed holdings à la Coval and Stafford (2007), and corroborates these findings. CLOs in the first quartile of the distance to the covenant threshold are 2.44% more likely to reduce their distressed holdings and 1.64% more likely to eliminate their distressed holdings, relative to CLOs in the fourth quartile. CLOs in the fourth quartile of the distance to the covenant threshold are 2.98% more likely to increase or expand their distressed holdings relative to CLOs in the first quartile.

Thus far, I have shown that tighter covenants exert greater selling pressure in the secondary loan market. I posit that fire sales occur when distressed loans are concentrated among constrained CLOs. Using the definition of constrained and unconstrained CLOs described previously, I classify each issuer as being held by constrained (unconstrained) CLOs if its share of loans held by constrained CLOs is above (below) the median before default. Then, I compare the monthly net purchase for loans held by constrained CLOs to that of unconstrained CLOs in Figure 7. Figure 7 plots the point estimate signifying the monthly net purchase amount for loans held by constrained and unconstrained CLOs, after controlling for borrower and common shocks through the inclusion of issuer and year fixed effects. The point estimates and the difference between the two groups are tabulated in Table 6. There are two key insights of this analysis. First, consistent with Figure 5(a), CLOs reduce the monthly net purchase amount, starting 12 months before default, and become net sellers several months prior to default. Although the amount of net sales is economically meaningful starting 10 months before default, the point estimates gain statistical significance starting four months before default and remains so until 11 months after default. This finding suggests that CLOs preemptively divest themselves of distressed loans several months prior to default. Second, consistent with the theoretical prediction, the total volume of sales is larger for loans that are held by constrained CLOs, relative to loans that are held by unconstrained CLOs in the months around default. The difference in the net purchase of loans held by constrained CLOs and loans held by unconstrained CLOs is largest in the month before default. This suggests that the degree of CLO covenant tightness can critically determine the magnitude of sales. Thus, it is predicted that the associated price effects are larger for loans held by constrained CLOs relative to loans held by unconstrained CLOs.

To gauge the magnitude of sales, I examine the net purchase amount as a fraction of the median issuer debt held across CLOs. As indicated in Table 1, issuers report a median CLO debt of $105 million. I cumulate the monthly net purchase amount reported in Table 6 from 12 months before default to 12 months after. Online Appendix Figure B.6 indicates that 41% of the median holdings held by constrained CLOs are sold by

Figure 7. (Color online) Monthly Net Purchase for Unconstrained and Constrained CLOs



Notes. The figure plots the point estimates of the monthly purchase around default for distressed loans held by constrained CLOs and unconstrained CLOs. A loan is distressed if it is issued by a firm that experiences default. *Constrained* (*Unconstrained*) CLOs are those with below (above) median distance to the interest diversion threshold over the sample period. The estimates are produced from the following regression: $\text{Transaction Amount}_{i,t} = \alpha + \sum_{t=-12}^{12} \beta_{t+13}\, \mathbb{1}_{\text{constrained CLO}} \times \mathbb{1}_{m==t} + \beta_{26} \mathbb{1}_{constrainedCLO} + \sum_{t=-12}^{12} \beta_{t+29}\, \mathbb{1}_{m==t} + \alpha_i + \alpha_y + \epsilon_{i,t}$, where t indexes the month-year, y denotes year, i denotes issuer, m indexes the month-year, and ϵ is the error.

Table 6. Unconstrained and Constrained Net Purchase

Months from default	Unconstrained	Constrained	Difference	P(Net Sales≥0) (p *value*)
−12	−273,417	3,973,405	4,246,822	0.1580
−11	370,465	2,402,515	2,032,050	0.1520
−10	1,104,982	−1,254,659	−2,359,641	0.6310
−9	3,766,913	−3,804,579	−7,571,492	0.9340
−8	−560,250	−1,757,733	−1,197,483	0.4370
−7	−817,364	−4,300,426	−3,483,062	0.6590
−6	−1,001,723	−3,196,944	−2,195,221	0.1050
−5	−316,417	−5,195,367	−4,878,950	0.1680
−4	−2,902,471	−5,325,729	−2,423,258	0.0080
−3	−2,081,033	−4,904,858	−2,823,825	0.0650
−2	−2,170,718	−6,203,886	−4,033,168	0.0650
−1	−1,920,007	−8,816,950	−6,896,943	0.0030
0	−2,740,011	−4,925,689	−2,185,678	0.0010
1	−2,164,529	−5,125,415	−2,960,886	0.0000
2	−2,843,905	−3,909,853	−1,065,948	0.0030
3	−2,457,948	−5,861,716	−3,403,768	0.0040
4	−3,364,926	−5,529,427	−2,164,501	0.0010
5	−3,020,860	−2,446,272	574,588	0.0080
6	−2,710,969	−3,044,430	−333,461	0.0000
7	−2,572,294	−6,061,253	−3,488,959	0.0320
8	721,121	−5,005,738	−5,726,859	0.0370
9	−821,215	−3,108,629	−2,287,414	0.0870
10	−157,520	−4,102,046	−3,944,526	0.0660
11	−440,003	−1,586,667	−1,146,664	0.4700
12	−1,982,831	−2,630,436	−647,605	0.6020

Notes. The table tabulates the point estimates of the monthly purchase around default for distressed loans held by constrained CLOs and unconstrained CLOs. A loan is distressed if it is issued by a firm that experiences default. *Constrained* (*Unconstrained*) CLOs are those with below (above) median distance to the most stringent capital covenant threshold over the sample period. The estimates are produced from the following regression: Transaction Amount$_{i,t}$ $= \alpha + \sum_{t=-12}^{12} \beta_{t+13}\, \mathbb{1}_{\text{constrained CLO}} \times \mathbb{1}_{m==\text{t}} + \beta_{26} \mathbb{1}_{constrainedCLO} + \sum_{t=-12}^{12} \beta_{t+29}\, \mathbb{1}_{m==t} + \alpha_i + \alpha_y + \epsilon_{i,t}$, where t indexes the month-year, y denotes year, i denotes issuer, and m indexes the month-year. The table tabulates the transaction amount for constrained and unconstrained CLOs, the difference between the two, and the p value associated with a sign test for whether the net sale frequency is greater than the net purchase frequency.

the default event. This figure is 9% for loans held by unconstrained CLOs. Thus, CLO sales constitute a sizeable fraction of the total amount of outstanding debt held across CLOs, moreso when the loans are concentrated among constrained CLOs.

