Financial Covenants and Fire Sales: Fractures in the Leveraged Loan Market *

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November 22, 2020

Abstract

Financial institutions constitute an increasingly important cornerstone of capital markets, yet research at the intersection of asset management contracts and asset pricing remains sparse. In this paper, I study how externalities of managerial contracts affect asset prices in the context of *Collateralized Loan Obligations* (CLOs). I introduce several new stylized facts about the role of CLOs in the provision of credit to risky firms. Managers are not passive buy and hold investors, unlike their CDO counterparts. There is selection, monitoring and churn. The trading behavior of managers with respect to loans issued by distressed firms generates price pressure around bankruptcy default events. This may culminate in fire sales of distressed loans. At its nadir, the cumulative average abnormal returns (CAAR) are -14% one month after default. The CAAR exhibits stark differences in returns between capital-constrained and unconstrained managers – unconstrained managers do not experience any distinguishable price pressure. Moreover, loans that are higher-rated or of longer-maturity experience a deeper trough, as compared to lower-rated loans or of shorter-maturity. I explore the mechanism through which this occurs. I find that managers sell loans issued by distressed firms *before* the firms file for bankruptcy, driven mainly by covenant considerations – namely, liquidity and capital constraints. The stringency and performance of these constraints can explain the size of the intermediaries, as well as their equity distributions. Thus, this work provides insights into the role of covenants in the provision of credit.

JEL Classification: E22, E32, G14, G23, G32, G33

Keywords: financial constraints, covenants, contracts, price pressure, fire-sales, intermediary asset pricing, financial intermediation, bankruptcy, real effects, capital structure, CLOs

*Acknowledgments: I am grateful to my committee chair, Anil Kashyap, and members, Douglas Diamond, Ralph Koijen, Yueran Ma, Raghuram Rajan, and Amir Sufi for their guidance, support, and invaluable discussions. I thank the PhD Program Office, the University of Chicago Library, and the Fama-Miller Center for Research in Finance for procuring several datasets that are used in this project, and, the Stigler Center for the Study of the Economy and State for financial support. I appreciate conversations with Ehsan Azarmsa, Wenxin Du, Yiran Fan, Mihir Gandhi, Arjun Gopinath, Agustin Hurtado, Zhiguo He, John Heilbron, Young Soo Jang, Steven Kaplan, Rayhan Momin, Negin Mousavi, Stefan Nagel, Simon Oh, Nishant Vats, Yiyao Wang, and Eric Zwick, as well as participants of the Economic Dynamics and Financial Markets Working Group and the Corporate Finance Working Group. I also appreciate insights and discussions from a CLO manager at a prominent firm.

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1 Introduction

How do financial contracts affect asset prices and market efficiency? Since the seminal work of Modigliani and Miller (1958), which underscored debt as a promissory source of cash flows, the field of financial contracting has emphasized the importance of managerial actions on firm profitability (e.g., Jensen and Meckling (1976); Myers and Majluf (1984)), the allocation of control rights as a critical determinant of firm value (e.g., Grossman and Hart (1988); Aghion and Bolton (1992); Diamond (1991)), and collateral as a central feature of debt contracts (e.g., Hart and Moore (1994, 1995, 1998)). While institutions constitute an increasingly important cornerstone of capital markets, research at the intersection of asset management contracts and asset pricing remains sparse. In this paper, I provide empirical evidence of how agency frictions affect asset prices. Specifically, I show that fire sale risk in the leveraged loan market can manifest from contractual features rather than asset fundamentals. This informs the discussion on how the allocation of control rights, as prescribed by covenants, affects asset prices.

To this aim, I document several fire sale facts as they pertain to the *Collateralized Loan Obligation* (CLO) market. CLOs operate as special purpose vehicles (SPVs) with a manager who makes active trading decisions. Akin to other intermediaries, CLOs facilitate the pooling of risks by reducing search frictions in the product market, and providing expertise in risk management and asset allocation (Koijen and Yogo (2020)). The CLO issues tranched asset-backed securities or notes to investors, and uses the proceeds to finance the purchase of the underlying portfolio of leveraged loans. CLOs constitute a consequential source of credit for constrained corporate borrowers – they purchased 75% of new institutional leveraged loans issued in 2019 and hold 25% of all outstanding leveraged loans (pro rata and institutional) (Leveraged Commentary and Data (2019); International Monetary Fund (2020)). Moreover, the actions and operations of a CLO are governed by a legal indenture, executed between the CLO manager and trustee – a fiduciary representative of CLO investors. As intermediaries situated between a range of investors and loan syndicates, a confluence of factors make the market an interesting natural laboratory to study economic questions. This paper is the second in a series of papers on the mechanics of the CLO market (Kundu (2020*a*,*b*,*c*)).

In recent years, central banks have forewarned of turmoil in the leveraged loan market. A recent report from the Financial Stability Board of the Bank of International Settlements highlights several vulnerabilities (Federal Stability Board (2019)). First, there is a concern that the degradation in the quality of loan contracts has not fully been priced. The simultaneous weakening of creditors' rights and increase in likelihood of default can reduce recovery rates and impact investors beyond measure. Second, there is concentration of leveraged loans and CLOs among a finite number of large banks, exposing them to several types of risk, including pipeline risk, warehousing risk, and credit risk. Unanticipated shocks affecting these risks can impinge upon banks' ability to perform other functions of financial services. Third, non-bank investors, including insurance companies, private equity, private capital investors, open-ended funds, and hedge funds constitute large buyers of CLOs and leveraged loans and are a source of long-term capital, hence, any episodes of distress for either these institutions, or, leveraged loan or CLO markets may spillover in the opposite direction. Lastly, in assessing vulnerabilities, the FSB notes that there is a paucity of work that investigates the relation between CLOs and banks, and assesses "systemic implications" of risks manifesting from connections.

In this paper, I focus on CLO managerial behavior, as prescribed by covenants, as a conduit for studying these risks in the leveraged loan market. Evidence from the Great Financial Crisis would suggest that unlike their CDO and CBO counterparts, CLOs are resilient, as they emerged from the crisis as unscathed survivors. This is commonly attributed to the underlying assets being corporate loans rather than residential mortgages. However, I argue that the perceived safety of the CLO market is a result of active management, informed, in part, by quality and coverage covenants that managers must comply with on a regular basis. Moreover, CLO markets are perceived to be impervious to fire sale risk, as long-term capital is locked-in for the duration the CLO is in operation, providing a stable source of macroeconomic investment (Kundu (2020*a*)). I introduce a new channel through which fire sale risk can transpire. I argue that covenants can force CLO managers to make perverse trading decisions with widespread consequences. I focus my analysis to a relatively benign macroeconomic period between 2009 and 2018, to show that latent sources of risk can have pernicious effects even during favorable conditions.

Quality and coverage covenants serve as checks against managerial risk-shifting behavior and reduce the possibility of "tranche warfare." There are eight covenants that are considered in this study: Weighted Average Spread, Weighted Average Rating Factor, Weighted Average Life, Interest Diversion, Junior Overcollateralization (Junior OC), Senior Overcollateralization (Senior OC), Junior Interest Coverage (Junior IC), and Senior Interest Coverage (Senior IC). The former three quality covenants ensure that CLOs are sufficiently diversified and have limited exposure to various qualitative dimensions of risk. The latter five coverage covenants ensure that CLOs have adequate liquidity and capital to finance their obligations. Regulatory bodies have limited supervisory authority to directly address the risks originating from CLOs.[1] I consider potential contract changes, and discuss the tradeoffs in adoption in Section 5.3.

I begin by developing a model that captures the problem of CLO managers. The model integrates elements from DeMarzo (2005), Vayanos and Vila (2019), and Bolton, Chen and Wang (2011). First, I explain that covenants arise to ensure that senior debt claims are virtually risk-free in securitization. Second, I show that these covenants make CLO managers *preferred-habitat* investors, subject to unique shocks that alter their demand. These shocks can transmit to asset prices via a market clearing condition, generating price pressure. Third, I show that the endogenous spread can affect a firm's optimal default policy. This model explains the empirical findings in this paper, as well as Kundu (2020*c*), and, provides a framework for assessing tradeoffs in considering structural modifications of covenants.

There is suggestive evidence that CLO managers engage in both selection and moni-

[1]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 which invest in newly issued loans.

toring of leveraged loans; the composition in the issuance of leveraged loans differs from the composition of CLO portfolios, and, the default rate of CLOs is significantly lower than the default rate of leveraged loans. This motivates my initial study of CLO manager behavior with regard to distressed loans. A loan is "distressed" if it is issued by a firm that files for Chapter 11 bankruptcy at some point during the sample period. I show that active management may generate price pressure around bankruptcy defaults when constrained managers are forced to sell distressed loans that put them near the covenant edge in the secondary loan market, in order to generate more slack in their capital and liquidity constraints. When a large cross section of managers become constrained, this can generate fire sale risk.

The main findings in this paper relate to price patterns. I show that there is price pressure around bankruptcy default events. The cumulative average abnormal returns (CAAR) declines to -13.53% one month after default, and reverts back to -0.46% twelve months after default. The fall and subsequent reversal in the trajectory of prices is explained by covenant-induced price pressure. Trading based on capital constraints can result in trades at fire sale prices, followed by subsequent positive abnormal returns that compensate liquidity providers. This is largely because CLOs are subject to cash-in-the-market pricing; distressed loans are mark-to-market or fair value.

Specifically, I exploit variation in the distance to various covenant constraints and find that there is heterogeneity in the CAAR based on capital constraints; price pressure is evident for CLOs that are relatively more constrained. Loans which belong to CLOs that are relatively capital-constrained experience a CAAR of -4.09% as compared to -0.79% for loans belonging to CLOs that are relatively capital-unconstrained at the trough.[2] In addition, I find that loans of longer maturities or loans of higher ratings experience deeper troughs as compared to loans of shorter maturities or lower ratings. These patterns hold for other events as well, including missed interest and principal payments, which are common precursors of downgrades and other adverse credit events. Lastly, I investigate whether CLO managers create price press or respond to it. I find that second-lien loans, which constitute a small share of a CLO's portfolio, do not exhibit the aforementioned patterns. Therefore, I attribute the price impact to CLO managerial behavior.

To further investigate the origins of price pressure, I examine the trading volume and consider its relation to the distance to covenant constraint. The trading volume mirrors the price patterns. I find that CLO managers actively divest themselves of loans issued by distressed firms, prior to Chapter 11 filing, despite a virtually, full recovery in prices. Twelve months before bankruptcy, a CLO manager sells a distressed issuer's loans at approximately twice the intensity of purchases in an average month. One month before bankruptcy, a manager sells at approximately four times the intensity of purchases in an average month. These sales are driven by capital and liquidity covenants. A one standard deviation increase in the distance to the capital covenant measures is associated with a 3-3.8% decline in the probability

[2] In conducting comparisons between groups, I compute the average abnormal returns (AAR) on a quarterly basis to ensure that the number of events remains sufficiently large. The quarterly AARs are likely to be smaller than monthly AARs, by averaging across a longer time horizon and reducing the influence of egregiously abnormal trades during particular episodes.

that a firm sells risky loans. A one standard deviation increase in the distance to the most stringent liquidity covenant is associated with a 1.71% decline in the share of risky loans. Hence, the quantity of risky loans varies significantly with covenant constraints, corroborating the price patterns discussed above. Further, I study how a CLO's size is related to the stringency of covenants as well as the equity distribution. I find that a CLO's size increases in the *threshold* of the covenant constraints. Equity distributions increase in the distance to the liquidity triggers.

This paper contributes to the extant literature, by introducing a new source of fire sale risk: covenants. Given that CLOs purchase bank loans, banks purchase CLO notes, shadow banking institutions directly purchase both loans and CLO notes, understanding possible mechanisms of spillover is paramount for unearthing latent sources of amplification and transmission. The study of covenants is critical for understanding if they fulfill their purported purposes, how they can impose externalities through asset prices (Kundu (2020*c*)), and inform discussion on contingent financial contracts. As the very structure of CLOs is opaque and involves convoluted links of intermediation, this work suggests that covenants may be a source of financial friction and amplification across chains of interconnected institutions. Specifically, forced sales by CLOs, originating from proximity to covenant constraints, can push other institutions who hold the affected debt closer to their constraints, precipitating additional forced sales and exacerbating volatility. This can create spirals and cascades of asset prices, fire sales, and firm distress, making risk systemic.

This paper contributes to the longstanding literature on why prices deviate from their fundamental value, including Shleifer and Vishny (1992), Scholes (1972), Fama (1970), as well as research on forced asset sales (e.g., Pulvino (1998), Coval and Stafford (2007); Mitchell, Pedersen and Pulvino (2007); Campbell, Giglio and Pathak (2011)). The main distinction from past work is that this paper shows that demand shocks, originating from CLO managerial covenants, may transmit to asset prices. Moreover, this work suggests that price pressure may be a mechanical outcome of managers conforming to their indentures. That is, selling riskier assets that are mark-to-market can generate slack in the constraints. This can explain the limited impairment of senior secured loans in the long-term and nearly full recovery to pre-distressed prices. Both the origin of fire sale risk, as well as potential impact are novel findings.

Broadly, this paper also has a specific contribution on the meager literature base at the intersection of asset prices and optimal compensation contracts. I show how managerial actions, driven by compensation contracts can affect asset prices. With the exception of Buffa, Vayanos and Woolley (2019) and Cvitanić and Xing (2017), most of the theoretical literature has fixed optimal contracts and found equilibrium asset prices, or fixed asset prices and found optimal contracts. This paper demonstrates the interaction between contracts and asset prices, providing direct evidence of how different degrees of constraint can produce heterogeneous effects on equilibrium asset prices.

In addition, this work is related to the active literature base on intermediary asset pricing, standing in contrast to the classical approaches of asset pricing in which intermediaries are insignificant. CLO intermediaries have a central role in determining asset prices in the relatively illiquid, leveraged loan market, as well as real economic outcomes to firms even during benign macroeconomic periods.The latter is shown in Kundu (2020*c*) This makes CLO intermediaries significant – not merely a "veil" through which the marginal representative investor determines asset prices (He and Krishnamurthy (2013)). The results in this paper are consistent with the strand of the theoretical intermediary asset pricing literature, in which intermediaries face constraints that affect their risk-bearing capacity.[3]

Lastly, this paper builds on nascent research on the CLO market, which has focused on the role of securitization in credit markets. CLOs facilitate the extension of credit in the overall economy through more borrower-friendly loan contracts, characterized by lower spreads, and weaker and standardized covenants (e.g., Ivashina and Sun (2011); Shivdasani and Wang (2011); Nadauld and Weisbach (2012); Becker and Ivashina (2016); Bozanic, Loumioti and Vasvari (2018); Ivashina and Vallee (2019))). The existing literature has shown that structural aspects of securitization have fueled an increase in credit alongside a degradation in contractual terms, with unclear ramifications regarding risk. In contrast to the existing literature, which has focused on the *structure* of CLOs as securitized instruments of debt, I focus on the *subject* of CLOs – the manager. Cordell, Roberts and Schwert (2020) and Loumioti and Vasvari (2019) also study the role of managers with regard to CLO performance. In this paper, I document the role of CLO managers in amplifying risk through of contractual obligations, set ex-ante by investors.

The closest paper to this work is independent work produced by Elkamhi and Nozawa (2020). They how adverse shocks affect CLO leverage by simulating different stress scenarios on the aggregate CLO market. In addition, they study if constrained CLOs pose fire sale risk, and analyze the causes and consequences of such risks. The second aim of their paper overlaps with some of the findings of this work. Both papers find that the magnitude of price impact is of comparable magnitude for different default events.[4] However, there are several noteworthy differences. First, I document several facts pertaining to managerial behavior, taking an agnostic approach to the underlying drivers thereof. Second, I provide a theoretical framework that proffers several predictions and explains the findings reported in this paper. Moreover, the model allows for examination of how outcomes may vary with modifications. Third, I dispel several competing hypotheses to show that *both* liquidity and capital covenants affect trading behavior of CLO managers, and study the consequences thereof. In contrast, Elkamhi and Nozawa (2020) focus on the OC ratio and interpret this as a stress test. This lends credence to consideration of alternative stress scenarios and their impact on the OC constraint – to study how the finding on the magnitude of price impact can amplify under more widespread shocks.

The roadmap for the paper is as follows. I provide a brief overview of the institutional

[3] These include: He and Krishnamurthy (2012); He, Kelly and Manela (2017). This paper contributes to the empirical literature, joining Froot and O'Connell (1999); Adrian, Etula and Muir (2014); Ivashina, Scharfstein and Stein (2015); Koijen and Yogo (2015); Du, Tepper and Verdelhan (2018); Du, Hébert and Huber (2019); Boyarchenko, Fuster and Lucca (2019) among others.

[4] Elkamhi and Nozawa (2020) find that the CAR based on the Junior OC result is -4.6% at the downgrade event, aggregating at the weekly level. I find that the CAAR based on the Interest Diversion result is -4.09% at bankruptcy default, aggregating at the quarterly level.

setting in Section 2. The model is presented in Section 3. Data sources used in this study are described in Section 4. The main results on price pressure and fire sale risk are in Section 5. I explore the underlying motives behind these price patterns in Section 6. Lastly, I conclude in Section 7.

2 Collateral and Covenants

In this section, I provide a condensed summary of covenants. For a comprehensive discussion of contracts, and the CLO market more broadly, I refer readers to Kundu (2020*a*).

CLOs are tranched financial instruments with two classes of tranches: debt and equity tranches. Debt tranches are senior to equity tranches. The debt tranches are paid a fixed spread above LIBOR based on seniority; higher-rated debt tranches have lower risk and pay out lower returns relative to lower-rated tranches which have higher risk and higher returns. The remaining *excess spread* – remaining proceeds after proceeds from the underlying pool of assets are distributed towards debt tranches – are allocated between the CLO manager and the equity class. Naturally, this generates an agency friction; the manager is incentivized to maximize the excess spread – where the management fees are created. A manager's compensation consists of a fixed fee and subordinated fees that are proportional to the residual interest available to the equity class, hence, compensation is like a European call option where the strike price is the face value of debt. This payoff structure can introduce gratuitous risk to CLO investors, providing the impetus for the implementation of covenants.

Covenants ensure that there is a specific level of coverage and subordination relative to the covenant triggers for each tranche. Covenants serve as course correction. If triggered, they may divert proceeds from junior tranches towards paying down liabilities in order of seniority, or towards the purchase of value-increasing collateral. Diversion is punitive for the manager who may suffer pecuniary losses, as well as social capital losses, with regard to career prospects and reputation. There are two types of covenants: quality covenants and coverage covenants. Quality covenants are maintain-or-improve constraints which do not directly prescribe any action on the manager in event that they are triggered. The Weighted Average Spread, Weighted Average Life, and Weighted Average Rating Factor, are quality covenants which stipulate that the underlying collateral must have sufficient interest proceeds to pay interest on rated notes and equity, is amortizing (limiting portfolios with high WAL exposed to downturn and default), and the average loan rating of the portfolio is above the specified threshold. Next, I will describe the coverage covenants.