4.3. Price Pressure

This section investigates whether increased selling pressure materializes as price pressure in the leveraged loan market. Specifically, I study the extent to which CLO sales impose externalities on asset prices. A key challenge in studying price effects is disentangling the motives, namely price pressure from information revelation. Information-based trades are opportunistic, whereas price pressure arises from necessity (Coval and Stafford 2007). If information revelation informs CLO sales, the secondary loan price should fall and stabilize at a permanent lower level with no evidence of drift. Evidence of price reversals following forced sales lends credence to the price pressure hypothesis. If expectations of terminal value are unchanged, reversal may reflect deviations between sale prices and fundamental valuations. In this case, positive abnormal returns following forced sales compensate liquidity providers (Scholes 1972). The empirical design therefore compares the price effects of loans held by constrained and unconstrained CLOs, exploiting variation in issuers' exposure to CLO covenant tightness.

The empirical strategy is similar in spirit to Mitchell et al. (2007), Coval and Stafford (2007), and Ellul et al. (2011). I follow the methodology of Ellul et al. (2011) to measure abnormal returns. I compute the total volume of trades and the median price for each issuer for each trade date. This allows me to study the price return, net trade direction, and trade size at the daily level. After controlling for both market and issuer-specific changes in fundamental value, the abnormal return reflects the liquidity component associated with price changes for each day. Daily abnormal returns are averaged to construct the average abnormal return at the monthly frequency. The monthly abnormal returns are then cumulated to construct the cumulative average abnormal return (CAAR). The CAAR is normalized to zero, 13 months before default.

Portfolio changes of managers are unlikely to be correlated with changes in the fundamental value of loans. As indicated in Table 1, CLOs hold largely overlapping portfolios; on average, an issuer's loans are held across 125 CLOs. Moreover, according to the FSB, 90% of CLOs are exposed to at least one of the top 50 borrowers and more than 80% of CLOs are exposed to the top five borrowers (Federal Stability Board 2019). Given the overlap in holdings, a comparison of the price effects of loans held by constrained and unconstrained CLOs should reflect differences in intermediary constraint rather than information about an individual loan. In addition, given that more than 60% of leveraged loans held in CLOs have a single-B rating, credit risk is nonnegligible; hence, the information content is expected to be limited (Kundu 2022a). Furthermore, I verify that concerns of attrition are minute; CLOs transact all distressed issuers' loans, before and after default.

The reduced form regression is of the following form:

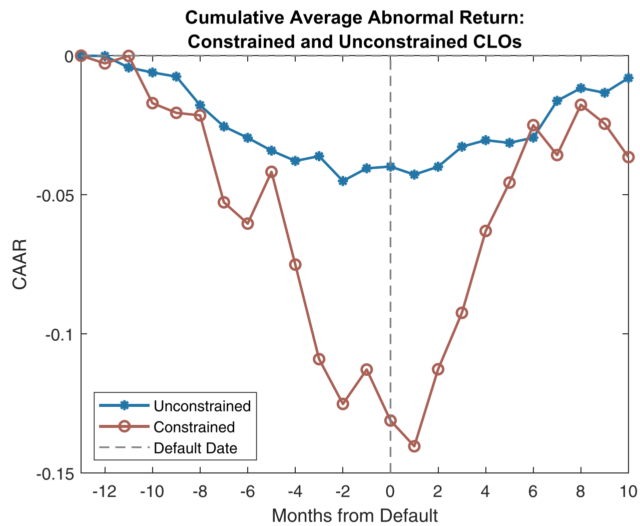
$$ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \delta_{r,q} + \delta_{d,q} + \delta_{r,d,y} + \theta_m + \epsilon_{i,t-1,t}, \quad (6)$$

where Q is a purchase indicator (-1 for sale), S is the trade size, Z denotes changes in fundamental value, r denotes the rating, d denotes the industry, q denotes the quarter, m indexes the month-year, and y denotes the year. This reduced-form equation is derived in Online Appendix A.

Abnormal returns are measured using a simple market model. I specify the change in fundamental value as Z, a function of the following: (1) changes in the 10-Year Treasury Constant Maturity Rate, (2) ICE BofA U.S. High Yield Index Effective Yield Spread, (3) ICE BofA U.S. Corporate Index Effective Yield Spread, (4) S&P 500 Index Return, and (5) S&P/LSTA Leveraged Loan Index. An empirical challenge of modeling changes in fundamental value is the lack of public information. Most firms held in CLO portfolios are private companies; hence, they are not subject to the same reporting standards and disclosures as public companies. For this reason, I account for changes in fundamental value through the addition of several fixed effects, including, rating × industry × year, rating × quarter, industry × quarter, and month × year fixed effects. Rating × industry × year fixed effects account for time-varying changes that affect industries of varying credit risk profiles. Rating × quarter and industry × quarter fixed effects control for industry-specific and credit risk–specific cyclical fluctuations. Month × year fixed effects control for common factors.[12]

I compare the CAAR of loans held by constrained CLOs to that of loans held by unconstrained CLOs. As before, each issuer is classified as belonging to constrained (unconstrained) CLOs if its share of loans held

Figure 8. (Color online) Cumulative Average Abnormal Return: Constrained and Unconstrained CLOs



Notes. The figure compares the monthly cumulative average abnormal return (CAAR) for loans issued by borrowers with above/below median CLO debt held by constrained CLOs around default. A borrower is *constrained* if its share of CLO debt (amount) held by constrained CLOs is greater than the median, and *unconstrained*, otherwise. Abnormal return is generated from the following regression: $ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1} ln(S_{i,t-1})) + \delta_{r,q} + \delta_{d,q} + \delta_{r,d,y} + \theta_m + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, i denotes the loan, r denotes the rating, d denotes the industry, t denotes the date, q denotes the quarter, m indexes the month-year, y denotes the year, and ϵ is the error.

by constrained CLOs is above (below) the median before default. By exploiting heterogeneity in the degree of covenant tightness, I examine how CLO covenant tightness may induce distressed sales. Figure 8 presents the CAAR for loans held by constrained CLOs and loans held by unconstrained CLOs. Table 7 tabulates the differences in the CAAR between these two groups and assesses statistical significance.[13] Loans held by constrained CLOs and loans held by unconstrained CLOs exhibit statistically distinguishable differences in their respective CAAR, starting seven months before default. Seven months before default, the CAAR for loans held by constrained CLOs is −5.27% compared with −2.54% for loans held by unconstrained CLOs. The two loans groups exhibit growing divergence in CAAR until after default. One month after default, loans held by constrained CLOs experience a CAAR of −14.04% compared with −4.27% for loans held by unconstrained CLOs. After this trough, the price effects reverse and slowly dissipate. Four months after default, the two loan groups do not exhibit statistically distinguishable differences in the CAAR. The CAAR of loans held by unconstrained CLOs reverts to 0%, 10 months after default.[14] In comparison, although loans held by constrained CLOs also rebound, the recovery does not fully revert to 0%;

Table 7. Constrained and Unconstrained CAAR

	Constrained			Unconstrained			Difference	
Months	CAAR	*N*	*t* statistic	CAAR	*N*	*t* statistic	Δ CAAR	*t* statistic
−12	−0.0028	100	−0.1707	−0.0001	164	−0.0250	−0.0027	−0.1970
−11	−0.0001	99	−0.0044	−0.0043	190	−0.6985	0.0042	0.4932
−10	−0.0171	114	−0.7596	−0.0060	173	−0.8270	−0.0110	−1.0696
−9	−0.0205	96	−0.8665	−0.0075	157	−0.9580	−0.0130	−1.7001
−8	−0.0214	104	−0.8321	−0.0178	156	−1.7889	−0.0037	−0.3783
−7	−0.0527	82	−1.8490	−0.0254	204	−2.5384	−0.0272	−2.3820
−6	−0.0603	75	−1.8211	−0.0295	167	−2.8401	−0.0308	−2.7863
−5	−0.0417	104	−1.1884	−0.0341	188	−2.6715	−0.0076	−0.5908
−4	−0.0751	85	−1.9078	−0.0378	254	−2.8442	−0.0373	−2.4503
−3	−0.1090	99	−2.6571	−0.0361	231	−2.4608	−0.0729	−5.2541
−2	−0.1251	104	−2.8655	−0.0450	248	−2.9448	−0.0801	−6.6586
−1	−0.1128	99	−2.5053	−0.0405	280	−2.5227	−0.0723	−5.0593
0	−0.1311	117	−2.5750	−0.0398	334	−2.3407	−0.0913	−5.6685
1	−0.1404	129	−2.6593	−0.0427	371	−2.4465	−0.0976	−7.3019
2	−0.1127	136	−2.0172	−0.0399	353	−2.2001	−0.0728	−5.0292
3	−0.0924	123	−1.4837	−0.0327	291	−1.6629	−0.0597	−3.9178
4	−0.0630	110	−0.9980	−0.0304	328	−1.5793	−0.0326	−2.4620
5	−0.0456	104	−0.7245	−0.0313	289	−1.5335	−0.0143	−1.0544
6	−0.0250	114	−0.3810	−0.0295	303	−1.4208	0.0045	0.3237
7	−0.0357	119	−0.5586	−0.0162	321	−0.7550	−0.0195	−1.4234
8	−0.0176	121	−0.2664	−0.0116	315	−0.5366	−0.0060	−0.4943
9	−0.0244	115	−0.3628	−0.0133	329	−0.5912	−0.0111	−0.9742
10	−0.0365	124	−0.5437	−0.0080	326	−0.3424	−0.0285	−2.9568

Notes. The table compares the monthly cumulative average abnormal return (CAAR) for loans issued by borrowers with above/below median CLO debt held by constrained CLOs around default. A borrower is *constrained* if its share of CLO debt (amount) held by constrained CLOs is greater than the median, and *unconstrained*, otherwise. Abnormal return is generated from the following regression: $ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \approx \alpha + \beta Z_{l,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \delta_{r,q} + \delta_{d,q} + \delta_{r,d,y} + \theta_m + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, i denotes the loan, r denotes the rating, d denotes the industry, t denotes the date, q denotes the quarter, m indexes the month-year, y denotes the year, and ϵ is the error. The CAAR, t statistic, and number of issuers is tabulated for loans held by constrained and unconstrained CLOs, respectively, along with the difference in the CAAR between the two groups of firms and the associated t statistic.