I focus on three types of coverage covenants: Overcollateralization (OC) covenants, Interest Diversion (ID) covenants, and Interest Coverage (IC) covenants.

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

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

The OC and ID covenants are *capital constraints* which are measured similarly; the ID covenant has a lower threshold than any of the OC covenants, and, if it is breached, proceeds are diverted towards the purchase of high-quality, value-increasing loans rather than paying down liabilities in order of seniority. The IC covenants are *liquidity constraints* which ensure that there is a specific level of coverage for interest due on tranches relative to the triggers.

Of noteworthy mention, is the *cliff effect*. For the most part, CLOs are immune from market volatility as assets are typically marked at par value. However, if an asset experiences default, downgrades to CCC/Caa1 or below, putting the CLO beyond its CCC/Caa1 concentration limit, or, is a discount obligation, the asset will be marked to the lower of market value or recovery value, market value, or purchase price, respectively. Mark-to-market accounting can impair a manager's ability to administer their portfolios, unimpeded.

3 Model

In the model, I develop a framework that captures the problem of CLO managers, integrating modeling techniques from Vayanos and Vila (2019) and Bolton, Chen and Wang (2011). The model has three main objectives. First, I explain the origin of covenants, referring to DeMarzo (2005). Second, I show that covenants can generate price pressure and trigger fire sales in the leveraged loan market. Lastly, I connect price pressure of loans to the affected issuers' default policy.

3.1 Model in a nutshell

I begin by referring to the model of DeMarzo (2005) to explain the origin of covenants. It has been shown that intermediaries can raise additional capital when securitization is possible. However, I argue that covenants are necessary to ensure that senior claims are managed appropriately and carry little risk, while the CLO is in operation – not just at conception. The presence of covenants allows the intermediary to raise additional capital (Predictions 1, 2, 3). Moreover, CLO-specific covenants make CLO managers preferred-habitat investors, subject to unique demand shocks – in contrast to risk-averse arbitrageurs, per Vayanos and Vila (2019). If preferred-habitat investors experience shocks that alter their demand, the shocks will transmit to asset prices via a market clearing condition (Predictions 4, 5). Further, by assuming that banks are pass-through intermediaries, and, that CLO managers do not differentiate between primary and secondary issuance, I show that the endogenous spread can affect issuing firms' optimal investment and financing decisions using the set-up of Bolton, Chen and Wang (2011), in which the firm's optimal policy is contingent on a "double-barrier policy" using the firm's cash-capital ratio. Experiencing pressure price can affect an issuer's default policy, and the decision to file for bankruptcy (Prediction 6).

3.2 Description of the Model

3.3 Origin of covenants

It has been shown that the size of an informed intermediary (CLO) will be larger when pooling and tranching of securities is possible than when assets are sold as purchased – the amount of cash that is raised increases in the quality of the asset pool. DeMarzo (2005) shows that with pooling and tranching, when residual risk is fully diversifiable, senior tranches are virtually riskless, making them attractive investments. However, in the absence of supervision over the life of a securitization, I posit that there may be deterioration in the quality of the asset pool and risk may no longer be diversifiable post-acquisition.[5] Hence, supervisory-linked covenants provide a mechanism of ensuring that after acquisition, senior tranches remain riskless. There are two key insights I extrapolate to the CLO setting from DeMarzo (2005). First, the intermediary can raise more capital by pooling and tranching than outright reselling of the assets. Second, the presence of covenants allow the intermediary to raise additional capital by mitigating agency frictions (1, 2).

Covenants provide a mechanism for ensuring that the associated portfolio satisfies quality and coverage restrictions. Covenants are associated with triggers to supervisory actions and thresholds, thereby ensuring that managers appropriately manage risk with options for recourse. With many covenants, a consequence of triggering a threshold is early amortization. This can accelerate repayment to investors, cut off manager fees and equity distribution, and hurt the reputation of the CLO manager. However, the presence of these covenants can also provide investors with protection from prolonged exposure to a risky pool of assets[6]. Covenants are significant in facilitating the provision of credit. In the absence of covenants, if defaults are realized and senior tranches bear losses, demand for the putative riskless tranches will shrink, reducing the aggregate amount of credit extended by the intermediary. The presence of covenants ensure that senior claims are virtually riskless, thereby, allowing the intermediary to raise more capital.

[5]Managers may also deliberately risk-shift. Given that managers are residual claimants of the equity tranche, it is in their personal interest to maximize the equity value. In this case, the intermediary may risk-shift. To investors, trades according to effort provision and assessing critical values is indistinguishable from risk-shifting trades. Hence, with risk-shifting trades, the assumption that residual risk is fully diversifiable may not be plausible even in large pools, and, consequently, the issued debt tranches may not be risk-free. More details of this are provided in Kundu (2020*a*).

[6]Covenant restrictions are a general equilibrium outcome that is determined jointly by CLOs and investors. Covenants are imposed ex-ante by investors, and may partially reflect their own risk-taking capacity. In the absence of any covenant that forces divestiture, a manager may hold onto risky loans, increasing the total amount of risk-based capital, lowering banks' capital ratios under Section 939A of Dodd-Frank and Basel regulatory frameworks, as discussed in Sections 4.2-4.4 of Kundu (2020*a*). If banks are pushed closer to their capital constraints, it may have pernicious effects on loan origination and securitization, and by extension, credit in the economy. Hence, this provides another explanation for how covenants serve to protect investors and their claims.

These covenants are an important component of the investors' problem, described below. Covenants are supervisory instruments unique to the liability structure of CLOs. Given these features, CLOs behave as *preferred-habitat* investors with demand for leveraged loans of specific characteristics, as stipulated by the covenants they are bound by – unlike the arbitrageurs which are other prospective purchasers of leveraged loans.

3.4 Investors' Problem

Suppose that are two types of agents in an economy, preferred-habitat investors (CLOs) and arbitrageurs (e.g., hedge funds, pension funds, etc.). Preferred-habitat investors are investors with very limited risk-taking capacity. They have demand for leveraged loans of specific characteristics. In this model, *Safe* captures the quality of the loan. In this model, how safe a loan is, is denoted by s. Arbitrageurs, on the other hand, are risk-averse mean-variance optimizers in the economy who are relatively unconstrained and have greater risk-taking capacity in comparison to preferred-habitat investors. r_t denotes an exogenous short rate in an economy.

The wealth position of an arbitrageur at time t is denoted by W_t. The dollar position of an arbitrageur in a representative leveraged loan of safety s is $X_t^s ds$ where $s \in (0, S)$. The budget constraint of an arbitrageur is:

$$dW_t = (W_t - \int_0^S X_t^s ds) r_t dt + \int_0^S X_t^s \frac{dP_t^s}{P_t^s} \tag{3}$$

where P represents the price of the leveraged loan

Arbitrageurs' optimization problem maximizes a mean-variance objective over dW_t:

$$\max_{\{X_t^s\}_{s\in(0,\infty)}} [\mathbb{E}_t(dW_t) - \frac{a}{2} Var(dW_t)] \tag{4}$$

where $a \geq 0$ is the risk-aversion coefficient.

Preferred-habitat investors have demand of the following form:

$$Z_t^s = -\alpha(s) \log(P_t^s) - \beta_t^s \tag{5}$$

where $\alpha(s) \geq 0$ is dependent on the safety of the loan, but time-invariant and represents the *demand slope*. β_t^s is time-varying and represents the *demand intercept*. The demand intercept is defined as follows:

$$\beta_t^s = \theta_0(s) + \sum_{k=1}^{K} \theta_k(s) \beta_{k,t} \tag{6}$$

where $\{\beta_{k,t}\}_{k=1,\ldots,K}$ are time-varying demand risk factors that preferred-habitat investors care about. Note that $\{\beta_{k,t}\}_{k=1,\ldots,K}$ is independent of s. $\{\theta_k(s)\}_{k=1,\ldots,K}$ are functions that specify the safety levels from which demand changes originate.

Covenants limit the actions CLO managers can take, ensure appropriate supervision, and stipulate actions in event of triggers. The covenants directly affect demand risk-factors $\{\beta_{k,t}\}_{k=1,...,K}$, which in turn, affect managers' demand and capacity to take on riskier loans, and may induce price pressure. Each covenant is intended to capture a different dimension of risk in a CLO's portfolio. Hence, this is modeled as K demand risk-factors.

Let $q_t \equiv (r_t, \beta_{1,t}, \dots, \beta_{K,t})$, a K+1 vector that evolves as follows:

$$dq_t = -\Gamma(q_t - \bar{r}\mathbb{E})dt + \Sigma dB_t \tag{7}$$

where $\bar{r}$ is a constant, $\mathbb{E} = [1, 0, 0, \dots, 0]^T$, and (Γ, Σ) are constant square matrices of dimension $K + 1 \times K + 1$. dB_t is the K+1 vector consisting of independent Brownian motions, i.e., $B_t = (dB_{r,t}, dB_{\beta,1,t}, \dots, dB_{\beta,K,t})^T$. Note that if Σ and Γ are non-diagonal, shocks to factors are correlated, and the the expected change in instantaneous drift of each factor depends on other factors.

3.4.1 Equilibrium

Following Vayanos and Vila (2019)'s conjecture that there exists K+2 functions $(A_r(s), \{A_{\beta,k}(s)\}, C(s))$, the price of a loan of safety s can be written as:

$$P_t^s = e^{-[A(s)^T q_t + C(s)]} \tag{8}$$

where $A(s)$ is a vector of dimension K+1, i.e., $(A_r(s), A_{\beta,1}(s), \dots, A_{\beta,K}(s))^T$, and $A_r(s)$ is the risk factor associated with the short rate, r_t The dynamics of the price process is given by Ito's Lemma and Equation 7:

$$\frac{dP_t}{P_t} = \mu_t dt - A^t \Sigma dB_t \tag{9}$$

where the instantaneous expected return, μ_t takes the following form:

$$\mu_t^s = A'(s)^T q_t + C'(s) + A(s)^T \Gamma(q_t - \bar{r}\mathbb{E}) + \frac{1}{2} A(s)^T \Sigma \Sigma^T A(s) \tag{10}$$

By substituting the price dynamics into Equation 3, the arbitrageurs' optimization problem in Equation 4 can be written as follows:

$$\max_{\{X_t^s\}_{s\in(0,\infty)}} \left\{ \int_0^\infty X_t^s(\mu_t^s - r_t)ds - \frac{a}{2}\left[\int_0^\infty X_t^s A(s)ds\right]^T \Sigma\Sigma^T \left[\int_0^\infty X_t^s A(s)ds\right] \right\} \tag{11}$$

The FOC with respect to X_t is:

$$\mu_t^s - r_t = aA(s)^T \Sigma\Sigma^T \left[\int_0^\infty X_t^s A(s)ds\right] \tag{12}$$

The LHS represents the increase in portfolio expected return if the arbitrageurs invest an additional dollar in the leveraged loan with safety s over investing at the short rate. The RHS represents the increase in portfolio risk, adjusted for risk-aversion a. This can equivalently be written as:

$$\mu_t^s - r_t = aA(s)^T\lambda_t \tag{13}$$

where λ_t represents factor prices, $\lambda_t = \Sigma\Sigma^T\Big[\int_0^\infty X_t^s A(s)ds\Big]$. Given that there are only two types of agents in the economy, for the market to clear, the position of arbitrageurs and preferred-habitat investors in the leveraged loan with safety s must be 0.

$$X_t^s + Z_t^s = 0 \tag{14}$$

Hence, by the market clearing condition, and Equations 5 and 8,

$$\lambda_t = (-\alpha(s)(A(s)^T q_t + C(s)) + \theta_0(s) + \Theta(s)q_t)A(s)ds\Big] \tag{15}$$

where Θ is a vector of dimension K+1, i.e., $(0, \theta_1(s), \ldots, \theta_K(s))$.

Substitution of the expressions for μ_t^s and λ_t from Equations 10 and 15 into 13 yields the following price condition

$$A'(s)^T q_t + C'(s) + A(s)^T\Gamma(q_t - \bar{r}\mathbb{E}) + \frac{1}{2}A(s)^T\Sigma\Sigma^T A(s) - r_t \tag{16}$$

$$= aA(s)^T\Sigma\Sigma^T\Big[\int_0^\infty (\theta_0(s) + \Theta(s)q_t - \alpha(s)(A(s)^T q_t + C(s)))A(s)ds\Big] \tag{17}$$

Let P^* denote the equilibrium price from.

3.5 Firm's Problem

In this section, I describe the firm's optimal value-capital ratio, optimal dynamic investment and financing policies using the framework of Bolton, Chen and Wang (2011).

The firm uses physical capital for production. The price of capital is unity. Let K and I denote the level of capital stock and gross investment respectively.

Capital stock follows a dynamic process:

$$dK_t = (I_t - \delta K_t)dt. \tag{18}$$

where δ is the rate of depreciation. A firm's operating revenue at time t is given by $K_t dA_t$ where dA_t is a risk-adjusted productivity shock that evolves according to:

$$dA_t = \mu_A dt + \sigma_A dZ_t. \tag{19}$$

The firm's cash flow from operations over time increment dt evolves according to:

$$dY_t = K_t dA_t - I_t dt - G(I_t, K_t)dt. \tag{20}$$

$G(I_t, K_t)$ denotes the firm's adjustment cost incurred during investment. $G(I_t, K_t)$ is homogenous of degree 1 in I and K, so that $G(I, K) = g(i)K$ where $g(i)$ is a convex and increasing function in i. the firm's investment capital ratio, $i = \frac{I}{K}$. For simplicity, the following functional form is adopted:

$$g(i) = \frac{\theta i^2}{2}. \tag{21}$$

where θ is the degree of the adjustment cost.

It is assumed that a firm's investment opportunities are constant across time. This allows the model to highlight the dynamic implications of financing frictions in the absence of any changes in the investment opportunity set.

Let H_t denote the firm's cumulative external financing until time t, dH_t – the firm's incremental external financing over time increment dt, X_t – the cumulative cost of external financing up to time t, and dX_t – the incremental cost of raising incremental external funds H_t.

Let W_t denote a firm's cash inventory at time t. If $W_t > 0$, the probability of the firm's survival is 1. If $W = 0$, the firm will either have to raise external funds to continue operating, i.e., pay financing costs, or, file for bankruptcy if financing costs are too high. τ denotes the firm's bankruptcy time. If $\tau = \infty$, the firm will never file for bankruptcy.

In addition to the risk-free rate, r, assume that there is a carry cost γ, which captures agency costs or tax distortions associated with free cash in the firm. Assume that both the risk-free and carry cost are time invariant. $\gamma > 0$ is needed for the firm to pay out cash, otherwise the firm will keep cash in the firm, incurring no costs, while generating slack in the financial constraints. A positive carry cost implies that shareholders can invest at rate r which is higher than the net rate of return $(r - \gamma)$. The payout of cash reduces the firm's cash balance, and exposes the firm to current and future underinvestment as well as future external financing costs. If there are positive costs associated with raising external funds, the firm can reduce future costs by retaining earnings to finance future investments. This generates a tradeoff.

Let U_t denote the firm's cumulative payout to shareholders up until time t, and dU_t – the incremental payout over time interval dt. Then, the firm's cash inventory will evolve according to the following process:

$$dW_t = dY_t + (r - \gamma)W_t dt + dH_t - dU_t. \tag{22}$$

In words, the incremental change in cash flow is equal to the sum of cash flow from operations, net interest income over time interval dt, and the net cash flow from financing.

3.5.1 Firm's Optimization Problem

$$\max_{I,U,H,\tau} E\Big[\int_0^\tau e^{-rt}(dU_t - dH_t - dX_t) + e^{-r\tau}(bK_t + W_t)\Big] \tag{23}$$

where b denotes the value of the firm if the firm files for Chapter 11 bankruptcy.

Let $P(K, W)$ denote the firm value. The firm's maximization problem in the interior region of W where $dU_t = 0$, $dH_t = 0$, and $dX_t = 0$ is:

$$rP(K,W) = \max_I \Big\{(I - \delta K)P_K + [(r-\gamma)W + \mu_A K - I - G(I,K)]P_W + \frac{\sigma_A^2 K^2}{2} P_{WW}. \tag{24}$$

The two-state optimization problem can be reduced to a one-state problem in ω where $\omega = \frac{W}{K}$, the cash-capital ratio. By exploiting homogeneity of degree 1, and substituting partial derivatives for Equation 24, the following ODE can be obtained.

$$rp(\omega) = (i(\omega) - \delta)(p(\omega) - \omega p'(\omega)) + ((r-\gamma)\omega + \mu_A - i(\omega) - g(i(\omega)))p'(\omega) + \frac{\sigma_A^2}{2} p''(\omega) \tag{25}$$

3.5.2 Firm is financially constrained

If the firm's cash-capital ratio, ω, is below a threshold $\underline{\omega}$, the firm will incur financing costs to raise new funds or file for bankruptcy.

In the absence of any financing costs, in a Modigliani-Miller world, the firm will not want to prematurely file for bankruptcy as production is efficient and cash can be stored internally without bearing any cost while loosening financial constraints. With financing costs, as internal cash earns below-market return, there is value to externally financing.

Next, I will define $\underline{\omega}$. Investment is smooth because of convex adjustment costs, hence, the firm can pay for any level of investment as long as $\omega > 0$. For this reason, it is always better to defer external financing as long as possible. Therefore, a firm will always prefer using cash and then seeking external options only when cash runs out. Hence, the optimal bankruptcy boundary is $\underline{\omega} = 0$

The firm value upon filing for bankruptcy is:

$$p(0)K = bK \Rightarrow p(0) = b. \tag{26}$$

To raise external financing, there is a fixed issuance cost S, and variable cost $s(P^*)$. The variable cost $s(P^*)$ is the spread associated with each loan – an inverse function of the price of the loan.

Because firm value is continuous pre and post obtaining external financing, the following condition must hold at the boundary:

$$\max_m p(0) = p(m) - S - (1 + s(P^*)). \tag{27}$$

m is optimally chosen, so that the last dollar raised is equivalent to the marginal cost of external financing, i.e.,

$$p'(m^*) = 1 + s(P^*) \tag{28}$$

When $\omega = 0$, the firm's value is:

$$V = \max \Big\{bK, (p(m^*) - S - (1 + s(P^*))m^*)K\Big\}. \tag{29}$$

The firm will decide to either seek external financing or file for bankruptcy to maximize the value of the firm.

$$Decision = \begin{cases} \text{Externally finance if } V = (p(m^*) - S - (1 + s(P^*))m^*)K \\ \text{File for bankruptcy if } V = bK \end{cases} \tag{30}$$

Coupling this with our results from the investors' problem, I now consider the dynamic implications of this.