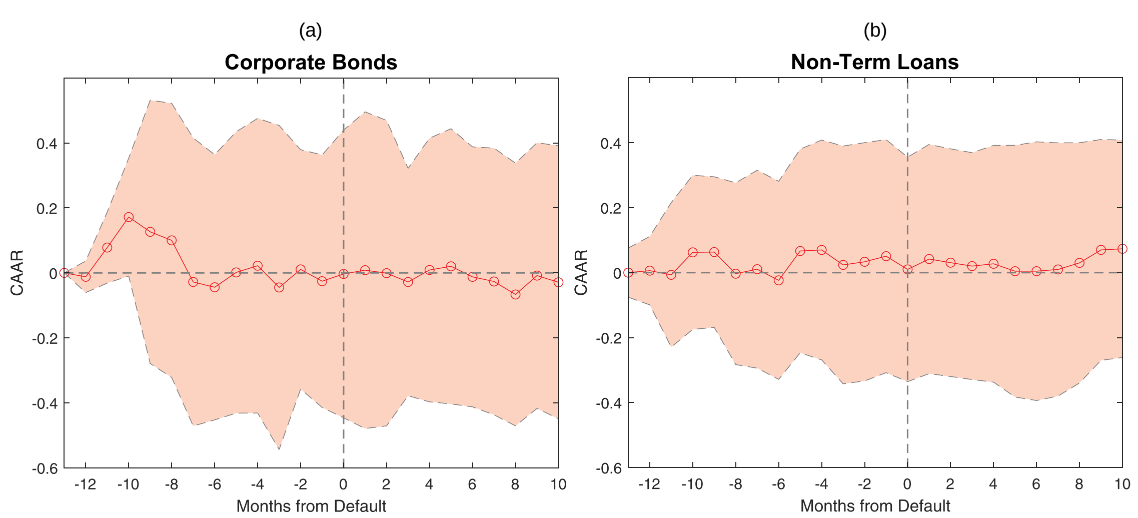
the CAAR of loans held by constrained CLOs is −3.65%, 10 months after default. Hence, liquidity provided by potential buyers may be insufficient to completely correct for mispricing; 74% of the costs of distressed loans held by constrained CLOs are recovered. For robustness, I also conduct the analysis at the loan level. A loan is deemed as *constrained* if the amount of the loan held by constrained CLOs is greater than the median and *unconstrained* otherwise. Online Appendix Figure B.7 and Online Appendix Table B.3 report these results. Consistent with the baseline analysis, the CAAR of constrained and unconstrained loans diverges in the immediate months surrounding default. The difference in the CAAR of constrained and unconstrained loans is 9.98%, one month after default.

Evidence of a price drop before default and subsequent reversal suggests that the price effects are driven by price pressure. To corroborate this, I examine the stock price changes of the affected loans around default. If CLO sales reflect information about firm fundamentals, the stock prices should also react around default. Online Appendix Figure B.8 presents the cumulative abnormal stock returns around default under the Fama-French three-factor model. A limitation of this analysis is that the vast majority of borrowers in the leveraged loan market are private companies. I do not find that stock prices exhibit any marked or persistent decline around the default event. The lack of significance rules out information as the primary driver of price effects, in favor of the price pressure hypothesis.

Thus far, the findings support the hypothesis that there is price pressure in the leveraged loan market around default. However, it is unclear whether CLO managers cause price pressure or respond to it. To study this, I examine the price effects of corporate bonds and nonterm loans held in CLO portfolios. CLOs are the largest purchasers of leveraged loans and leveraged loans constitute the largest share of CLO portfolios. CLOs purchased 75% of new institutional leveraged loans in 2019, and more than 80% of CLO portfolios consist of leveraged loans (Leveraged Commentary and Data 2019, Kundu 2022a). In contrast, CLOs are neither active in the corporate bond and nonterm loan (subordinated loans, revolvers, lines of credit, and other securities) markets, nor are their exposures to these securities sizeable. Examination of the price effects of other asset classes in which CLO managers are inactive can indicate whether CLO forced sales are an externality of forced sales induced by a distinct set of intermediaries that are not as specialized in a particular asset class. That is, a fund that faces a margin call may be forced to sell, thereby impacting prices of other funds that face similar constraints (Mitchell et al. 2007). The price effects are expected to be muted for corporate bonds and nonterm loans if CLO managers *cause* price pressure in the leveraged loan market and other buyers have undifferentiated demand across securities. Conversely, if the price effects of corporate bonds and nonterm loans mirror the price patterns illustrated in Figure 8, it may suggest that the source of price pressure is outside of the CLO market. A limitation of this falsification test is that nonterm loans are traded infrequently. I find that the corporate bond and nonterm loan market do not exhibit statistically significant abnormal returns around default, as shown in Figure 9. Furthermore, the selling behavior of institutional investors is not correlated with that of CLOs; Giannetti and Meisenzahl (2022) find that mutual funds and hedge funds replace banks and CLOs when the quality of a loan deteriorates, operating as "stabilizing forces" against CLO constraints.[15] These findings dispel two hypotheses: (1) firm fundamental changes drive the price effects, and (2) CLO managers respond to price pressure in the leveraged loan market.

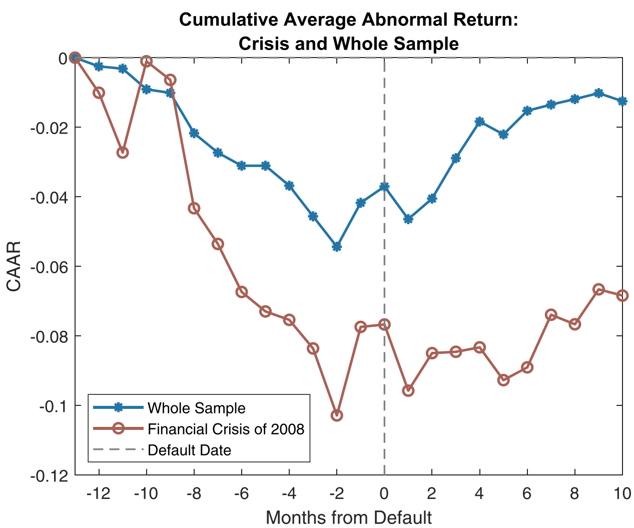
Fire sales costs are aggravated when the pool of potential buyers is limited. Theoretically, Shleifer and Vishny (1992) argue that when a firm experiences financial distress and is forced to sell specialized assets, the most natural buyers are the firm's industry peers who are also likely to experience similar levels of financial distress. Therefore, potential buyers of such assets are likely industry outsiders who have lower valuations. If financial distress is widespread, these potential buyers may also experience tighter constraints, for example, limits to arbitrage, regulation, and so on, limiting the pool of unconstrained buyers. In these instances, sellers may be forced to sell at additional discounts and price dislocations may persist (Shleifer and Vishny 1997). I compare the price effects when there is a scarcity of potential buyers to when there is not by studying the CAAR during two periods: the GFC and the entire sample period. During crisis periods, markets are illiquid and financial constraints bind; hence, the number of healthy buyers are limited. An examination of the CAAR during financial crises provides insight into potential fire sale costs when buyers' capital is limited. I compare the CAAR during the GFC to the whole sample period in Figure 10. The CAAR experienced during the GFC is computed using loan defaults from Q12009 to Q12010.[16] The difference in the CAAR between the crisis period and the whole sample is statistically distinguishable starting seven months prior to default, and remains statistically distinguishable, even 10 months after default. In the month after default, the CAAR experienced during the GFC is almost twice as large as the CAAR experienced throughout the entire sample period (−9.57% versus −4.64%). This difference of 4.93% grows in the subsequent months, as tabulated in Table 8. The CAAR is 7.38% lower, six months

Figure 9. (Color online) Falsification Tests: CAAR for Corporate Bonds and Nonterm Loans



Notes. (a) Corporate bonds. (b) Nonterm loans. The figure presents the monthly cumulative average abnormal return (CAAR) for corporate bonds (left) and nonterm loans (right) held by CLOs around default. Nonterm loans include subordinated loans, revolvers, lines of credit, and other securities. Abnormal return is generated from the following regression: $ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t} ln(S_{i,t}) - Q_{i,t-1} ln(S_{i,t-1})) + \delta_{r,q} + \delta_{d,q} + \delta_{r,d,y} + \theta_m + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, i denotes the loan, r denotes the rating, d denotes the industry, t denotes the date, q denotes the quarter, m indexes the month-year, y denotes the year, and ϵ is the error. The CAAR is normalized to be zero 13 months from default.

Figure 10. (Color online) CAAR: Financial Crisis vs. Whole Sample



Notes. The figure presents the monthly cumulative average abnormal return (CAAR) during the Great Financial Crisis of 2008 (GFC) and for the entire sample period. The CAAR during the GFC is computed using loan defaults from Q12009 to Q12010. The CAAR during the whole sample period is computed using loan defaults from 2009 to 2019. Abnormal return is generated from the following regression: $ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \delta_{r,q} + \delta_{d,q} + \delta_{r,d,y} + \theta_m + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, i denotes the loan, r denotes the rating, d denotes the industry, t denotes the date, q denotes the quarter, m indexes the month-year, y denotes the year, and ϵ is the error. The CAAR is normalized to be zero 13 months from default.

after default, during the crisis period, relative to the overall sample period. Ten months after default, the CAAR is −1.25% for the entire sample period, whereas it is −6.84% during the financial crisis. The divergence in the CAAR trajectories demonstrates how market illiquidity can prolong price recovery and amplify fire sale costs during periods of financial stress.

4.3.1. Robustness Checks. This section investigates the robustness of the main finding: price pressure occurs when distressed loans are concentrated among constrained CLOs. Specifically, I find that loans that are held by constrained CLOs experience larger price discounts around default relative to loans held by unconstrained CLOs. First, I demonstrate that the difference in the CAAR of the two groups is economically and statistically significant, regardless of the precise methodology. Second, I disaggregate the CAAR by default type, demonstrating that the deviation from fundamental value is similar across initial default events.

4.3.1.1. Alternative Methodology for Computing CAAR. The baseline empirical specification compares the monthly CAAR for loans held by constrained and

Table 8. Monthly Cumulative Average Abnormal Return: GFC Crisis and Whole Sample

Months	$CAAR_{crisis}$-$CAAR_{all}$	t statistic
−12	−0.0076	−0.3803
−11	−0.0241	−1.4129
−10	0.0081	0.3788
−9	0.0038	0.2193
−8	−0.0216	−1.0586
−7	−0.0262	−1.9794
−6	−0.0363	−2.1421
−5	−0.0419	−2.4839
−4	−0.0386	−3.4226
−3	−0.0380	−2.2721
−2	−0.0485	−3.5544
−1	−0.0357	−2.6765
0	−0.0397	−3.2451
1	−0.0493	−4.5459
2	−0.0444	−3.9003
3	−0.0557	−4.5178
4	−0.0649	−5.2654
5	−0.0706	−5.5452
6	−0.0738	−6.2694
7	−0.0604	−5.9506
8	−0.0647	−6.4846
9	−0.0564	−4.9976
10	−0.0559	−4.2694

Notes. The table compares the monthly cumulative average abnormal return (CAAR) for loans that experienced default in the aftermath of the Great Financial Crisis of 2008 and loans that experienced default across the sample period (2009–2019). Abnormal return is generated from the following regression: $ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t} ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \delta_{r,q} + \delta_{d,q} + \delta_{r,d,y} + \theta_m + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, i denotes the loan, r denotes the rating, d denotes the industry, t denotes the date, q denotes the quarter, m indexes the month-year, y denotes the year, and ϵ is the error. The difference in the CAAR and t statistic associated with this difference is tabulated by the months around default.

unconstrained CLOs around default. An issuer is constrained (unconstrained) if its share of loans held by constrained CLOs, defined by share, is above (below) the median, before the initial default event. I apply an alternative definition of constrained/unconstrained to study whether the results are sensitive to the classification scheme.