3.6 Dynamic Implications

Consider the following sequence of events. The price of a representative loan issued by a firm is P^*. The issuer misses an interest payment on the loan and is in distress. The CLO manager who is holding on to the loan will be closer to her covenant constraints. Given this shock to the CLO manager, who has limited risk-taking capacity, her demand for the affected loans will decrease. Consequently, the price of a firm's debt will fall from P^* to P^{**}, and the corresponding spread will increase, i.e., $s(P^{**}) > s(P^*)$. The CLO manager's trading actions occur in the secondary market, and financing occurs in the primary market. The CLO manager, however, is a large, active purchaser in both markets and therefore has undifferentiated demand between an issuer's primary and secondary issuance. Suppose the firm was an ex-ante marginal firm, indifferent between filing for bankruptcy and raising external financing. That is,

$$p(m^*) - S - (1 + s(P^*))m^*)K = bK. \tag{31}$$

Proposition 3.1. *A marginal firm indifferent between seeking external financing and filing for bankruptcy will file for bankruptcy if the spread increases.*

Proof. Let m^{**} represent the optimal amount of external financing per Equation 27. The value of the firm if the firm seeks external financing is given by Equation 30. For the firm to file for bankruptcy, the following inequality must be satisfied:

$$p(m^{**}) - S - (1 + s(p^{**}))m^{**})K <= p(m^*) - S - (1 + s(P^*))m^*)K. \tag{32}$$

According to Equation 28,

$$p'(m^*) =< p'(m^{**}). \tag{33}$$

By concavity, $m^{**} < m^*$

The line tangent to the point $p(m^*)$, $p^T(m)$ for any m is of the form:

$$p^T(m) = p(m^*) + p'(m^*)(m - m^*) \tag{34}$$

Because $m^{**} < m^*$ and $p(m)$ is a concave function, the following holds:

$$p(m^{**}) <= p(m^*) + p'(m^*)(m^{**} - m^*) \tag{35}$$
$$p(m^{**}) - p(m^*) <= p'(m^*)m^{**} - p'(m^*)m^*. \tag{36}$$

Appealing to Equation 33, and substituting for the marginal cost of financing from Equation 28 yields:

$$p(m^{**}) - p(m^*) <= p'(m^{**})m^{**} - p'(m^*)m^*) \tag{37}$$
$$p(m^{**}) - S - (1 + s(p^{**}))m^{**})K <= p(m^*) - S - (1 + s(P^*))m^*)K. \tag{38}$$

If there is price pressure in the secondary loan market due to unanticipated demand shocks experienced by CLO managers, the spread will increase. This will induce marginal firms to file for bankruptcy.

3.7 Predictions

The discussion and model of Section 3.2 proffers several predictions, enumerated below.

1. **Prediction #1:** CLO size increases in the stringency of covenant constraints
2. **Prediction #2:** Equity distributions increase in the performance of covenant constraints
3. **Prediction #3:** Share of risky assets decreases in the performance of covenant constraints
4. **Prediction #4:** Price impact decreases in the performance of covenant constraints
5. **Prediction #5:** Price impact increases in the scarcity of potential buyers' capital, i.e., lower arbitrageur demand
6. **Prediction #6:** Firms which experience downward price pressure are more likely to file for bankruptcy

In this paper, I provide empirical tests of Predictions 1, 2, 3 and 4. Empirical tests of Prediction 6 are provided in Kundu (2020*c*). Kundu (2020*c*) studies how diffuse idiosyncratic shocks can snowball into systemic rick as distress propagates to portfolio firms through CLO intermediaries.

There are methodological challenges in implementing an empirical test of Prediction 5. Using data from Lipper Hedge Fund Database (TASS) and Thomson Reuters Lipper U.S. Mutual Funds, I find that the aggregated amount of potential buyers' capital increases over the sample period.[7] Hence, a regression of the price impact on buyers' potential capital cannot disentangle the effect of the time trend from the effect of the change in the supply of capital. A

[7]Potential buyers include bankruptcy-focused hedge funds, distressed markets hedge funds, private equity hedge funds, alternative event driven mutual funds, corporate debt funds BBB-rated, and loan participation Funds

cross-sectional test relating potential buyers' capital to price pressure by comparing different types of funds, e.g., industry-specific funds, may inform the estimated relation between the two variables. However, the limited number of distinct funds that constitute potential buyers, as well as the lack of variation in the composition of CLO assets, namely, by maturity and rating, suggest that the statistical power of the test is limited. With supplementary data on lapsed payments from CLOs, structural estimation techniques à la Koijen and Yogo (2019) may be used to study more broadly, how the degree of price pressure varies with the elasticity of arbitrageurs demand upon experiencing an exogenous shock. This provides an avenue of future work.

4 Data and Motivation

4.1 Data

The primary data source for this project is the *CreditFlux CLO-i Database*. The database utilizes data from over 35,000 trustee reports, prospectuses, and covers over 1,200 CLOs in the US. It contains information on transactions, holdings, test results, tranches and equity distributions. In terms of coverage, in 2019, the CLO-i database covered 67-76% of the entire CLO market (Kundu (2020*a*)). Past research that has used the CLO-i database has cited coverage to be between 46-65% of the market (Benmelech, Dlugosz and Ivashina (2012)). In this paper, the sample period of interest starts in 2009 and ends in 2018.

As shown in Table 1 of Kundu (2020*a*), over this period, the median size of a CLO is \$427 million, with a standard deviation of \$218 million. The median Moody's Weighted Average Rating Factor is 2,853, which suggests that the pool of assets is rated in the B2-B3 range. The median annual equity distribution is 16.625%. The loans of a leveraged loan issuer are distributed across a median value of 78 CLOs. Across all CLOs, the median par value of an issuer's loans total to \$105 million. The median size of a trade is $\sim$ \$250 million. The median transaction trades at par.

I gather data on defaults from the UCLA-LoPucki Bankruptcy Database and Moody's Default & Recovery Database. The UCLA-LoPucki Bankruptcy Database provides detailed data on all large, public companies that have filed for bankruptcy since October 1, 1979. A company is considered to be "public" if it filed an Annual Report with the SEC within the last three years of filing for bankruptcy. A company is considered "large" if the Annual Report listed total assets to be at least \$100 million (in 1980 dollars). In contrast, the Moody's Default & Recovery Database does not have any stipulations on the size and status of a company. It provides comprehensive data on defaults, ratings, recoveries, and detailed information on debt, as far back as the 1920s. Moody's Default & Recovery Database segments defaults by the type of default. My primary focus is on on Chapter 11 bankruptcies. An ancillary consideration in this study is whether the effects are robust to "intermediate" default events including missed interest and principal payments, sourced from the Moody's database. In total, there are 400 borrowers who file for Chapter 11 bankruptcy in the CLO portfolios at some point in the sample period. There are 72 borrowers who missed an interest or principal payment at some point in the sample period. Additionally, in the absence of information on bankruptcy outcomes, or dates of filing, I consult additional resources on bankruptcy data, including S&P's Leveraged Commentary and Data's List of Leveraged Loan Defaults.

I use data on private equity firms to investigate whether the divestment of loans issued by distressed firms is unique to "sophisticated" CLO managers who are affiliated with private equity firms. The two countervailing hypotheses are that: (1) managers affiliated with PE firms hold onto loans because they can better maneuver bankruptcy, and, (2) managers affiliated with PE firms sell loans more aggressively because they have private information. The data on private equity firms comes from *Private Equity International*'s List of 300 Private Equity International Firms, and the frequently updated, crowd-sourced encyclopedia page titled *List of private equity firms* from Wikipedia.

To study price pressure in the CLO market, I model the change in fundamental value using the following data series: (1) 5-Year Treasury Constant Maturity Rate, (2) Barclay's Corporate IG Index Return, (3) Barclay's Corporate HY Index Return, (4) S&P 500 Index Return, (5) S&P/LSTA Leveraged Loan Index Return, (6) Analyst forecasted earnings. Data series 1-5 are available through the Bloomberg Terminal. Data series 6 is obtained from the Thomson Reuters Institutional Brokers' Estimate System Analyst Forecasted Earnings via Wharton Research Data Services.

To rule out competing hypotheses, I integrate other datasets. To dispel the hypothesis that new information is responsible for price changes, I examine whether there are informational spillovers in the stock market from trades in the loan market through an event study framework. For this, CRSP daily data is used in the Event Study by WRDS service. I also use S&P's Capital IQ Capital Structure data to study dynamics in debt structure, for better understanding how bankruptcy affects firm organization.

The lack of issuer identification in the CLO-i database necessitates hand-matching of the data. Punctuation, case sensitivity, abbreviations, and inconsistent syntax, and conflation of subsidiaries/holding companies in reporting are some of the issues which hinder merging mechanically. Hence, I have generated crosswalks between the CLO-i datasets and other databases.

4.2 Motivation: Evidence of Screening and Monitoring

CLO managers are not passive buyers. They actively screen their investments. Figure 1 shows two dimensions through which CLO managers screen their portfolios: industry and lien. Discrepancies between the CLO distribution of loans at issuance, and the leveraged loan market, suggest that managers do not make indiscriminate purchases of leveraged loans. The top 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 industry distribution of leveraged loan issuance.[8] The bottom figure shows that CLO managers

[8]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, informing expectations on future performance.

typically hold onto a smaller share of second-lien loans relative to issuance.

CLO managers also monitor the quality of their investments. Figure 2 indicates that the trailing twelve month default rate among leveraged loans was 1.75% at the end of 2018, as compared to 2.4% at the end of 2017, based on Thomson Reuters' estimates. S&P places a higher estimate of the default rate for leveraged loans, ranging from 2.77% to 3.26% from 2015 through 2018. Regardless of the exact percentage, CLOs have reported a significantly lower default rate as compared to leveraged loans. The bottom figure in Figure 2 shows that among post-crisis vintage CLOs, 86% reported no defaulted assets in their portfolio, and 10% had 1-2% of principal in default at the end of 2018. This informs that CLO managers take actions to reduce the risk of their portfolios.

To further explore the difference in default rates, I calculate the median projected default rate of CLO. The projected default rate is calculated under the assumption that CLOs are unable to make any trades from the closing date until maturity. The median projected default rates are reported in Table 1. The projected default rate often exceeds the realized default rate on leveraged loans, and *far* exceeds the realized default rate of CLOs in every year (see Figure 10 of Kundu (2020*a*)). This suggests that managers may make ex-ante riskier bets, and sell out of risky positions before the positions bear losses. This behavior may be explained by managerial incentives. When managers create CLOs, they focus on the equity tranche, because that is where the management fee is created. While the CLO is in operation, managers adjust their portfolio in response to covenant constraints. The covenants are intended to check against the deterioration in quality of asset pools and risk-shifting behavior, and may force divestitures of riskier loans.

5 Price Patterns

In this section, I investigate the *price* patterns of distressed loans around bankruptcy. In Figure 3, I present the price of loans issued by distressed firms around bankruptcy. To construct this figure, I plot the kernel-weighted local polynomial of the median price of an issuer's loans for each day surrounding default. The figure shows that there is a precipitous drop in the price around bankruptcy, when the price of a loan falls to 70 cents on the dollar. However, there is nearly full recovery, as the price rebounds to its pre-distressed price. I confirm that this pattern withstands additional testing. To verify that the pattern holds within issuer, I absorb issuer fixed effects, and plot the residual price in Figure A.1.

5.1 Empirical Methodology

I analyze these patterns in a more rigorous framework. Applying the framework in Ellul, Jotikasthira and Lundblad (2011), the observed trade price, $P_{i,t}$ of loan i on date t is a function of the $E_t(V_i)$, $Q_{i,t}$, and $A_{i,t}$ which denote the fundamental value, purchase indicator (-1 for sale), and half spread (spread around the fundamental loan value), respectively.

$$P_{i,t} = (1 + A_{i,t}Q_{i,t}) \times E_t(V_i) \tag{39}$$

$$ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx (A_{i,t}Q_{i,t} - A_{i,t-1}Q_{i,t-1}) + ln(\frac{E_t(V_i)}{E_{t-1}(V_i)}) \tag{40}$$

$$A_{i,t} = \gamma_0 + \gamma_1 ln(S_{i,t}) + \eta_{i,t} \tag{41}$$

$A_{i,t}$, the half-spread is a function of the trade size, $S_{i,t}$ where $E(\eta_{i,t}) = 0$.

Abnormal returns are measured using a simple market model. Given the similarities between loans and bonds, à la Merton (1974) and Ellul, Jotikasthira and Lundblad (2011), I specify the change in fundamental value as Z, a function of the following: (1) 5-Year Treasury Constant Maturity Rate (match duration of average leveraged loan), (2) Barclay's Corporate IG Index Return, (3) Barclay's Corporate HY Index Return, (4) S&P 500 Index Return, (5) S&P/LSTA Leveraged Loan Index Return, (6) Thomson Reuters Analyst Forecasted earnings. $Z_{i,t-1,t}$ denotes the vector of these components from $t-1$ to t. The change in the expected fundamental value is assumed to be a linear function of the realized change. The results are robust to alternative specifications using realized earnings or firm's stock returns in lieu of forecasted earnings, and, loan-level control variables.

$$ln(\frac{E_t(V_i)}{E_{t-1}(V_i)}) = \alpha + \beta Z_{i,t-1,t} + \nu_{i,t-1,t} \tag{42}$$

By substitution, this yields:

$$ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t} \tag{43}$$

where $E(\nu_{i,t-1,t}) = 0$ and $\epsilon_{i,t-1,t} = \nu_{i,t-1,t} + Q_{i,t}\eta_{i,t} - Q_{i,t-1}\eta_{i,t-1}$
I use this regression specification to study the cumulative average abnormal return (CAAR), similar to Coval and Stafford (2007). After controlling for both market and issuer-specific changes in fundamental value, the abnormal return, $AR_{i,t-1,t}$, reflects the liquidity component associated with price changes. For each issuer-month, I compute the monthly average abnormal return (AAR). Standard errors are computed by hand, and are described in Section A.2. I normalize the AAR in month -13 to 0. The AARs are accumulated to CAARs by month in the baseline specification.

The results show that price declines are succeeded by reversals. If information revelation informed selling behavior, the price would fall to a new level and stabilize at a lower level. The lack of "flattening" in prices suggests that trades are not driven by new information[9], and lends credence to the price pressure hypothesis – trading can result in trades at fire sale prices, followed by subsequent positive abnormal returns that compensate liquidity providers.

The baseline CAAR result is shown in Figure 4. This figure shows a steady decline in the CAAR from twelve months before default until one month after default. After the trough is reached one month after default, the CAAR increases, approaching zero, one year after the

[9]This is discussed at length in Section 6.3.1

default. The table associated with this figure reports the CAAR estimate, number of issuer-month pairs, and associated t-statistic.[10] The table indicates that the CAAR twelve months before default is -0.25%, -13.53% one month after default, and -0.46% twelve months after default. The CAAR is statistically significant for a contiguous period, starting nine months before default until one month after.

Next, I compare the CAAR across various dimensions of heterogeneity. To ensure that the number of events remains sufficiently large, I compute the AARs based on quarters. Quarterly CAARs are likely to be smaller than monthly CAARs, as taking the average across a large time horizon is likely to reduce the influence of egregiously abnormal trades during specific periods (See Figure A.4 for quarterly aggregation). Hence, the quarterly CAAR estimates may be interpreted as a lower bound for the CAAR in any given period.

5.2 Interest Diversion Covenant and CAAR

In this section, I find that the price of distressed loans exhibit greatest sensitivity to the Interest Diversion covenant – the most stringent of capital constraints. The Interest Diversion covenant ensures that there is sufficient subordination and coverage in a CLO.[11]

I compare the CAAR of loans that are held by relatively capital-constrained CLOs with loans that are held by relatively capital-unconstrained CLOs. A loan is designated as "constrained" if its distance to the Interest Diversion covenant is below the median, and "unconstrained" otherwise. Hereafter, I use the term *covenant performance* to refer to the distance to the covenant threshold.[12] I find that loans which belong to constrained CLOs experience higher cumulative abnormal losses than loans belonging to unconstrained CLOs. In the quarter after default, the CAAR of loans held by CLOs that are capital-constrained is -4.09% as compared to -0.79% for loans held by CLOs that are capital-unconstrained. The CAAR of loans held by relatively unconstrained CLOs do not experience virtually any losses. In contrast, the loans held by constrained CLOs experience a sharp drop in the CAAR around default and a gradual recovery. There is persistence in the differences between the constrained and unconstrained groups. Figure A.5 presents the CAAR for a longer-time horizon. Nine quarters before default, the AAR is normalized to be 0. Even several quarters after default, there are signs of growing divergence – CLOs that are relatively unconstrained experience higher CAAR relative to CLOs that are relatively constrained.

Potential buyers can exploit the discrepancy in cumulative returns, based on how constrained a CLO is, to increase returns. For example, "vulture funds," which specialize in in-

[10]Note that N is the number of issuers whose loans are traded x months around default, where x is the corresponding month around default. It is not the number of trades in a given month, which would be $\sum_{i=1}^{N} T_{i,m}$ where $T_{i,m}$ is the number of trades of issuer i's loans in month m.

[11]Among the capital constraints, recall that the Interest Diversion (ID) covenant is similar to the OC covenants insofar as the ratios are computed identically. However, there is a lower threshold for the ID covenant, hence, the covenant is triggered before any of the OC covenants. Further, an ID violation forces managers to divert interest proceeds towards the purchase of value-increasing collateral, in order to increase the numerator of the Interest Diversion ratio, bringing the CLO's performance into compliance.

[12]Specifically, covenant performance is the ratio between its reported result on the constraint and the constraint threshold.

vestments in distressed assets, may significantly increase their coffers by purchasing distressed loans from these CLOs at significantly low prices in the days around default and sell in the quarters thereafter. The market price of these assets deviate from their fundamental values. Arbitrageurs can profit from purchasing the least adversely selected assets at the trough, and selling post-recovery.

5.2.1 What explains the price pattern?

The observation that managers choose to divest of assets preemptively suggests that the cost of holding onto distressed assets and breaching a covenant, is greater than the cost of premature selling. In this section, I investigate the relation between market price, decision to sell, and capital covenant ratio – specifically, the Interest Diversion ratio.

In this simplistic set-up, assume that there are only two types of loans: non-distressed and distressed loans with share $1 - x$ and x. Before experiencing any distress, the manager's Interest Diversion covenant result is:

$$ID^{orig} = \frac{A}{L} = \frac{(1-x)A + xA}{L}, \tag{44}$$

If the manager holds on to the distressed assets through bankruptcy, the CLO's Interest Diversion ratio will be:

$$ID^{post} = \frac{(1-x)A + x\theta A}{L}, \tag{45}$$

where θ represents the lower of market value, or recovery value. This is lower than the initial ratio, ID^{orig}.

Discount obligations, obligations that trade below 90% of par,[13] or CCC-assets in excess of the 7.5%, are often subject to alternate accounting treatments. Excess CCC assets are marked to market value, discount obligations are marked to the purchase price, and defaulted assets are marked to the lower of recovery and market price. I consider how the conditions for γ are affected given that loans issued by firms at the cusp of bankruptcy are likely fall in one of these categories. If the manager preemptively sells the distressed assets – marked at market value, at a fraction γ of the par value, A, her Interest Diversion ratio will be:

$$ID^{sell} = \frac{(1-x)A}{L - x\gamma A} \tag{46}$$

For $ID^{sell} > ID^{post}$, the following condition must hold:

$$L\theta < \gamma A(x\theta - x + 1). \tag{47}$$

To solve for the values of γ which satisfy this relation, I substitute for the other parameters. Suppose that a CLO's ID ratio ($\frac{A}{L}$) is 1.05, 10% of a CLO consists of distressed assets, and θ

[13] This threshold varies.

is 0.50. Then, $\gamma > 0.501$. Empirically, this is likely to hold. Therefore, it is optimal for the manager to sell distressed assets that are marked at market price.

Hence, this explains why CLO managers may sell distressed loans in anticipation of impending adverse credit events, thereby creating price pressure.

Additionally, the low level of impairment is plausible. Managers can maximize their Interest Diversion covenant performance by selling assets in descending order of mark-to-market, subject to cash-in-the-market pricing. That is, CLOs can optimize improvements to their capital constraints by selling the best of the riskiest assets. Therefore, the assets that experience price pressure may not necessarily be the worst performing assets. CLOs are marginal agents whose SDFs price assets in the secondary loan market. The secondary market spread can become the effective cost of capital for distressed firms, affecting firm spending and real decisions. Thus, consistent with the model presented, bankruptcy may be an endogenous outcome of secondary market spreads – not necessarily tethered to firm fundamental value.[14] This provides an explanation for price recovery.

Moreover, the minimal level of impairment from bankruptcy is plausible by the nature of the claim. 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. Creditors 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 will rank with other unsecured claims and receive payment on a pro rata basis.

Furthermore, recovery is enabled through restructuring of new and existing contracts and improvements to the capital structure. It takes between 1 to 2 years for the price to recover fully to par. According to the UCLA-LoPucki Bankruptcy Research Database, the annual average case duration ranges from 216-613 days in the sample period. Hence, the time to recovery is within reasonable range of the case duration. Figure A.2 shows that among the distressed firms in the sample, the total amount of debt falls by 56% after restructuring.[15] There is approximately a 22% decline in the amount of secured debt, and 75% in the amount of unsecured debt. The reduction in secured debt is likely understated, as it encompasses new issuance from restructuring, including DIP loans. Figure A.3 shows the relative changes in capital structure pre and post bankruptcy. The figure shows that the relative share of unsecured debt decreases after bankruptcy, as the relative share of secured debt increases. The decrease in debt may be attributed to debt-equity swaps or writeoffs. Strengthening of the capital structure can facilitate firm operations, providing a path for recovery. This provides another possible explanation for the price pattern.

Lastly, anecdotal evidence indicates that the median discounted ultimate recovery bank loans is 100%. As the percent of debt junior to bank debt increases, bank loan recovery rate

[14] While there may be concerns about selection bias, these concerns are relatively minute. There is no difference in the trajectory if I impose the same group of issuers pre- and post default. Moreover, attrition of issuers is $< 5\%$, indicating that the vast majority of firms that have entered Chapter 11 bankruptcy from 2009-2018 have emerged successfully.

[15] I compare the capital structure 6-18 months before bankruptcy, to the capital structure 6-18 months after bankruptcy.

is higher (Emery, Cantor and Ou (2007)). The most likely ultimate recovery rate was reported to be 100%, occurring in almost two-thirds of cases for global project finance loans from 1983-2015. Further, the recovery rate has increased over time (Davison et al. (2017)). In the COVID-19 era, it has been reported that bank loans with more than a 75% cushion reported a 94% average discounted recovery with very low variation (Lukatsky (2020)). Larger cushions are characteristic of leveraged loans .

5.3 Implications and Discussion

Price pressure may culminate in fire sales if distressed loans are held disproportionately by relatively constrained CLOs, or if other institutional participants are also experiencing stress. In this case, financial frictions can extend the price recovery period, and amplify the magnitude of deviation. Encumbrances to liquidity provision à la Shleifer and Vishny (1992) may arise from search costs or slow-moving capital (e.g., Duffie and Gârleanu (2005); He and Krishnamurthy (2012); Duffie and Strulovici (2012); Acharya, Shin and Yorulmazer (2009); Brunnermeier and Pedersen (2009)), or other regulatory constraints. Given the low liquidity, macroeconomic risks emanating from the loan market may magnify to a larger extent relative to risks from more liquid equity markets. Moreover, in the event of a fire sale, more covenants may be triggered. In response, to loosen the constraints, CLOs may further sell risky loans, creating a self-perpetuating cycle of economic decay. The externalities of covenant management are studied in Kundu (2020*c*) – showing that there are real effects of covenant constraints. As the linchpin situated between financial markets and economic activity, intermediary distress can propagate to other firms, making risk systemic. Further, for issuers of leveraged loans, price pressure can lead to further distress and potentially push firms into bankruptcy by increasing the cost of financing. This mechanism is illustrated in the model of Section 3.2.

Of noteworthy importance is the finding that the source of financial frictions are covenants. In particular, it is found that prices are most sensitive to the Interest Diversion covenant. ID-constrained CLOs have inadequate coverage of liabilities; the adjusted par value of the asset portfolio is insufficient to cover (senior) liabilities. This may imply that such intermediaries are excessively levered; the level of subordination may be inadequate to cover liabilities, hence, covenant breaches may force deleveraging. In addition, as covenants are features of incomplete contracts, negotiated and arranged between the CLO manager and investors, evidence of price pressure in the CLO market resulting from such contractual features indicate that covenants have unintended consequences on financial stability.

These unintended consequences intimate that while managerial contracts may be optimal in safeguarding the interests of the CLO manager and investors, concerns about price impact likely do not factor in the decisionmaking process or are of material consideration to either party. This motivates the following questions à la Buffa, Vayanos and Woolley (2019): "Would a regulator or a social planner internalize that [this] effect and impose laxer constraints? More generally, how do privately optimal constraints and contracts compare to socially optimal ones?" In consideration that CLO managers purchased 75% of all new institutional leveraged loans issued in 2019, and hold 25% of all global leveraged loans (pro rata and institutional loans), alterations to covenants can significantly affect the aggregate supply of credit to risky firms in the economy, suggesting that there are broad effects on equilibrium asset prices (Leveraged Commentary and Data (2019); International Monetary Fund (2020)).

This begs to following question: can structural modifications to covenants reduce price pressure in the market? Suppose liquidity and capital covenants are based on long-term thresholds, analogous to long-term value-at-risk measures used in the insurance industry, or, that they include supplemental clauses which allow thresholds to vary with the business cycle rather than the current monthly reporting standard. Extending the time horizon of performance measures may make CLOs less susceptible to transient shocks that may amplify and propagate across institutions through CLO covenant management. In addition, laxer covenants may also reduce the risk of a CLO "run," and create a buffer to absorb shocks. However, as explained in Section 3.2, there is an inverse relation between the amount of capital an intermediary raises and the quality of assets acquired. The stringent reporting that is required of covenants in the current schema, ensures that the asset quality does not deteriorate post-acquisition and that senior debt tranches remain riskless. These covenants make senior debt virtually riskfree, thereby, increasing investor demand for CLO notes, in turn, increasing the total amount of capital raised by CLOs. The implication of this is that as the CLO raises more capital, it may extend credit to riskier firms, which otherwise, would not have access to credit in the absence of securitization and covenants. In this view, price pressure, and fire sales of distressed assets may be efficient outcomes of managerial contracts. In summary, structural modifications to reduce the stringency of covenants may reduce the size of the CLO and introduce risk to senior claims.[16] This change may culminate in a credit crunch, stifling economic growth, ex-ante. Hence, it remains ambiguous what the efficient outcome is. Future theoretical work on this area can enrich the discussion on market efficiency at the intersection of optimal contracts and equilibrium asset prices.

5.4 Extensions: CAAR by loan characteristics

In this section, I compare price pressure for distressed loans that are higher rated, to distressed loans that are lower-rated, and, distressed loans that are of longer maturities to loans of shorter maturities.

Figure 5 presents the CAAR for higher-rated issuers as compared with lower-rated issuers. "Higher-rated" loans are loans rated Baa3 and above. "Lower-rated" loans cover all other loans. I find that lower-rated loans exhibit a lower CAAR than higher-rated loans. This is expected – deviations from fundamental values, which are informed by the ratings, are expected to be larger for firms with higher ratings as compared to firms with lower ratings. It is typically not forecasted that a BBB rated firm will file for default with the same likelihood that a C rated firm will, hence, the magnitude of the CAAR may capture an element of surprise. One to two quarters before default, the CAAR of the higher-rated loans ranges from negative 4.12-5.41%, while the CAAR of the lower-rated loans ranges from negative 1.19-2.22%. The

[16]Under the implementation of a countercyclical buffer, the costs of monitoring and verification may also be expensive.

difference in the CAAR between the two categories ranges from 2.93-3.19%, and is statistically meaningful. Additionally, higher-rated loans reach their trough during the quarter of default, while lower-rated loans reach their trough in the quarter after default.

In Figure 6, I analyze loans based on remaining maturity, and segment them into "longer" maturity loans, and "shorter" maturity loans, based on whether the remaining maturity is above or below the median remaining maturity. I find that while shorter maturity loans exhibit full recovery, longer-maturity loans show a slower trajectory of rebounding. Three to four quarters after default, the difference in CAAR ranges from 4.71-8.10% and is statistically significant.

Higher-rated or longer-maturity loans experience a deeper trough, as compared to lower-rated loans or shorter-maturity loans.

5.5 Do CLO managers cause price pressure or respond to it?

Do CLO managers cause price pressure or respond to it? To address this question, I look at second-lien loan prices. Second-lien loans constitute a small sliver of a CLO manager's portfolio, as described in Table 5 of Kundu (2020*a*). CLO managers are not active buyers of second-lien loans, hence, the price impact of second lien loans is expected to be muted. If the price effects of second lien loans are consistent with the patterns illustrated above, it may suggest that the source of price pressure is elsewhere. I plot the CAAR for second-lien loans in Figure A.6. The CAAR of second-lien loans does not exhibit any large reaction, until default. In the quarter of default, the CAAR is almost -40%. Moreover, the CAAR does not exhibit signs of recovery.[17] Hence, this test substantiates the hypothesis that CLO managers create price pressure.

Similar price patterns occur with other negative credit events, including missed interest/principal payments, which often portend downgrades.[18] There are three potential differences between these "intermediate" events and bankruptcy defaults: (1) magnitude of adverse credit event, (2) scarcity of capital among potential buyers, and (3) duration. First, if the missed payments are reflective of business cycle fluctuations, or, downgrades are limited to the triple-B category, the effect on a CLO manager's trading behavior may be limited – the capital and liquidity constraints may largely be unaffected. Second, as trading often occurs among CLOs, under more adverse scenarios, a greater share of potential CLO buyers may also become constrained, making capital more scarce with greater price impact. Hence, variation in the degree of price pressure is contingent on the magnitude of stress. Lastly, while intermediate events like missed payments and downgrades are relatively abrupt events, the restructuring process may be protracted, extending and exacerbating the capital and liquidity constraints of CLOs. Thus, managers may manage adverse credit events differentially.

[17] Even after extending the time horizon, CAAR remains stabilized around a new low

[18] The analysis is replicated for a smaller sample of interest/principal payments which exhibit similar price patterns. Elkamhi and Nozawa (2020) focus on downgrades in their analysis.

6 Mechanism: Portfolio Management

Thus far, I have studied the price patterns of defaulted loans around bankruptcy events. In the remaining sections of this paper, I investigate the potential mechanisms underlying the main results. I begin by studying changes in quantity around default.

6.1 Quantity Consideration: Managers preemptively sell distressed loans

The binscatter diagrams in Figure 8 illustrate how the net transaction size of distressed loans varies around bankruptcy. To limit the influence of outliers, I winsorsize 1% of each tail in the distribution of the transaction sizes. Figure 8a exhibits the binned estimates of the net amount transacted across all CLOs for distressed issuers -8/+8 quarters around bankruptcy. Figure 8b exhibits the binned estimates of the net amount transacted across all CLOs for distressed issuers -12/+12 months around bankruptcy. Managers start selling distressed assets before bankruptcy default. Further, a quadratic pattern fits the selling behavior around default; the largest amount of selling occurs in the immediate period around bankruptcy. As time from bankruptcy increases, the amount of selling declines. After a point, CLOs become net buyers. This relation is codified through a regression framework. I regress the monthly net transaction size of each distressed issuers' assets, aggregated either by manager ("manager-level") or CLO ("CLO-level") on month dummies, signifying months surrounding distress. For ease of interpretation, I scale the monthly point estimates by the constant which represents the average monthly net transaction size. This yields a measure of the *relative* amount transacted on a monthly basis. Figure 9 plots the point estimates by month and the associated 95% confidence interval for each estimate. As the regression is estimated at either the manager-month year level or CLO-month year level, the residuals are likely to be correlated at these levels. For this reason, standard errors are two-way clustered at either the manager and month year levels or CLO and month year levels, depending on the level of the regression. The point estimates from the manager-level and CLO-regressions track one another, albeit, the confidence interval from the manager-level regression is generally, slightly larger. This figure depicts that there is a monotonic increase in the amount of selling that occurs in the months preceding bankruptcy default. One month before bankruptcy, a manager sells at approximately four times the intensity of purchases in an average month. The magnitude of sales declines starting from the default month, until 10 months after default, after which, managers and CLOs do not exhibit any statistically significant deviation in the amount transacted, relative to the mean.

Hence, the trading volume mirrors the price pattern.

6.1.1 Identification of effect

In this section, I explore potential confounding variables that may drive the results. First, I investigate whether the selling pattern is correctly identified, or driven by unobserved heterogeneity in various dimensions, correlated with the independent variables. Second, given that many of the most active CLO managers are affiliated with private equity firms, I investigate whether the selling pattern is only apparent for PE-affiliated managers. Third, I consider whether trading decisions reflect information about the firm's ability to emerge from bankruptcy, by studying whether managers hold onto *winners*, while selling *losers* – trades based on private information. Fourth, I study whether the trading dynamics are unique to particular periods of the CLO's lifespan i.e., when the CLO comes into existence, or at the end of its life. Fifth, I look at whether managers are cognizant about their market impact by studying the intensive margin of trades – a potential sign of sophistication. Lastly, I run two placebo tests to ensure that the results are not driven by omitted variable bias and to ensure that the timing of default is endogenous to the issuer: (1) I randomize default dates from a uniform distribution while maintaining the same set of issuers, and, (2) I randomize the issuers while maintaining the default dates. The analysis described below shows that the trading pattern applies across all CLOs regardless of age, affiliation or identity of the manager/CLO, time of trade, and quality of underlying issuers. Hence, I conclude that the trading response to distress is reflexive.

Inter- and intra-issuer variation: In Figure B.1a, I first compare how the *same* issuer's assets are traded month-to-month around default. Second, I exploit within issuer-year variation to ensure that the baseline effect is not driven by time-varying characteristics of issuers. Third, in addition to the issuer fixed effect, I consider how manager fixed effects and month-year fixed effects alter the estimated monthly point estimates. This regression specification is interpreted as a within manager estimator that controls for both time-invariant and time-varying characteristics. By fully absorbing issuer-specific and time-specific heterogeneity, the estimated difference is intended to capture a given manager's transacting patterns around default. Lastly, the most stringent specification includes issuer-manager fixed effects and month-year fixed effects. This is interpreted as a within issuer-manager estimator with time controls, providing the most conservative estimate of the effect of trade size on month dummies. The analogue of the latter two specifications for regressions at the CLO-level include issuer, CLO, and month-year fixed effects, and, issuer-CLO and month-year fixed effects, respectively. These results are shown in Figure B.1b. The addition of fixed effects do not drastically change the results; the same monotonic patterns that are depicted in the baseline specification are exhibited in these figures. This suggests that the regression specification plausibly identifies the associated effect of transacting in a particular month.

Private equity affiliation: As Figure 4 of Kundu (2020*a*) indicates that a large share of the most active CLO managers are affiliated with private equity firms, I compare how the results differ for managers affiliated with private equity firms relative to unaffiliated managers. There are two possible hypotheses, explaining potential differences in the trading patterns between these two groups. The first hypothesis is that managers affiliated with PE firms may hold onto loans because they are better equipped to maneuver bankruptcy. Alternatively, managers affiliated with PE firms may sell loans more aggressively because of private information. I do not find any conclusive evidence of differences between managers in either groups. I plot the most conservative regression estimates, accounting for issuer-manager and month-year fixed effects in Figure B.2a, and, issuer-CLO and month-year fixed effects in Figure B.2b. The trading patterns for the two groups are similar, disputing both of the aforementioned hypotheses.

Superior information: I consider whether trading decisions reflect information about the firm's ability to weather restructuring. The *superior information hypothesis* posits that managers utilize information on the quality of issuers, i.e., which loans are projected to fall in value and which are projected to increase in future. Under this conjecture, it is hypothesized that managers will purchase loans from distressed firms that emerge from bankruptcy and sell loans from distressed firms that do not recover. I test this directly. Figure B.3 shows that managers sell loans issued by distressed firms which do successfully exit bankruptcy, invalidating the hypothesis. Hence, managers do not base trading decisions based on the prospect of emergence. This result also seems to suggest that managers do not possess private information on the recovery of the firm.

CLO age considerations: I consider whether the trading dynamics examined so far, are unique to particular periods of the CLO's lifespan. It may be plausible that earlier in a CLO's life, when a CLO has not experienced any losses, a manager may be more willing to take on greater risk. Conversely, towards the end of a CLO's life, a manager may be less diligent about satisfying covenants, and risk-shift. I add age decile fixed effects to absorb age-specific differences in the transaction size. Figure B.4 shows that there is little change in the relation between transaction size and months to default, thereby dispelling the hypothesis that the baseline trading effect is unique to particular periods in the CLO's life.

Intensive margin: Additionally, I look at individual transactions to examine if the intensive margin is affected. While managers may want to reduce exposure to particular issuers, they may choose to do so strategically to avoid market impact, by increasing the number of transactions and maintaining the size. The results contradict this hypothesis as shown in Figure B.5. The trend in individual transaction size mimics the trend for monthly net purchases at both the manager- and CLO-level, even with the inclusion of various levels of fixed effects. This demonstrates that the baseline result is robust to a more diffuse measure of transaction size. It also intimates that managers do not internalize consequences of market impact.

Placebo tests: Two placebo tests are studied to ensure that the results are not driven by anomalous features of the data, or, capture a spurious relationship. In the first placebo test, I randomize the default dates from a uniform distribution while maintaining the same set of issuers. I use this test to check that omitted variable bias is not driving the results. In the second placebo test, I randomize the distressed issuers while maintaining the same set of default dates, to make sure that the timing of default is endogenous to the issuer. This process is replicated 1,000 times. A histogram of the β point estimates associated with each month around default are shown in Figures B.6a and B.6b. The "true" β value from the baseline regression is represented by a dashed red line (when it fits in the frame). All the β estimates are centered at 0. In many instances, the minimum estimate is above the baseline point estimate. The inability to distinguish β from 0 indicates a failure to reject the null hypothesis. Hence, it can be ruled out that the results reflect alternative aspects of the data.