An issuer is designated as constrained (unconstrained) if the share of loans held by constrained CLOs, defined by the number of loans, is above (below) the median. Online Appendix Figure B.9 presents a comparison of the CAAR experienced by loans held by constrained CLOs and unconstrained CLOs. The figure demonstrates that there is a significant price drop and reversal around default events. Consistent with the baseline results, loans held by constrained CLOs experience greater price discounts, relative to loans held by unconstrained CLOs. One month after default, loans held by constrained CLOs experience a 5.78% discount relative to loans held by unconstrained CLOs. Although the

CAAR experienced by loans held by unconstrained CLOs reverts to 0% after 10 months, the CAAR experienced by loans held by constrained CLOs does not fully rebound to 0% and remains at −3.92%. That is, 60% of the costs of distressed loans held by constrained CLOs are recovered, 10 months after default. The discrepancy in the CAAR of the two loan groups around default are tabulated in Online Appendix Table B.2. Hence, this robustness check emphasizes the main finding: Costs are larger when CLOs face tighter covenants.

A potential concern of this robustness check is that it relies on the classification of constrained and unconstrained CLOs. To assuage the concern that the results are sensitive to this designation, I compare the CAAR by covenant failure propensity. A CLO is deemed as *Fail* if it has breached a covenant in the sample period, and *Pass*, otherwise. An issuer's loans are then classified as being held by failed (passed) CLOs if its share of loans held by CLOs that breached covenant in the sample period is above (below) the median. Online Appendix Figure B.11 compares the CAAR for loans held by failed CLOs and loans held by passed CLOs. The figure indicates that the costs borne by loans held by failed CLOs is substantially larger than that borne by passed CLOs. One month after default, the CAAR experienced by loans held by failed CLOs is −18.87% compared with −3.25% for loans held by passed CLOs. This difference in the CAAR is 15.62%, as documented in Online Appendix Table B.4. The figure indicates that the rebound associated with loans held by failed CLOs does not fully absorb all losses, as the CAAR increases by 4.72%, 10 months after default. Hence, only 25% of the costs of distressed loans held by failed CLOs are recovered in the months after default. In contrast, the entirety of costs associated with loans held by passed CLOs are recouped.

Overall, these tests substantiate that loans that are concentrated among CLOs with tighter covenants experience greater price pressure.

4.3.1.2. CAAR by Default Type. This section investigates whether the CAAR differs based on the type of default event. As described in Section 2, 56% of initial default events are downgrades, whereas 44% represent other loan defaults. Online Appendix Figure B.10 examines whether the CAAR differs for downgrades and other default events. Several months before default, downgrades experience negative CAAR. In contrast, the CAAR associated with other default events turns negative, only four months before default. Although there is a gradual decline in the CAAR in the 12 months prior to downgrades, the CAAR drops dramatically in the months leading up to other default events. However, the magnitude of the CAAR during the event is similar across downgrades and other defaults. Moreover, the recovery, ex post, exhibits similar trajectories for the two categories of defaults. Hence, these findings indicate that the CAAR experienced around downgrade and other initial default events is similar.

4.4. Pecuniary and Nonpecuniary Costs of Covenant Breaches

By revealed preferences, the costs associated with holding onto distressed loans are larger than the costs associated with preemptive sales. This section estimates the pecuniary and nonpecuniary costs of covenant breaches.

I begin by investigating the equity cost of covenant breaches. CLO liabilities are structured as a series of debt tranches and an equity tranche. Debt tranches are paid a fixed spread above a benchmark interest rate based on seniority. The equity tranche receives the remaining spread between the assets (leveraged loans) and liabilities (notes/bonds). Generally, a CLO manager's financial interests are aligned with the equity class. This is because subordinated fees that are proportional to the proceeds available to the equity class constitute the bulk of management fees. Kundu (2022a) documents that the junior management fees are larger than senior management fees; from 2012 to 2018, the median senior fee was 15 basis points (bps), compared with 30 bps for the median junior fee. After the junior fee is paid, the equity tranche receives the remaining proceeds up to a prespecified hurdle rate. Beyond this hurdle rate, the manager receives an additional performance fee and the remaining proceeds are split between the manager and the equity class. Hence, a CLO manager's compensation consists of a fixed fee and a series of subordinated fees.

Table 9 reports the equity cost of covenant breaches. The dependent variable is the equity distribution at time $t + 1$. The independent variable of interest indicates whether a CLO is in violation of its most stringent capital covenant at time t. As before, I use a within CLO × year estimator. I do not include any fixed effects in column 1. In columns 2 to 4, I successively add CLO, year, and CLO × year fixed effects. CLO controls, size, age, and maturity are included in all specifications. I find that there is a negative relation between a covenant breach and the equity distribution in the subsequent period. Specifically, a covenant breach reduces the equity distribution by 0.29 standard deviations to 0.71 standard deviations or 4.64 percentage points to 11.29 percentage points. This is economically meaningful, as it accounts for up to 67% of the average equity distribution. The point estimates are statistically significant at the 1% level across all columns. Hence, covenant breaches can substantially reduce equity distributions. Moreover, Online Appendix Figure B.12 presents a time-series plot of covenant breach and annualized equity distributions across all CLOs by quarter-year. The figure indicates that the correlation of risky loans and the equity distribution is −0.62. During recessionary periods, equity distributions are especially low.

Table 9. Equity Cost of Covenant Breaches

Equity distribution$_{t+1}$	(1)	(2)	(3)	(4)
$\mathbb{1}_{Fail,t}$	−0.7109***	−0.5352***	−0.3353***	−0.2924***
	(0.0637)	(0.0756)	(0.0577)	(0.0719)
CLO Controls	✓	✓	✓	✓
CLO FE		✓	✓	
Year FE			✓	
CLO × Year FE				✓
N	21,756	21,756	21,756	21,756
R^2	0.0484	0.2919	0.3311	0.5684

Notes. Standard errors are two-way clustered by CLO and month-year in parentheses. The table presents the relation between covenant breaches and the annualized equity distribution. A CLO. The dependent variable is the annualized equity distribution, defined as $\frac{\text{Interest payment}\times\frac{12}{\text{Payment frequency}}}{\text{Par value of equity}} \times 100$. The independent variable takes the value of one if the CLO breaches the most stringent capital covenant and zero otherwise. The regression specification is the following:

$$\text{Annualized Equity Distribution}_{c,t+1} = \alpha + \beta \times \mathbb{1}_{Fail,c,t} + \text{CLO Controls}_{c,t} + \theta_{c,y} + \epsilon_{c,t},$$

where c denotes the CLO, t indexes the month-year, and y denotes the year. CLO controls consist of CLO size, age, and maturity. The independent variables are standardized in both panels. The likelihood of standard errors are two-way clustered by CLO and month-year.

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

This suggests that pecuniary losses are pronounced during periods of financial stress.

I examine the nonpecuniary costs of covenant breaches in Table 10. Table 10 estimates how various managerial outcomes are affected in the six months after a manager's first covenant breach. The independent variable, *Post*, indicates the timing of the breach. Post takes the value of one in the six months after a manager's first covenant breach, and zero otherwise. The dependent variable in column 1 indicates whether a manager launches a new CLO deal. The dependent variable in column 2 is a manager's mean distance to the covenant threshold across all managed deals. The dependent variable in column 3 is a manager's mean deal size. I use a manager × year

Table 10. Managerial Costs of Covenant Breaches

	(1) $\mathbb{1}_{\text{New Deal}}$	(2) Covenant threshold	(3) Deal size
Post	−0.0557***	0.0260*	−0.0292**
	(0.0185)	(0.0145)	(0.0138)
Manager × year fixed effects	Yes	Yes	Yes
N	13,357	13,357	13,357
R^2	0.9163	0.8108	0.8893

Summary statistics

	N	Q1	Median	Q3	Mean	Standard deviation
$\mathbb{1}_{\text{New Deal}}$	13,381	0.0000	0.0000	1.0000	0.3512	0.4775
ln(Covenant Threshold)	13,381	4.6399	4.6538	4.6759	4.6922	0.1909
Size	13,381	19.5171	19.7783	19.9497	19.6435	0.5101

Notes. Standard errors are two-way clustered by manager and month-year in parentheses. The table presents the relation between covenant breaches and managerial effects. The dependent variables are: an indicator variable, specifying whether a manager launches a new deal, the mean natural log-transformed most stringent capital covenant threshold across a manager's deals, and the mean deal size across a manager's deals. The indicator for launch of a new deal reports a mean (sd) of 0.1111 (0.3142). The covenant threshold reports a mean (sd) of 4.6922 (0.1909). The 25th, 50th, and 75th percentile values are 4.6399, 4.6538, and 4.6759. The size reports a mean (sd) of 19.6435 (0.5101). The 25th, 50th, and 75th percentile values are 19.5171, 19.7783, and 19.9497.

The timing of the covenant breach corresponds with the first instance that the manager breaches the most stringent capital covenant threshold across all deals administered by that manager. *Post* indicates the timing of the breach. Post takes the value of one in the first six months after the first covenant breach, and zero otherwise. The regression specification is the following:

$$Y_{m,t} = \alpha + \beta \cdot Post_{m,t} + \theta_{m,y} + \epsilon_{m,t},$$

where m denotes the manager, t indexes the month-year, and y denotes the year. Standard errors are two-way clustered by manager and month-year.

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

estimator to account for all manager-specific heterogeneity, including taste, style, sophistication, risk aversion, reputation, and common factors.

Covenant breaches are associated with large nonpecuniary costs. The likelihood that a manager launches a new CLO deal falls by 5.57% in the first six months after a manager's first covenant breach. Moreover, the mean covenant threshold increases by 2.60%, whereas the mean deal size decreases by 2.92% in the same period. These findings suggest that upon breaching a covenant, managers are less likely to launch new deals, face more stringent covenants, and administer smaller portfolios. Hence, covenant breaches have detrimental effects on CLO managers' reputation and career prospects. These estimates are economically meaningful, relative to their mean values throughout the sample period (see table notes).

Overall, the results suggest that the covenant breaches can impose large pecuniary and nonpecuniary costs. These costs may amount to be larger than the costs associated with distressed sales.

5. Conclusion

This paper provides evidence that fire sale risk can materialize in closed-end funds. Closed-end funds are thought to have negligible fire sale risk as they have stable funding. However, I show that embedded covenants can generate price pressure in CLOs.

The central hypothesis of this paper is that fire sales occur when distressed loans are concentrated among constrained CLOs. Supporting this hypothesis, I document a strong relation between the degree of covenant tightness and the probability of a distressed sale. Distressed loans that are held by constrained CLOs experience a greater volume of sales, relative to loans that are held by unconstrained CLOs. Managers preemptively sell these loans before the issuers default.

CLO sales may be explained by contractual arbitrage, a practice by which CLOs can mechanically loosen their coverage covenants. When loans experience distress, CLOs switch from accounting for the loans at historical cost to alternative accounting schemes, tightening their covenants. Managers can exploit discrepancies between the loans' market values and accounted values to build par and avoid covenant violations. Specifically, managers may generate slack in their covenants by selling loans that report higher market values than accounted values. Hence, this provides a potential explanation behind CLO sales of distressed leveraged loans.

Covenant-induced sales exert price pressure in the leveraged loan market. I document a significant price drop and reversal around firm defaults. The cumulative average abnormal return experienced by loans held by constrained and unconstrained CLOs diverges around default. One month after default, loans held by constrained CLOs experience a cumulative average abnormal return of −14.04% compared with −4.27% for loans held by unconstrained CLOs. In the months following default, the discrepancy narrows; 10 months after default, loans held by constrained CLOs experience a cumulative average abnormal return of −3.65%, whereas loans held by unconstrained CLOs experience a cumulative average abnormal return of 0%. Furthermore, fire sale costs are aggravated when there is a scarcity of potential buyers; the price effects experienced at default are twice as large during the Great Financial Crisis of 2008, relative to the overall sample period, and, recovery is longer. The absence of significant abnormal returns in the event studies of price changes of other securities reflects the salience of CLO intermediaries in generating price pressure in the secondary loan market. Lastly, by revealed preferences, the costs associated with holding onto distressed loans are larger than the costs associated with preemptive sales. Consistent with this, I find that holding onto distressed loans can increase the incidence of covenant breaches which are associated with significant pecuniary and nonpecuniary costs.