Cumulative effect: The estimated cumulative amount transacted, starting from 12 months prior to bankruptcy is shown in Figure B.7. The figure exhibits a marked change in the slope of the cumulative transaction size pre- and post-bankruptcy, suggesting that CLOs are less aggressive in offloading assets after bankruptcy as compared with before. Moreover, the figure shows that CLOs sell almost $30 million of an issuer's assets in the year surrounding bankruptcy (blue line). Based on the median statistic reported in Table 1 of Kundu (2020*a*), CLOs divest of 30% of an issuer's assets within 12 months of bankruptcy. Considering that bankruptcy is only one type of adverse credit event that a firm can experience, often after experiencing several other events including missed interest/principal and distressed exchanges, 30% provides a lower bound of the size of the total amount of divestiture. In addition, considering that CLOs are the largest buyers of leveraged loans, widespread selling can be consequential to other investors. This is investigated further, below.

Other credit events: Thus far, it has been shown that CLO managers preemptively sell loans issued by distressed borrowers before the filing date. However, are these trading patterns are unique for bankruptcy events? To answer this, I focus on a smaller set of credit events which typically precede downgrades: missed interest and/or missed principal payment. Figure B.8 shows the net transaction size of loans issued by distressed borrowers around dates of missed interest and principal payments. Both figures show a quadratic pattern similar to Figure 8, with the trough coinciding with the missed payment period. Similar to Figure 9, Figure B.9 shows that CLO managers sell loans in anticipation of adverse credit events.

Hence, the result applies across the board – regardless of CLO age, affiliation, identity of CLO or manager, time of trade, or quality of underlying issuers.

Next, I demonstrate that covenant considerations drive preemptive sales.

6.2 Covenants drive Preemptive Sales

6.2.1 Quality and coverage covenants

Quality and coverage covenants check against risk-shifting behavior to ensure that the manager appropriately screens and monitors the CLO. Section 3 provides several predictions as they apply to covenant constraints. In this section, I implement empirical tests for these predictions. I begin by studying which covenants, if any, serve as potential determinants in the share of risky assets. This can explain the preemptive selling decisions of CLOs.

An overview of covenants

There are a total of 780 covenant observations covered in the dataset. I look at the covenants which have more than 100 observations, and filter them into eight categories: Weighted Average Rating Factor (WARF), Weighted Average Spread (WAS), Weighted Average Life (WA Life), Interest Diversion, Senior Overcollateralization (Classes A/B), Junior Overcollateralization (Classes $<=$ D), Senior Interest Coverage (Classes A/B), Junior Interest Coverage (Classes

<= D), and Interest Diversion.[19] For a given covenant, I compute the covenant performance as the ratio between its current result and the current threshold.[20]

Table B.5 shows the summary statistics for the constraints, post-winsorization. Two of the maintain-or-improve covenants, WA Life and WARF, exhibit median values below the threshold of 1. The median capital constraint is slightly above the threshold, while the median liquidity constraint exhibits much greater slack from the threshold. In addition, the interquartile range of the capital constraints is <2% for the Interest Diversion constraint, <3% for the Junior OC constraint, and <15% for the Senior OC constraint. The liquidity constraints exhibit greater variation. Furthermore, as suggested by Figure 10 of Kundu (2020*a*), the average share of risky loans is 9%. The average CCC-bucket of a CLO is 6.5%, and the average percent of defaulted loans is 2.5%.

How do covenants affect portfolio management?

In this section, I study how covenants affect portfolio management by examining how managers' trading decisions are influenced by covenant restrictions. First, using a linear probability model, I study how the choice to sell risky loans is related to a CLO's quality and coverage covenant constraints. Second, I study the sensitivity of risky loans to constraints by relating the levels and changes of the share of risky loans to covenant performance, using various measures. Across the regression specifications, I include manager-year, arranger, and trustee fixed effects, to ensure that the results are not driven by structural differences across CLOs. In addition, I control for performance, size, and CLO age, when appropriate. The standard errors are two-way clustered at the manager and year levels. I report the main findings below.

Extensive Margin

In Table 2, I examine the relation between a manager's choice to sell risky loans and covenant performance. Risky loans are defined as the sum of the share of CCC-rated loans, defaulted loans and discount obligations. A one standard deviation change in the Junior OC covenant performance (Column 5), relative to the mean, is associated with a 3.8 percentage points decline in the probability that a manager sells risky loans. The estimated decline is 3 percentage points and 3.18 percentage points for a one standard deviation change in the Interest Diversion and Senior OC covenant performance measures (Columns 3, 7), respectively, relative to their respective means. All three of these measures are capital constraint measures, reflecting a CLO's specific level of subordination and coverage, relative to the triggers associated with

[19] Details on the covenants are described in Section 2 and Section 3 of Kundu (2020*a*).

[20] Table 2 of Kundu (2020*a*) shows the correlation across different covenants. Predictably, the Interest Diversion constraint is highly correlated with the Junior OC constraint – the two most restrictive capital constraints. The liquidity constraints exhibit high correlation amongst each other. The capital constraints are moderately correlated with the liquidity constraints. Liquidity constraints are moderately correlated with the Weighted Average Spread constraint. The quality constraints do not exhibit much correlation among each other, suggesting that the covenants capture different quality dimensions of the CLO portfolio.

the tranches.[21]

Intensive Margin

Next, I study how outcomes of risky loans, on the intensive margin, vary with several measures of covenant performance. I winsorize 1% of the covenant performance measures and outcome variables of each tail, and standardize the covenant results (mean = 0, standard deviation = 1) for ease of comparison and interpretation. The results from this cross-sectional analysis are shown in Table 3. I omit the ratings-based covenants from my analysis, as the measures of risky assets are strongly influenced by the rating.

In Panel A, I examine the relation in levels between the covenant performance and the share of risky loans. Panel A of Table 3 indicates that the share of risky assets is most strongly explained by the liquidity constraints. A one standard deviation increase in the Junior IC covenant performance (Column 4), relative to the mean, is associated with a 1.71 percentage points decline in the share of risky assets. A one standard deviation increase in the Senior IC covenant performance (Column 6), relative to the mean, is associated with a 0.77 percentage points decline in the share of risky assets.

In Panel B, I examine how the covenant performance in a given period is related to subsequent trading of risky loans. The liquidity constraints are most strongly related with the change in the share of risky loans. A one standard deviation increase in the Junior IC covenant performance (Column 4), relative to the mean, is associated with a 1.06 percentage points decline in the subsequent amount transacted. A one standard deviation increase in the Senior IC covenant performance (Column 6), relative to the mean, is associated with a 0.41 percentage points decline in the subsequent amount transacted. The WAS covenant performance (Column 1) also exhibits a strong relation, consistent with the maintain-or-improve conjecture as well as the moderate correlation with liquidity covenant performance; a higher WAS is associated with lower subsequent purchase of risky loans – a one standard deviation increase in the WAS covenant performance, relative to the mean, is associated with 0.58 percentage points decline.

In Panel C, I examine the reverse relation – how changes in the share of risky loans related to changes in the covenant performances. I find that a 1 percentage point increase in the share of risky loans transacted is associated with a reduction in the Junior and Senior IC covenant performances (Columns 4, 6) by 0.009 and 0.006 standard deviations, relative to their respective means. Moreover, a 1 percentage point increase in the share of risky loans transacted

[21] The significance of the Junior IC covenant performance suggests that a one standard deviation change in the Junior IC covenant performance (Column 4), relative to the mean, is associated with a 3.28 percentage points *increase* in the probability that a manager sells risky loans. This suggests that greater liquidity, vis-à-vis interest payments, increases the probability that a manager sells risky loans. As risky loans have higher interest rates relative to assets that are less risky, managers who are more liquidity-constrained, may be *less* likely to sell risky loans to improve their liquidity constraint measures. This may explain the positive effect. In contrast, risky loans carry greater credit risk, which can pose solvency concerns to CLOs. For this reason, CLOs that are more capital-constrained, may be *more* likely to sell risky loans to improve their capital constraint measures. Hence, there is divergence in the effect. However, as the magnitude of the effect of capital constraints is larger than the magnitude of the effect from the liquidity constraint, even considering alternate specifications, I conclude that the propensity to sell risky loans most strongly varies with the performance on the capital covenants.

is associated with an increase in the WAS covenant performance by 0.01 standard deviations, relative to the mean.

Hence, these findings corroborate Prediction 3 that the share of risky assets decreases in the performance of covenant constraints.

Robustness

I examine whether these findings on the extensive and intensive margins are robust to alternative specifications. In Table B.1, I consider how the results vary under different outcome variables, and empirical methodologies. Using a linear probability model, Columns 1-3 indicate that a one standard deviation change in the capital constraints, relative to the respective means, is associated with a decline in the likelihood that a manager sells defaulted loans by 2.55-3.84 percentage points. Columns 4-5 indicate that a one standard deviation change in the capital constraints, relative to the respective means, is associated with a decline in the likelihood that a manager sells defaulted loans by 2.34-2.68%. In Columns 5-7, I apply a "leave-one-out" strategy, iterating through each firm and recomputing the covenant performance in the absence of that particular firm.[22] The adjusted covenant performance measures provide a measure of potential constraint rather than realized constraint. Based on Columns 5-7, a one standard deviation change in the junior capital constraints, relative to the means, is associated with a decline in the likelihood that a manager sells risky loans by 11.02-24.95%. For the most senior of the capital constraints, this estimate is 2.42%.

While capital constraints are a large determinant of whether CLO managers sell risky loans in the subsequent period, the amount of risky loans exhibits greatest sensitivity to the liquidity constraints. To show this, I replicate the analysis using two alternative measures of distressed loans: the percent of defaulted loans, and the percent of loans rated CCC in Tables B.2 and B.3, respectively.

Consistent with the main result, I find that the Junior IC covenant performance, the tightest of CLO liquidity constraints, is strongly associated with trades of risky loans. Panel A of B.2 and B.3 confirm that a one standard deviation increase in the Junior IC covenant performance (Column 4), relative to the mean, is associated with a 1.08 percent points reduction in the share of defaulted loans, and 0.62 percent point reduction in the share of CCC loans. Panel B of B.2 and B.3 confirm that a one standard deviation increase in the Junior IC covenant performance (Column 4), relative to the mean, is associated with a 0.28 percentage points decline in the subsequent amount of defaulted loans transacted, and a 0.67 percentage points decline in the subsequent amount of CCC loans.[23] In Panel C of Table B.3, I do not find that changes in the amount of CCC loans transacted are related to tangible changes in the liquidity constraints.

[22]The assumption in applying this methodology is that the firm has the same adjustment factor in recomputing the capital constraint as the liquidity constraint.

[23]While the point estimate for the Junior IC covenant performance in Panel B of B.2 is not statistically significant, the R^2 value is the highest among all capital and liquidity results, and there is significance in the Senior IC covenant performance, which is indicative that managers exhibit sensitivity to liquidity performance measures. Specifically, a one standard deviation increase in the Senior IC covenant performance, relative to the mean, is associated with a 0.24 percentage points in the subsequent amount of loans transacted. Given the hierarchy in

However, a 1 percentage point increase in the amount of defaulted loans transacted is associated with a reduction of 0.01 standard deviations of the Junior IC covenant performance and 0.004 standard deviations of the Senior IC covenant performance, relative to their respective means.

Further, I repeat the baseline regressions after applying the leave-one-out strategy, iterating through each firm and recomputing the Junior IC covenant performance in the absence of that particular firm. A one standard deviation increase in the Junior IC covenant performance, relative to the mean, is associated with a decrease of 0.38-0.55 percentage points in the share of risky loans, 0.33-0.58 percentage points decline in the subsequent amount transacted, 0.27-0.38 percentage points decline in the share of defaulted loans, and 0.23-0.28 percentage points decline in the share of CCC loans. For further confirmation of this result, I use an a posteriori method of defining *risky* loans to study if the relation to liquidity performance bears scrutiny. Loans are *risky* if they are issued by firms that file for bankruptcy at some point in the sample period. The graphical results in Figure B.11 exhibit a negative relation. Thus, the result is robust.

These results suggest that covenants affect CLO trading decisions, providing an explanation for the price and volume patterns presented thus far. Next, I examine how covenants affect characteristics of CLO deals, namely, size and financial performance.

Extension #1: Covenants as determinants of CLO size

As explained in Section 3, the presence of covenants ensure that senior claims are virtually risk-free, and provide opportunities for recourse in the event of breaches. In theory, the certainty associated with senior riskless claims allows the intermediary to raise more capital than in the absence of these covenants. This is tested in the data. The results are presented in Table 4. For ease of interpretation, the outcome variable, size, defined as log of total assets is standardized. The independent variable denotes the standardized *threshold* of the constraints. CLOs exhibit wide variation in the reported threshold values. Therefore, I scale all reported thresholds to lie between 0 and 10 pre-standardization.[24] The results are reported in Table 4. As the threshold may vary across CLOs, I use a within manager-year estimator, and include arranger and trustee fixed effects to control for unobserved heterogeneity across agents involved with CLOs. Additionally, I control for the age of the CLO and financial performance.

There is a positive relation between coverage covenant thresholds and the size of the CLO. For coverage tests (Columns 4-7), a higher threshold signifies greater stringency. I find that a one standard deviation increase in the Junior IC and Senior IC thresholds (Columns 4, 6), relative to the means, is associated with an increase in the CLO size by 0.15 and 0.19 standard deviations, respectively. A one standard deviation increase in the Interest Diversion and Junior OC thresholds (Column 5), relative to the means, is associated with an increase of 0.12 standard

thresholds, significance in the Senior IC covenant performance strongly implies the importance of the Junior IC covenant performance.

[24] If the reported threshold is less than 10, there is no adjustment. If the reported threshold is between 10 and 100, I scale by a factor of 10. If the reported threshold is between 100 and 1000, I scale by a factor of 100.

deviations in the size of the CLO. The effect of a one standard deviation increase in the Senior OC threshold (Column 7) is economically meaningful, albeit statistically insignificant. Among the quality tests, the effect of the WAS threshold (Column 1) is statistically significant – a one standard deviation increase in the Weighted Average Spread, relative to the mean, is associated with a 0.03 standard deviations reduction in the size.

Thus, the evidence corroborates Prediction 1 that CLO size increases in the stringency of covenant constraints.

Extension #2: Covenants as determinants of equity distributions

In this section, I study the relation between a CLO's equity distribution and covenant performance. In event of coverage covenant breaches, managers may be forced to divert equity proceeds towards the purchase of new collateral until the covenant is no longer breached. This can reduce equity distributions. Hence, I hypothesize that equity distributions increase in the performance of covenant constraints (Prediction 2). Table 5 presents the results. I include CLO-year, arranger, and trustee fixed effects to control for unobserved heterogeneity in these dimensions. In addition, I control for the performance and age of the CLO. The outcome variable is a standardized measure of the equity distribution, and, the independent variable is the covenant performance.[25] The equity distribution exhibits greatest sensitivity to the liquidity constraints. A one standard deviation increase in the Junior and Senior IC covenant performance measures (Columns 6, 8), relative to the means, is associated with a 0.67 and 0.33 standard deviations increase in the equity distribution, relative to the mean. Using the leave-one-out methodology, the effect of a one standard deviation increase in the Junior IC covenant performance, relative to the mean, is larger than the estimate using the realized measure – 0.76 standard deviations increase in the equity distribution, relative to the mean. For the quality tests, a one standard deviation increase in the performance of the WAS (Column 1) and WARF (Column 2) covenants, relative to their respective means, is associated with 0.32 and 0.47 standard deviations increase in the equity distribution, respectively. These results are consistent with Prediction 2. In summary, I find compelling evidence that the choice to sell risky loans is most strongly associated with the capital constraints, while the amount of risky loans varies most with the liquidity constraints. In addition, I find that there is a strong positive relation between the size of a CLO and the stringency of covenants, as well as the CLO's equity distribution and covenant performance.

6.3 Consideration of alternative hypotheses

I have shown that covenants can explain CLO trading decisions as well as characteristics of CLO. In this section, I consider three additional hypotheses of why managers preemptively sell loans in distress: (1) private information, (2) reputational concerns, and (3) bankruptcy.

[25] Equity Distribution $= \frac{\text{Interest payment} \times \frac{12}{\text{Payment frequency}}}{\text{Par value of equity}} \times 100$

In addition to covenants, reputational considerations may also factor into managers' trading decisions.

6.3.1 Private Information

I assess whether managerial trades reflect new information on the financial performance of the issuer, using indirect and direct methods.

The results from the previous section suggests that managerial consideration of private information is limited. Despite the potential for exchange of information from various arms of private equity firms which are affiliated with CLO managers, it does not appear that managers affiliated with PE firms behave any differently from managers who are not, despite presuppositions of greater sophistication (Figure B.2b, B.2a). Additionally, tests of the *superior information hypothesis* show that managers do not exhibit greater proclivity to hold onto "winners" who emerge from bankruptcy (Figure B.3). Thus, selling decisions do not appear tethered to information on firm fundamentals. Further, if trades are made based on private information, managers may attempt to reduce how conspicuous their trades are to recover the highest value. However, evidence of this is scant (B.5). Anecdotally, a CLO manager confirmed that managers do not solicit private information on firms. They are attuned to firms' quarterly calls and assess the health of firms' based on public reports. However, these reports are backwards-looking, and promulgated widely, hence, markets react instantaneously. Thus, private information does not appear to be a driver of preemptive sales.

As an additional test of private information, I study whether there are spillovers from the loan market to other financial markets, upon revealing information through systematized trades. In particular, I apply an event study framework to analyze whether large sales (above the 95$^{\text{th}}$ or 99$^{\text{th}}$ percentile of all sales) are associated with subsequent negative, abnormal returns in the stock market. If abnormal returns after a large sale are negative, statistically significant, and persistent, it could indicate that CLO managerial sales provide a meaningful signal to other institutional players about the quality of the underlying loans. Moreover, it may also suggest that information propagates from active managers in the loan market to other participants in the stock market.

In the event study framework, I focus on large sales by CLO managers. I define an event by the issuer-date pair in one of two ways: either the size of an *individual* transaction is located in the tail of the distribution of all transaction sizes, or, the daily transaction volume of an issuer's loans is located in the tail of the distribution of all daily issuer volumes. The tail of the distribution is defined above the 95$^{\text{th}}$ and 99$^{\text{th}}$ percentiles. I use both the market-adjusted and Fama-French three factor model to study abnormal returns. Depending on the threshold and the specific definition of an event, the number of events ranges from 146 to 1,724. Across the specifications, the results do not substantively change. I do not find any evidence of cumulative abnormal returns. I report the most conservative results, using the Fama-French three factor model with a cutoff at the 99$^{\text{th}}$ percentile in Figures B.10 and B.10. These figures do not exhibit any marked change around the sale date, nor, is there downward persistence in the return. Hence, I rule out that private information drives these trades.

6.3.2 Reputational concerns

A potential determinant of preemptive sales is reputational concerns. Reputational concerns may be entwined with the design of loss-averse covenants; when covenants are triggered and CLOs begin paying down liabilities, investors may lose confidence in the ability of the manager to perform. Distinct from this, I consider how reputational concerns may directly cause CLO managers to prematurely divest of risky assets as a way to signal adeptness in marketing and advertising to potential investors. In other words, investors care about default, but not recovery; "It's almost axiomatic in our market that every CLO manager's pitch book has a page showing how they outperformed the broad loan market, either on a total return basis, or on a default / loss basis" (Ashton (2019)).

Consider the following microcosm: CLOs operate in a two period world and hold a single loan with initial value v_0 at $t = 0$. Suppose that news is released right before $t = 1$ that the loan will experience default and have a recovery value of v_2 at $t = 2$. If investors know with considerable certainty that the firm will recover, under rational expectations, the value of the loan today, v_1 should equal the recovery value at $t = 2$, v_2. If the CLO attempts to sell the loan at $t = 1$, they will receive a price of v_2. Hence, investors should be indifferent between the manager selling at $t = 1$ or holding the loan until $t = 2$. The results from Section 6.1, coupled with the price patterns from Section 5, suggest that $v_1 \neq v_2$. This may be explained if rational expectations do not hold.

In Figure B.12, I examine how the CLO default rate is related to the subsequent initial deal size of a CLO for a given manager. The top left figure indicates that over time, managers oversee CLOs of larger sizes. Additionally, the percent of defaulted assets decreases over time (top right). This may suggest that managers become more skilled with time. In the table underlying the figure, I codify these relations and find that they are statistically significant. Additionally, I relate the percent of a CLO's defaulted assets to the manager's subsequent initial CLO deal size. If the percent of defaulted assets experiences an increase of 1%, the subsequent deal size is expected to decline by 0.5-1.4%. Hence, reputational concerns may influence managerial trading decisions.

6.3.3 Bankruptcy

Lastly, I consider whether managers may be driven to preemptively sell distressed loans in consideration of bankruptcy defaults. There are several reasons for this including the inability to maneuver bankruptcy, ex-ante, and, alterations to the original claim, ex-post. While these bankruptcy-specific concerns can compound the effect of a fire sale on distressed loans, they do not appear to be primary factors that drive preemptive selling in the first place.

An ex-ante concern may be that the restructuring process can be convoluted, protracted, and require unflagging attention and active participation in deliberations with other investors who hold stake. If managers lack the sophistication to maneuver the bankruptcy process, they may preemptively sell, allowing more sophisticated participants the capacity to arbitrate the bankruptcy process. Given the large percentage of firms emerging from bankruptcy, this conjecture is plausible. However, the counterfactual cannot be assessed – that is, if CLO managers were to hold onto their claims, how many firms would file out of bankruptcy.

In addition to the ex-ante concern, managers may also fear that debt restructuring could result in unfavorable outcomes for leveraged loan investors, ex-post. Restructuring often results in the introduction of super-senior claims like debtor-in-possession financing and pari-passu debt, as well as write-offs, which may dilute the value of the original senior secured loans. Ivashina and Vallee (2019) provides specific evidence of this behavior through a case-study of J.Crew in 2016. In 2016, J.Crew exploited a weak credit covenant to move assets from a restricted subsidiary to an unrestricted subsidiary, allowing J.Crew to secure new debt, while diluting the existing claims of senior secured creditors. To test this in-sample, I show that restructuring of defaulted portfolio firms leads to the fortification of the capital structure, as shown in Figures A.2 and A.3, and discussed in Section 5. This can occur through debt-equity swap arrangements and write-offs. Debt-equity swap arrangements are unfavorable to CLOs. As CLOs are cash flow based enterprises, holding equity can have material effects to noteholders. As cash flow dwindles, the likelihood of triggering covenants increases. Covenant breaches materialize as loss when proceeds used for junior management fees and equity distributions are diverted towards paying down liabilities or the purchase of high-quality assets (See Section 3 of Kundu (2020*a*)).

In spite of these considerations, bankruptcy is not of cardinal consideration to managers in preemptively selling distressed loans. The trading patterns of loans issued by firms surrounding other adverse credit events including missed interest and principal payments are examined in Section 6.1.1. It is found that a similar quadratic pattern fits the trading pattern of these loans (Figure B.8). Hence, managerial trading behavior around default is not unique to bankruptcy default events. Furthermore, while managers may be concerned by the imminent and associated risks of bankruptcies, the risks often materialize along concentration, capital and liquidity dimensions per covenant restrictions. In other words, default is consequential to a manager, insofar, as it tangibly affects the manager's ability to supervise a CLO, the composition and cash flow of a CLO's assets, confidence of investors, and, by extension, its performance. These elements are best captured by the covenant restrictions. Thus, the indenture a manager is bound by and the covenants therein provide a measurable framework for assessing proximate considerations of managers.

Hence, concerns that are unique to bankruptcy default events appear limited.

7 Conclusion

This paper shows that CLO contracts have externalities on asset prices. I begin with a model that explains the origin of covenants in ensuring senior debt claims remain risk-free in securitization. Covenants allow the intermediary to raise a greater amount of capital than in their absence. If managers are subject to shocks that alter their demand, such shocks can transmit to asset prices and generate price pressure. This can affect a firm's choice to file for bankruptcy over seeking external financing. The real effects of price pressure are explored in the subsequent paper in the series, Kundu (2020*c*).

The model provides a framework for considering alternate contracts. A contract with covenants that bind in the long-term, rather than the current monthly arrangement can reduce price pressure, but it can also make senior debt claims less than risk-free. This can reduce the total amount of capital that is raised by CLO intermediaries which may have adverse welfare implications. An avenue of future theoretical work may explore the design of optimal contracts, in joint consideration with equilibrium asset prices and market efficiency.

I introduce several new stylized facts about the role of CLOs in the intermediation of credit in the leveraged loan market. First, managers are not passive buy and hold investors, unlike their CDO counterparts. There is selection, monitoring and churn. Second, I provide evidence of price pressure around bankruptcy defaults – the CAAR one month after default is -14%, but reverts afterwards, as senior secured loans exhibit virtually no impairment through bankruptcy and recover nearly fully to their pre-distressed prices. Third, there are stark differences in returns for capital-constrained and unconstrained managers; the CAAR of loans held by CLOs that are relatively capital-constrained is -4.09% in the quarter after default, as compared to -0.79% for CLOs that are relatively capital-unconstrained. Lastly, differences are also apparent for loans of higher ratings as compared to loans of lower ratings, as well as loans of longer maturities as compared to loans of shorter maturities. If a large cross-section of CLOs experience simultaneous stress, price pressure may manifest as fire sale risk.

What is the mechanism for this? CLOs fire sell loans issued by distressed firms before they file for bankruptcy. This effect is robust to a battery of additional factors. Managerial trading behavior is mainly driven by covenant considerations, as the propensity to sell risky loans most strongly varies with the performance of the capital constraints, while the amount of risky loans – in levels and changes – is most strongly explained by the liquidity constraints. Covenants can also determine the size of a CLO, as well as the equity distribution; a CLO's size increases in the threshold of the covenant constraints, and, a CLO's equity distribution increases in the liquidity constraints. In addition to covenants, reputation and bankruptcy are two additional considerations that may influence managers' trading decisions.

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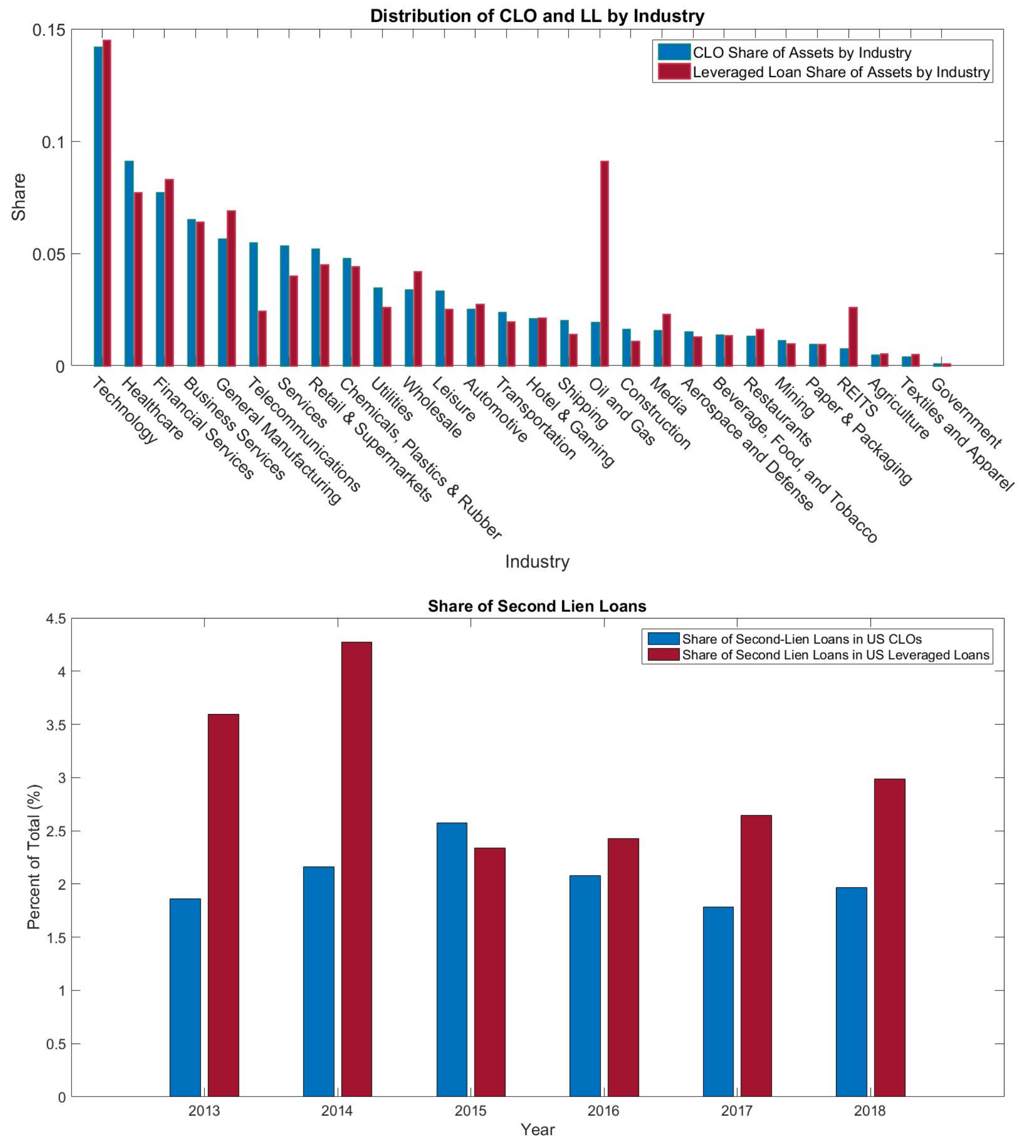
8 Figures and Tables

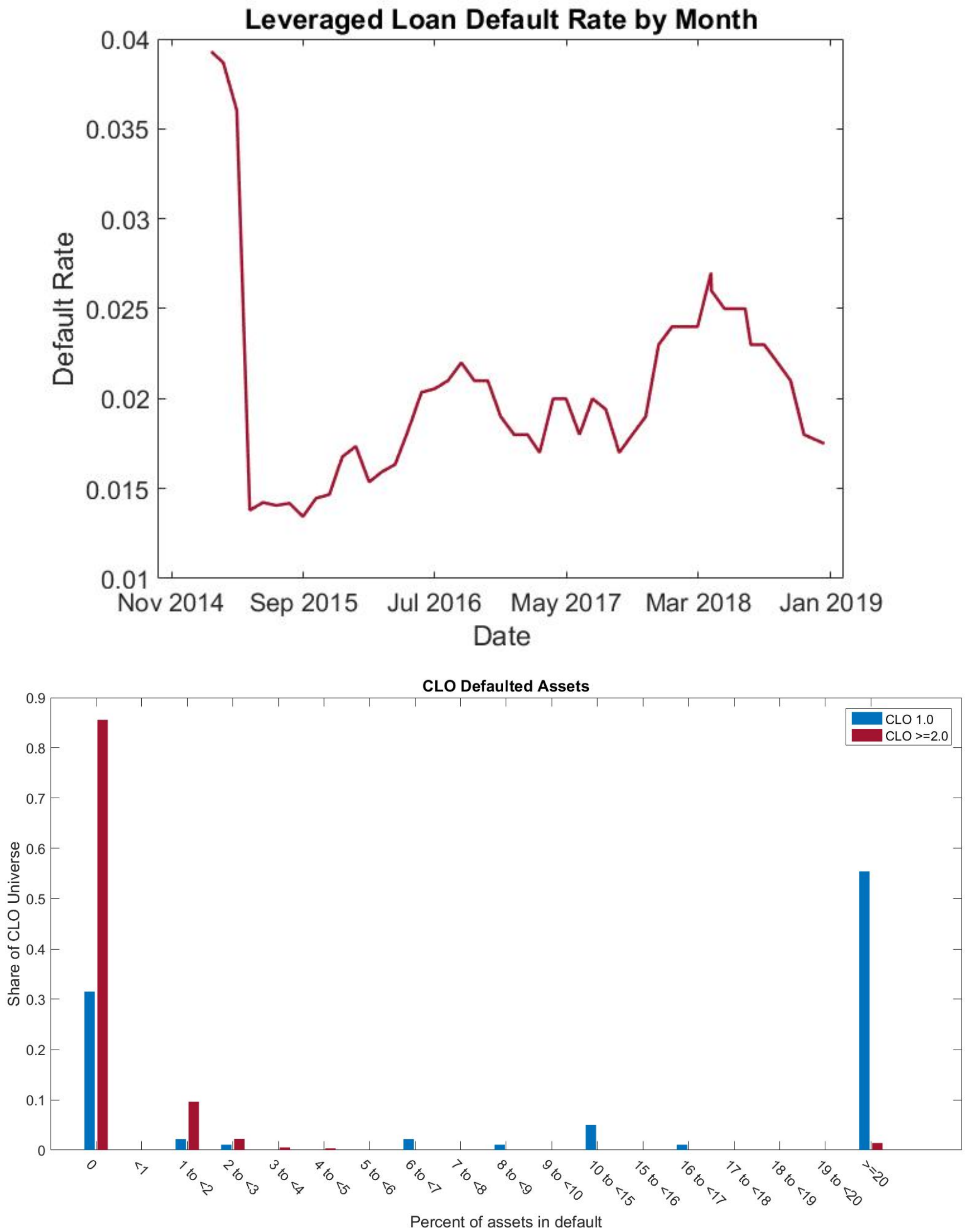
8.1 Figures

Figure 1: Evidence of Screening: Collateral Distribution of Leveraged Loans and CLOs



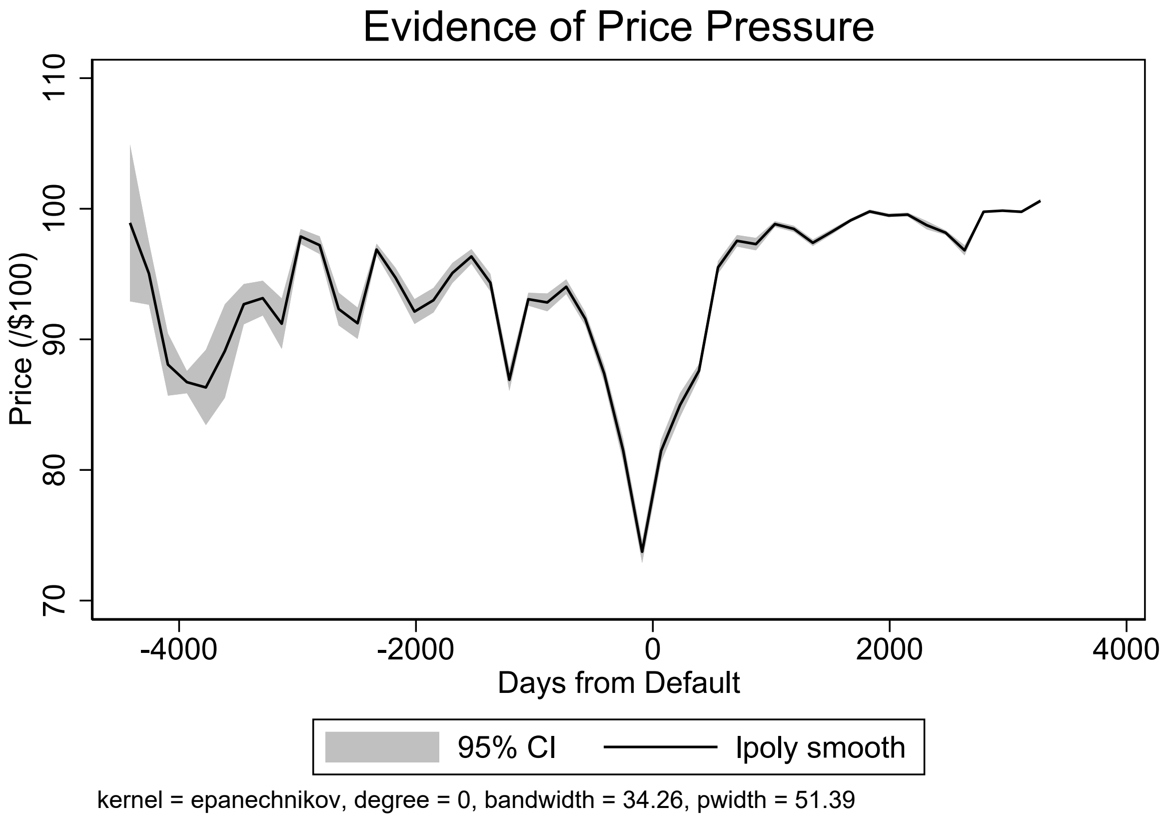
Notes: The top figure shows the industry distribution of leveraged loans at issuance, and leveraged loans in CLOs. The red bar indicates the share of leveraged loans by industry. The blue bar indicates the share of leveraged loans in CLOs by industry. The x-axis indicates the industry. The y-axis indicates the share (out of 1). The bottom figure shows the percent of second-lien loans among new issuance of leveraged loans and CLO issuance. The red bar indicates the percent of second-lien loans in leveraged loans. The blue bar indicates the percent of second-lien loans in CLOs. The x-axis is the year. The y-axis is the percent. Source: Refinitiv LPC Loan Pricing Data

Figure 2: Evidence of Monitoring: Default of Leveraged Loans and CLOs



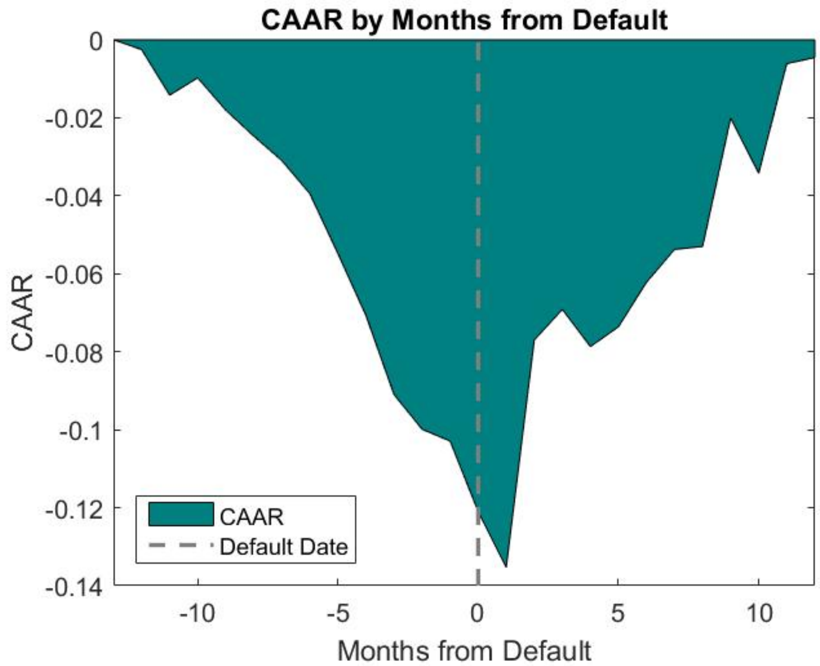
Notes: The top figure shows the leveraged loan default rate from 2015 through 2018. The x-axis indicates the date. The y-axis indicates the default rate. The bottom figure shows the percent of assets in default by CLO vintage at the end of December 2018. The blue bar indicates CLO 1.0s. The red bar indicates CLO 2.0s. The x-axis indicates the percent of assets in default. The y-axis indicates the share of CLOs across the universe of CLOs.