Despite the historical resiliency of CLOs, the financial stability risks originating from the CLO market are unclear. On the one hand, the *originate-to-distribute* model has diversified banks' credit and liquidity risks to CLOs, reducing the "too-big-to-fail" risk of any single bank. On the other hand, CLO portfolios have exhibited increasing overlap; although the total value of outstanding CLOs increased from 2007 through 2019 from $308 billion to $606 billion, the number of issuers across CLOs experienced a rather meager increase from 4,229 to 4,659 over the same time horizon (Kundu 2022b). Kundu (2022b) documents the externalities of fire sales, demonstrating that idiosyncratic shocks can amplify through the CLO structure and impose externalities on other unrelated firms. Given the low liquidity of the secondary loan market, macroeconomic risks originating from the loan market may magnify to a larger extent relative to risks from more liquid markets. Future research can inform the magnitude of the CLO market's systemic footprint, relative to other institutions.

These findings suggest that, although managerial contracts may be optimal in safeguarding the interests of the CLO manager and investors and addressing the agency problem, they can also kindle fire sales. This begs the question: Can structural modifications to covenants reduce fire sale risk? Covenant modifications that are intended to alleviate fire sale risk may inadequately address the fundamental agency problem. Covenant modifications may have significant effects on the aggregate supply of credit extended to risky firms, with broad effects on equilibrium asset prices. Thus, the welfare implications of covenants remain ambiguous. Future theoretical work in this area could contribute to a better understanding of market efficiency at the intersection of optimal contracts and equilibrium asset prices.

Overall, this work implies that differences in the organizational structure between closed-end and open-end funds may not fully address both the underlying agency problem and fire sale risk. The remediation that is designed to address the agency problem in CLOs, a segment of closed-end funds, can also generate fire sale risk like their open-end counterparts.

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Endnotes

[1] These papers include Boudreaux (1973), Barclay et al. (1993), Ross et al. (2002), Berk and Stanton (2007), Cherkes et al. (2008), Bradley et al. (2010), and Wang and Nanda (2011).

[2] In April 2020, the Federal Reserve announced that loans and CLOs are included in term asset-backed securities loan facility (TALF), providing funding to entities that hold AAA notes of new CLOs that invest in newly issued loans.

[3] In recent years, central banks have forewarned of turmoil in the leveraged loan market. A recent report from the Financial Stability Board (FSB) of the Bank for International Settlements (BIS) highlights several vulnerabilities, including the weakening of creditor protections and mispricing of risk inherent in loan contracts, high concentration of CLOs and leveraged loans in banks, and growing exposure of nonbank institutional investors (Federal Stability Board 2019).

[4] The CAAR is measured relative to 13 months before default.

[5]The *closed-end puzzle* refers to the finding that closed-end funds shares sell at prices that diverge from the per market value of assets the fund holds. This has been partly attributed to the agency costs between fund managers and shareholders (Boudreaux 1973, Barclay et al. 1993, Ross et al. 2002, Berk and Stanton 2007, Cherkes et al. 2008, Bradley et al. 2010, Wang and Nanda 2011).

[6] I refer readers to Moody's Investors Service Glossary of Terms for a complete concordance table between Moody's rating factor and Moody's letter rating.

[7] I consider how the improvement to the covenants from contractual arbitrage compares to an alternative mechanism of selling an equal amount of nondefaulted loans with higher market values than book values in Online Appendix C. I show that the gains are greater with contractual arbitrage.

[8] The findings, presented later in Section 4.3, suggest that prior to default, the market prices of distressed loans held by CLOs operating farthest away from the covenant threshold (unconstrained) approximate the actual realized recovery values. This indicates that market participants can accurately assess the true recovery values of distressed loans.

[9] The equal-weighted HHI benchmark reports a mean (median) value of 0 (0).

[10] Historically, CLOs held a large share of asset-heavy businesses in the industrial sector. In particular, managers had sizeable exposures to the oil and gas industry. However, after the oil price plunge in 2015, managers reduced their exposure to the oil and gas industry by a significant margin.

[11] See Kundu (2022a) for a timeline of a CLO's life.

[12] As loans do not trade often, I examine the cumulative returns based on the estimates yielded from a panel regression; segmentation into groups may yield noisy and unreliable results (Ellul et al. 2011). Moreover, the leveraged loan market exhibits less variation in ratings and maturity relative to other markets; hence, segmentation is less relevant in this setting.

[13] Unconstrained issuers have more loans outstanding than constrained issuers; hence, the number of observations is higher.

[14] The nature of the claim can make impairment limited. CLOs hold senior secured debt, secured by collateral with a first lien. Senior secured debtholders experience the strongest creditor control and protection. They are ensured the collateral security as recourse in event of default and are entitled to the collateral until they are paid in full. In the event that the value of the collateral is below the value of the loan, the residual claim ranks with other unsecured claims and debtholders receive payment on a pro rata basis. In addition, the mechanism behind the forced sales provides an explanation for the recovery of bank debt. CLO managers can maximize improvements to the CLO covenant by selling distressed loans in descending order of the differences between the market values and accounted values. The loans that ex exhibit the greatest discrepancy between the market and accounted values are unlikely to be the worst performing loans.

[15] The authors find that mutual funds and hedge funds are specialized in holding claims of low credit quality borrowers. Consequently, the hedge fund and mutual fund concentration of loan syndicates increases after loan downgrades. Thus, the selling behavior of institutional investors is not positively correlated with that of constrained CLOs, thereby lending credence to the hypothesis that CLO managers create price pressure in the leveraged loan market.

[16] Defaults and covenant breaches occur with a lag. See Section 3.3.

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