Figure 3: Price Patterns around Bankruptcy



Notes: The figure plots the kernel-weighted local polynomial of median price of loans issued by defaulted firms by the days from default. 1% of observations in the tails are trimmed. The gray shading indicates the 95% confidence interval. The solid line presents the estimate. The x-axis represents the days from default. The y-axis represents the price per $100.

Figure 4: CAAR by Month

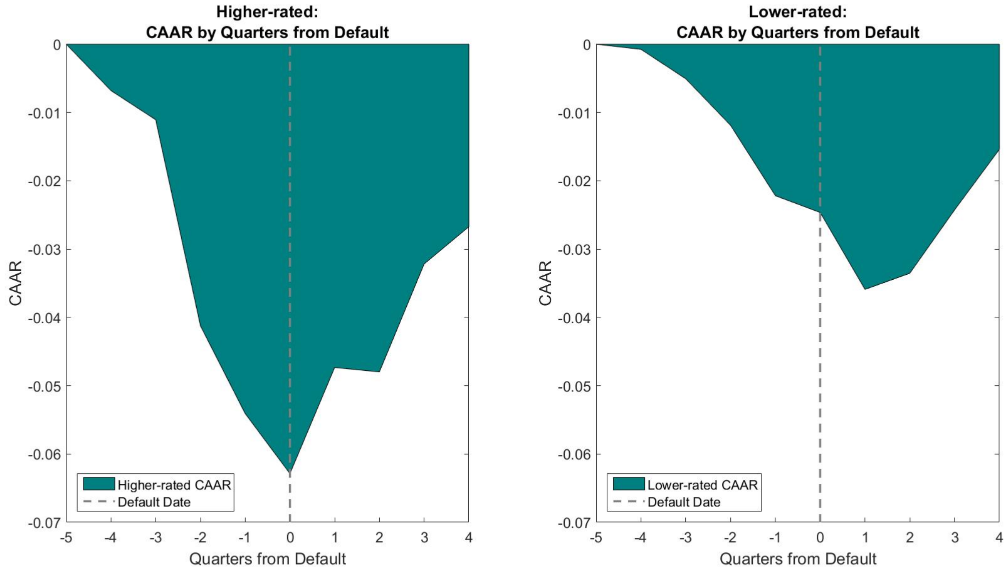


Monthly Cumulative Average Abnormal Returns

Months	CAAR	N	t-statistic	Months	CAAR	N	t-statistic
-12	-0.0025	96	-0.5742	1	-0.1353	77	-2.6114
-11	-0.0142	90	-2.6462	2	-0.0770	74	-1.4241
-10	-0.0098	122	-1.4680	3	-0.0692	37	-1.0706
-9	-0.0180	117	-2.4404	4	-0.0787	75	-1.1318
-8	-0.0247	131	-2.4232	5	-0.0736	84	-1.0076
-7	-0.0310	89	-2.1535	6	-0.0622	47	-0.7332
-6	-0.0395	151	-2.6281	7	-0.0538	68	-0.6327
-5	-0.0548	131	-2.8828	8	-0.0530	122	-0.6045
-4	-0.0707	116	-3.3901	9	-0.0201	93	-0.2296
-3	-0.0910	125	-4.1438	10	-0.0342	108	-0.3917
-2	-0.0999	90	-3.5531	11	-0.0061	95	-0.0631
-1	-0.1029	177	-3.3078	12	-0.0046	76	-0.0477
0	-0.1210	126	-3.4603				

Notes: The figure plots the monthly cumulative average abnormal return (CAAR) by months from default. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. The abnormal returns are averaged by months from default, and accumulated. The CAAR, 13 months before default, is normalized to be 0. The x-axis plots months from default. The y-axis plots the CAAR. The associated table tabulates the main results. The CAAR, t-statistic, and number of issuers is listed by months from default. The gray shading indicates that the CAAR is statistically significant above the 10% threshold.

Figure 5: CAAR for Loans of Higher vs. Lower Ratings

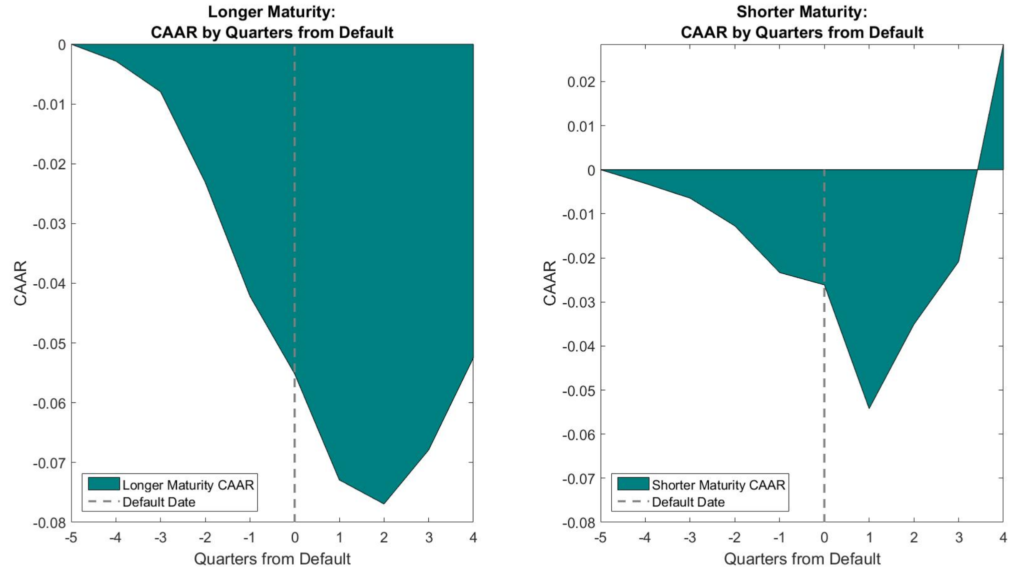


Quarterly Cumulative Average Abnormal Returns: Higher vs Lower Rated Loans

	Higher-Rated			Lower-Rated			Difference	
Quarters	CAAR	N	t-statistic	CAAR	N	t-statistic	Δ CAAR	t-statistic
-4	-0.0068	128	-1.7788	-0.0007	303	-0.3090	-0.0060	-1.3536
-3	-0.0111	72	-1.2218	-0.0051	295	-1.3246	-0.0060	-0.7653
-2	-0.0412	56	-2.5272	-0.0119	309	-2.4545	-0.0293	-3.2103
-1	-0.0541	44	-1.9155	-0.0222	239	-3.1519	-0.0319	-2.2844
0	-0.0629	64	-1.4947	-0.0246	174	-1.0817	-0.0382	-0.8449
1	-0.0473	36	-0.8602	-0.0359	97	-1.0461	-0.0114	-0.2528
2	-0.0480	59	-0.7461	-0.0335	124	-0.8712	-0.0144	-0.4155
3	-0.0322	58	-0.5076	-0.0243	111	-0.5814	-0.0079	-0.3676
4	-0.0267	173	-0.4168	-0.0154	149	-0.3408	-0.0113	-0.8082

Notes: The figure plots the quarterly cumulative average abnormal return (CAAR) by quarters from default for higher-rated loans (left figure) and lower-rated loans (right figure). Higher-rated loans are loans rated Baa3 and above. Lower-rated loans cover all other loans. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. These abnormal returns are averaged by quarters from default, and accumulated. The CAAR, five quarters from default, is normalized to be 0. The x-axis plots quarters from default. The y-axis plots the CAAR. The associated table tabulates the main results. The CAAR, t-statistic, and number of issuers is listed by quarters from default for higher- and lower-rated loans, respectively. Additionally, the difference (higher-rated CAAR minus lower-rated CAAR) and associated t-statistic are tabulated in the last two columns. The gray shading indicates that the CAAR is statistically significant above the 10% threshold.

Figure 6: CAAR for Loans of Longer vs. Shorter Remaining Maturities

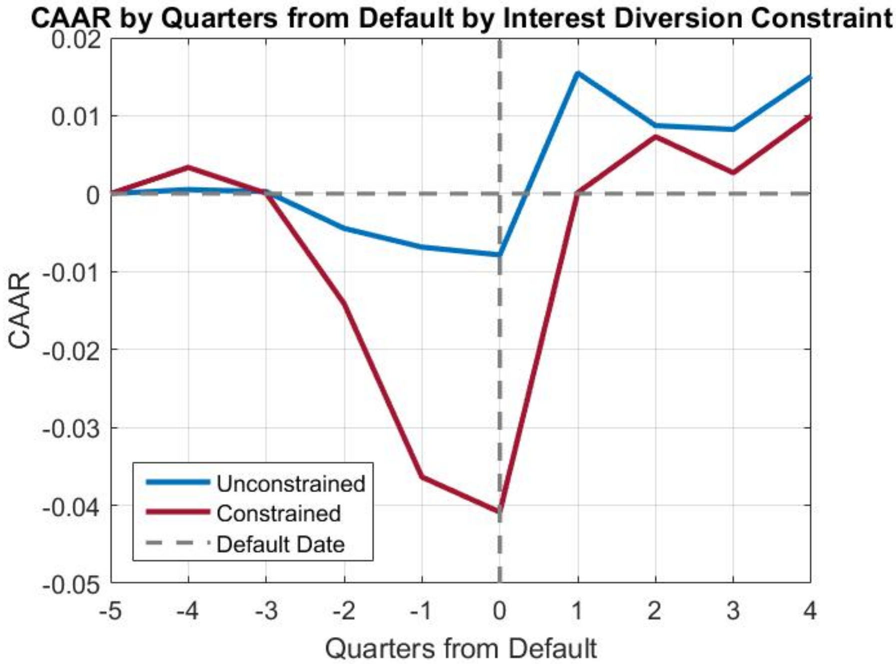


Quarterly Cumulative Average Abnormal Returns: Longer vs Shorter Remaining Maturity

	Longer Remaining Maturity			Shorter Remaining Maturity			Difference (Longer-Shorter)	
Quarters	CAAR	N	t-statistic	CAAR	N	t-statistic	Δ CAAR	t-statistic
-4	-0.0028	178	-0.8894	-0.0031	210	-1.0577	0.0003	0.0612
-3	-0.0080	131	-1.6199	-0.0065	159	-1.0952	-0.0015	-0.2482
-2	-0.0231	213	-3.3927	-0.0128	235	-1.7705	-0.0104	-1.4119
-1	-0.0422	158	-5.1690	-0.0233	169	-2.7731	-0.0188	-1.7264
0	-0.0552	106	-1.5450	-0.0261	131	-0.8849	-0.0290	-0.6326
1	-0.0729	31	-0.9312	-0.0542	47	-0.8801	-0.0187	-0.3602
2	-0.0769	40	-0.8140	-0.0351	42	-0.4472	-0.0418	-1.2032
3	-0.0679	40	-0.6060	-0.0208	54	-0.2676	-0.0471	-1.6959
4	-0.0525	51	-0.4314	0.0285	78	0.3330	-0.0810	-2.8274

Notes: The figure plots the quarterly cumulative average abnormal return (CAAR) by quarters from default for longer maturity loans (left figure) and shorter maturity loans (right figure). Longer maturity loans are loans with a remaining maturity above the median. Shorter maturity loans are loans with a remaining maturity below the median. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. These abnormal returns are averaged by quarters from default, and accumulated. The CAAR, five quarters from default, is normalized to be 0. The x-axis plots quarters from default. The y-axis plots the CAAR. The associated table tabulates the main results. The CAAR, t-statistic, and number of issuers is listed by quarters from default for longer- and shorter-maturity loans, respectively. Additionally, the difference (longer-maturity CAAR minus shorter-maturity CAAR) and associated t-statistic are tabulated in the last two columns. The gray shading indicates that the CAAR is statistically significant above the 10% threshold.

Figure 7: Constrained vs. Unconstrained CAAR by Interest Diversion Covenant Results

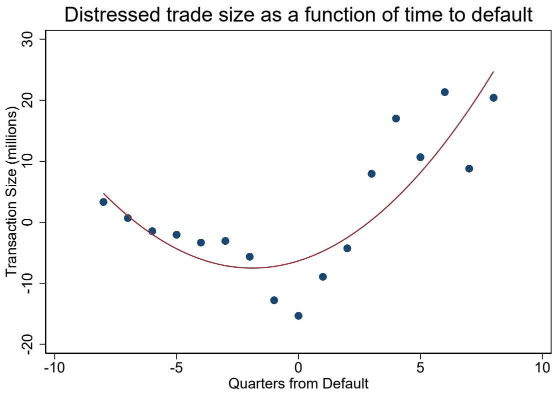


Quarterly Cumulative Average Abnormal Returns: Junior IC Ratio

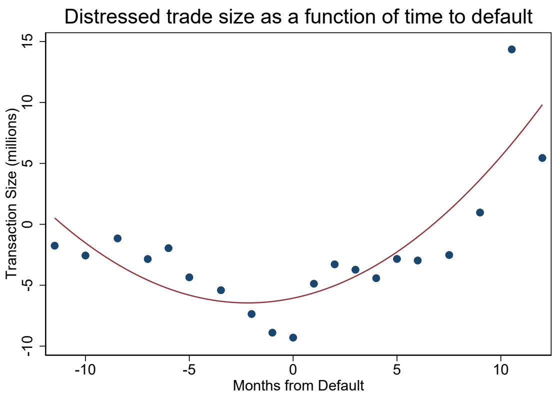
	Constrained			Unconstrained			Difference (Constrained-Unconstrained)	
Quarters	CAAR	N	t-statistic	CAAR	N	t-statistic	Δ CAAR	t-statistic
-4	0.0034	22	0.7691	0.0005	42	0.1902	0.0028	0.5896
-3	0.0001	42	0.0099	0.0003	65	0.0805	-0.0002	-0.0726
-2	-0.0141	19	-1.9867	-0.0045	86	-1.0319	-0.0096	-1.5638
-1	-0.0364	25	-4.6832	-0.0069	63	-1.2124	-0.0295	-6.2073
0	-0.0409	23	-4.5974	-0.0079	44	-1.0692	-0.0330	-4.4883
1	0.0001	14	0.0105	0.0155	16	1.5043	-0.0154	-1.5463
2	0.0073	31	0.5863	0.0087	15	0.6667	-0.0014	-0.1493
3	0.0027	33	0.1952	0.0082	20	0.6878	-0.0056	-0.8428
4	0.0100	57	0.8050	0.0151	47	1.1728	-0.0051	-1.7305

Notes: The figure plots the quarterly cumulative average abnormal return (CAAR) by quarters from default for loans that belong to Interest Diversion constrained CLOs (red) and Interest Diversion unconstrained CLOs (blue). Constrained CLOs are CLOs that have a Interest Diversion result below the median. Unconstrained CLOs are CLOs that have a Interest Diversion result above the median. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. These abnormal returns are averaged by quarters from default, and accumulated. The CAAR, five quarters from default, is normalized to be 0. The x-axis plots quarters from default. The y-axis plots the CAAR. Returns are winsorised at 3% level for each tail. The associated table tabulates the main results. The CAAR, t-statistic, and number of issuers is listed by quarters from default for loans belonging to constrained and unconstrained CLOs, respectively. Additionally, the difference (constrained CAAR minus unconstrained CAAR) and associated t-statistic are tabulated in the last two columns. The gray shading indicates that the CAAR is statistically significant above the 10% threshold.

Figure 8: Binscatter of Managerial Trading Behavior around Bankruptcy



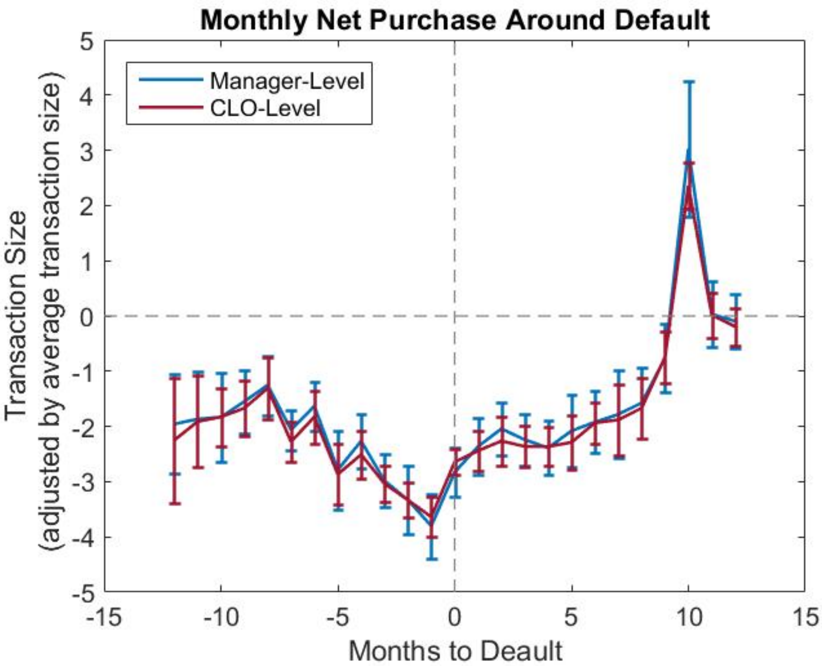
(a) Quarter



(b) Months

Notes: The binscatter diagrams show the net transaction size of distressed loans around bankruptcy. The left diagram exhibits the binned estimates of the total amount transacted across all CLOs for each distressed issuer -8/+8 quarters around bankruptcy. The right diagram exhibits the binned estimates of the total amount transacted across all CLOs for each distressed issuer -12/+12 months around bankruptcy. The x-axis indicates the time from bankruptcy. The y-axis indicates the net transaction size (in millions).

Figure 9: Monthly Net Purchase around Default



Notes: The figure plots the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the manager-and CLO-levels on month dummy variables. The red line indicates the results of the CLO-level regression. The blue line indicates the results of the manager-level regression. The x-axis indicates months to default. The y-axis indicates the monthly transaction size at the manager- or CLO-level, adjusted by the average transaction size. Standard errors are two-way clustered at the manager and month-year levels, and CLO and month-year levels for the manager-level and CLO-level regressions respectively.

8.2 Tables

Table 1: Projected Default Rates by Closing Year

Year	Projected Default Rate
2011	2.37%
2012	1.73%
2013	3.27%
2014	3.78%
2015	3.73%
2016	3.37%
2017	3.25%
2018	4.04%

Notes: The table reports the median projected default rate across all CLOs if CLOs were unable to trade from the closing date to maturity. The closing year is reported in the left column. The right column reports the corresponding the projected default rate.

Table 2: Extensive Margin: Distressed Loans and Covenant Results

	Risky Sale and Covenant Result						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbb{1}_{\text{Risky Sale, ct}}$	WAS	WA Life	Interest Div.	Junior IC	Junior OC	Senior IC	Senior OC
Covenant Result	0.0065	-0.0189***	-0.0300***	0.0328***	-0.0380***	-0.0122	-0.0318***
	(0.0097)	(0.0048)	(0.0095)	(0.0119)	(0.0053)	(0.0105)	(0.0057)
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	13,933	14,820	5,209	12,388	13,072	13,656	14,959
R^2	0.0957	0.0942	0.1393	0.1068	0.1069	0.1030	0.0990

Standard errors in parentheses, and two-way clustered at the Manager Month-Year Level

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the relation between a CLO's decision to sell risky assets and quality and coverage covenant results. The regression specification follows a linear probability model: $\mathbb{1}_{risky,ct} = \alpha + \beta \times \Delta Result_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. $\mathbb{1}_{risky,ct}$ takes on the value 1 if there is a decline in the share of risky assets (sum of defaulted and CCC-rated loans) between consecutive months, ϵ is the error, c denotes CLO, t denotes the month-year pair, m denotes CLO manager, y denotes the year, a denotes the arranger, and w denotes the trustee. The columns denote different covenant results (standardized); Weighted Average Spread covenant, Weighted Average Life covenant, Interest Diversion covenant, Junior IC covenant, Junior OC covenant, Senior IC covenant, and Senior OC covenant (Column 1-7, respectively).

Table 3: Intensive Margin: Distressed Loans and Covenant Results

Panel A: Risky Share$_t$ and Covenant Result$_t$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Risky Share$_t$	WAS	WA Life	Interest Div.	Junior IC	Junior OC	Senior IC	Senior OC
Covenant Result$_t$	0.3580	-0.0185	-0.2916	-1.7149***	-0.1888	-0.7715**	0.6295*
	(0.3631)	(0.2002)	(0.2231)	(0.2791)	(0.3069)	(0.3256)	(0.3203)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,533	4,453	1,598	4,142	4,137	4,443	4,860
R^2	0.7200	0.6470	0.5001	0.7762	0.6927	0.7496	0.6541

Panel B: Δ Risky Share$_{t+1}$ and Covenant Result$_t$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔRisky Share$_{t+1}$	WAS	WA Life	Interest Div.	Junior IC	Junior OC	Senior IC	Senior OC
Covenant Result$_t$	-0.5801*	-0.0468	-0.2773	-1.0587***	0.2636	-0.4080***	0.3420
	(0.3467)	(0.1925)	(0.2546)	(0.2603)	(0.1899)	(0.1511)	(0.2106)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,750	3,647	1,315	3,421	3,444	3,665	4,021
R^2	0.1880	0.1435	0.1616	0.2455	0.1570	0.1515	0.1464

Panel C: Δ Covenant Result$_t$ and Δ Risky Share$_t$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Covenant Result$_t$	WAS	WA Life	Interest Div.	Junior IC	Junior OC	Senior IC	Senior OC
ΔRisky Share$_t$	0.0106*	-0.0002	-0.0005	-0.0088**	-0.0017	-0.0058**	0.0009
	(0.0057)	(0.0004)	(0.0004)	(0.0036)	(0.0022)	(0.0025)	(0.0034)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,207	3,132	1,027	2,820	2,885	3,059	3,425
R^2	0.1837	0.1787	0.1988	0.1750	0.2065	0.1550	0.1769

Standard errors in parentheses, and two-way clustered at the manager and month-year levels

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the relation between distressed loans and quality and coverage covenant results. Panel A tests the relation between the risky share and standardized covenant results. The regression specification is: $Risky_{ct} = \alpha + \beta \times Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. Panel B tests the relation between the change in risky share in the subsequent period and current standardized covenant results. The regression specification is: $\Delta Risky_{ct+1} = \alpha + \beta \times Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. Panel C tests the relation between the change in risky share and change in standardized covenant result. The regression specification is: $\Delta Risky_{ct} = \alpha + \beta \times \Delta Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. $Risky_{ct}$ is the risky share, $\Delta Risky_{ct+1}$ is the change in the risky share in the subsequent period, $\Delta Risky_{ct}$ is the change in the risky share in the current period, $Result$ denotes the covenant results, Z contains all control variables, including size, performance, and age, ϵ is the error, c denotes CLO, t denotes the month-year pair, m denotes CLO manager, y denotes the year, a denotes the arranger, and w denotes the trustee. The columns denote different covenant restrictions; Weighted Average Spread covenant, Weighted Average Life covenant, Interest Diversion covenant, Junior IC covenant, Junior OC covenant, Senior IC covenant, and Senior OC covenant (Column 1-7, respectively).

Table 4: CLO Size and Covenant Threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Size_t	WAS	WARF	WA Life	Junior IC	Low OC	Senior IC	Senior OC
Threshold_t	-0.0302*	0.0205	0.0044	0.1539**	0.1227*	0.1876*	0.1181
	(0.0166)	(0.0184)	(0.0035)	(0.0760)	(0.0648)	(0.1016)	(0.1074)
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,595	4,823	4,569	4,221	6,076	4,492	4,911
R^2	0.5641	0.5625	0.5632	0.5878	0.5963	0.6033	0.5710

Standard errors in parentheses, and two-way clustered at the manager and month-year levels.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the relation between a CLO's size and quality and coverage thresholds. The regression specification is: $Size_{ct} = \alpha + \beta \times \Delta Threshold_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. $Size_{ct}$ is the size (standardized), Z contains all control variables, including performance and age, ϵ is the error, c denotes CLO, t denotes the month-year pair, m denotes CLO manager, y denotes the year, a denotes the arranger, and w denotes the trustee. The columns denote different covenant results (standardized); Weighted Average Spread threshold, Weighted Average Rating Factor threshold, Weighted Average Life threshold, Junior IC threshold, Interest Diversion/Junior OC threshold, Senior IC threshold, and Senior OC threshold (Column 1-7, respectively).

Table 5: Equity Distribution and Covenant Result

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equity Distribution$_t$	WAS	WARF	WA Life	Interest Div.	Junior IC	Junior OC	Senior IC	Senior OC	Junior IC
Covenant Result$_t$	0.3214*	0.4695***	0.1044	0.0118	0.6697***	-0.0700	0.3256**	-0.0311	0.7629***
	(0.1644)	(0.1394)	(0.0859)	(0.0600)	(0.1541)	(0.0834)	(0.1561)	(0.0396)	(0.2460)
Size Control	✓	✓	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓	✓	✓
CLO-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,107	4,296	4,009	1,428	3,764	3,888	3,994	4,354	984,455
R^2	0.6452	0.6543	0.5882	0.7654	0.6743	0.6425	0.6880	0.6917	0.7576

Standard errors in parentheses, and two-way clustered at the manager and month-year levels

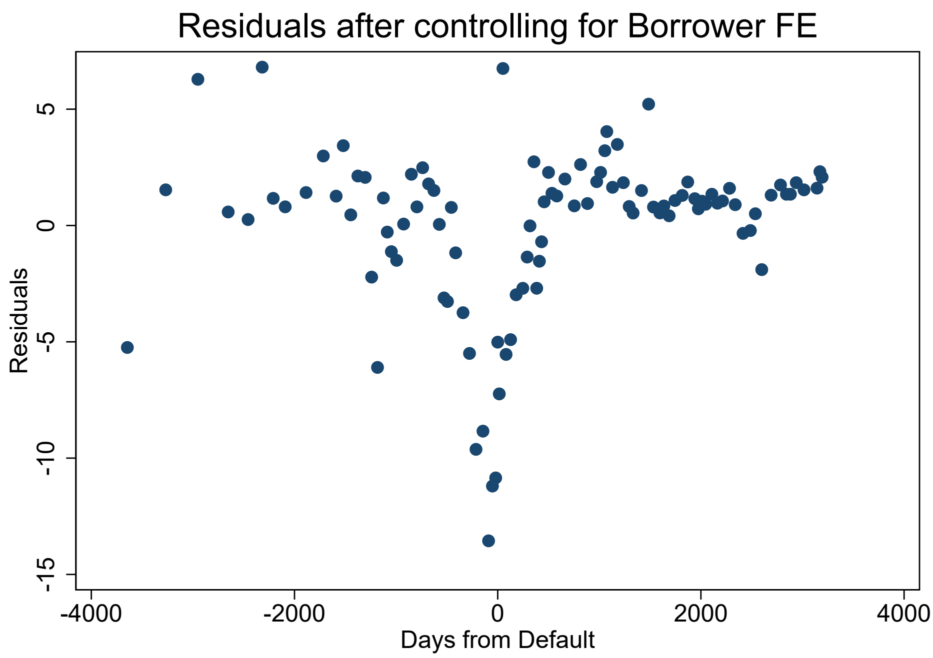
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the relation between a CLO's equity distribution and quality and coverage covenant results. The regression specification is: $Distribution_{ct} = \alpha + \beta \times \Delta Result_{ct} + \Gamma Z_{ct} + \gamma_{cy} + \delta_a + \delta_w + \epsilon_{ct}$. $Distribution_{ct}$ is the equity distribution (standardized), Z contains all control variables, including size and age, ϵ is the error, c denotes CLO, t denotes the month-year pair, c denotes CLO, y denotes the year, a denotes the arranger, and w denotes the trustee. The columns denote different covenant results (standardized); Weighted Average Spread covenant, Weighted Average Rating Factor, Weighted Average Life covenant, Interest Diversion covenant, Junior IC covenant, Junior OC covenant, Senior IC covenant, and Senior OC covenant (Column 1-8, respectively). In Column (9), I represent the results from the "leave-one-out" methodology, in which I iterate through each firm and recompute the Junior IC ratio without accounting for the presence of that particular firm.

Appendix A Additional Price Related Findings and Calculations

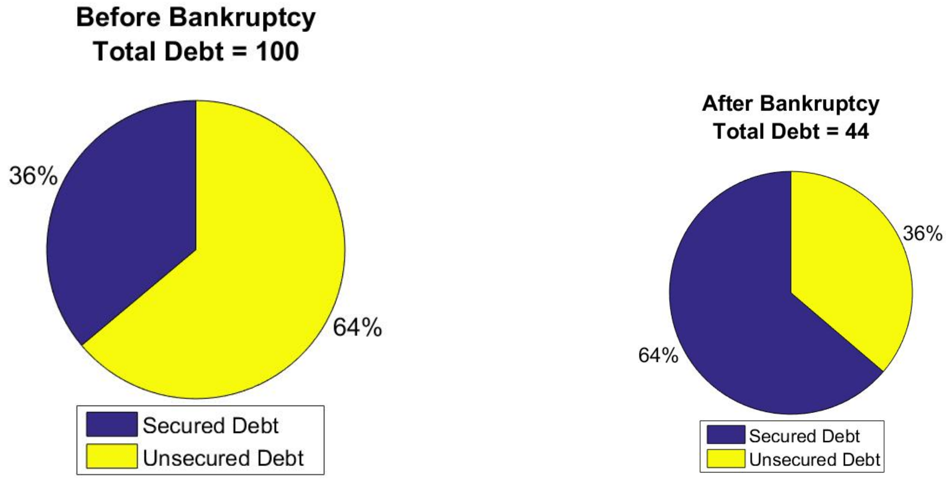
A.1 Figures

Figure A.1: Residuals after absorbing issuer



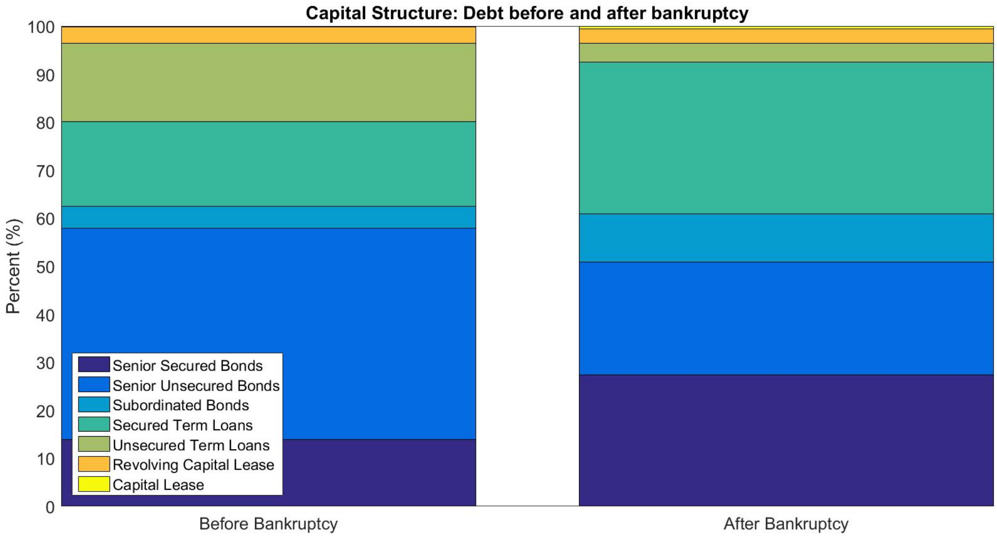
Notes: The figure plots the residual of the following regression: $Price_{lt} = \alpha + \delta_f + \epsilon_{lt}$ where l denotes the loan, t denotes the day from default, and f denotes the firm. The x-axis plots the days from default. The y-axis plots the residual value.

Figure A.2: Total Debt: A breakdown



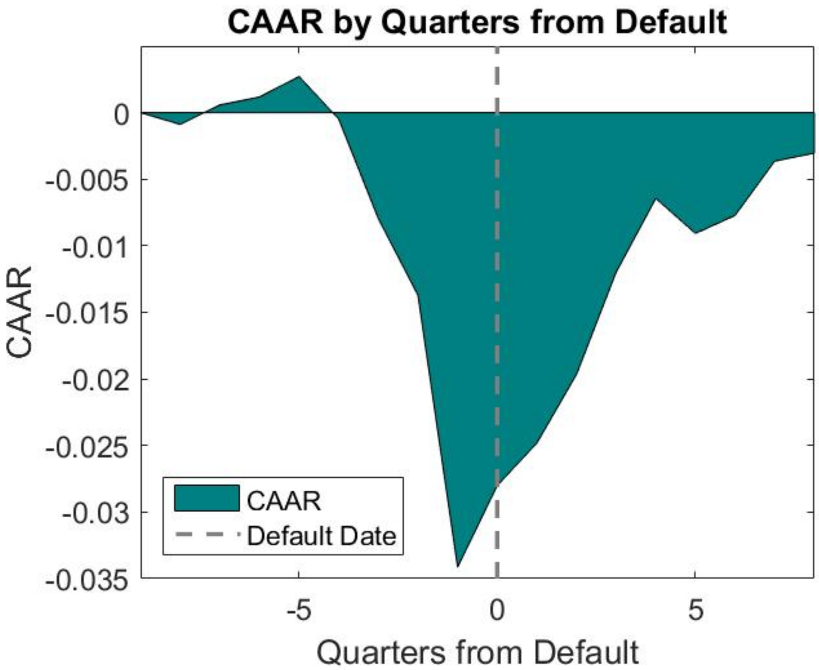
Notes: The figure presents the change in total amount of debt before (left figure) and after (right figure) bankruptcy, and the share of secured and unsecured debt for distressed issuers in the sample. "Before" bankruptcy is defined 6-18 months before the bankruptcy date. "After" bankruptcy is defined as 6-18 months after the bankruptcy date. The share of secured debt is represented in blue. The share of unsecured debt is represented in yellow. The total amount of debt before bankruptcy is normalized to be 100.

Figure A.3: Debt Structure



Notes: The figure presents the debt structure before (left figure) and after (right figure) bankruptcy. "Before" bankruptcy is defined 6-18 months before the bankruptcy date. "After" bankruptcy is defined as 6-18 months after the bankruptcy date. The figures show the relative composition of debt before and after bankruptcy. From top to bottom, the figure shows the amount of capital lease, revolving capital lease, unsecured term loans, secured term loans, subordinated bonds, senior unsecured bonds, and senior secured bonds.

Figure A.4: CAAR by Quarters

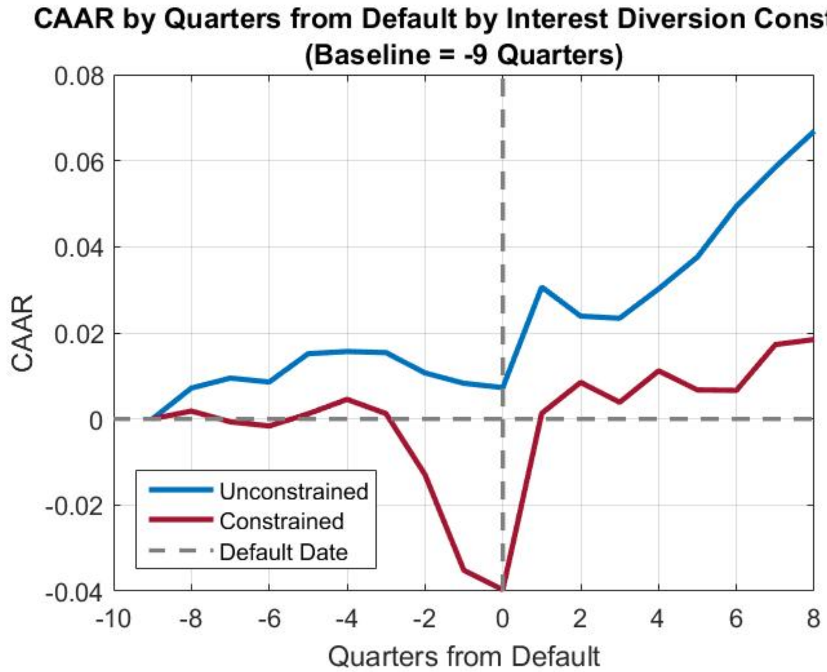


Monthly Cumulative Average Abnormal Returns

Months	CAAR	N	t-statistic	Months	CAAR	N	t-statistic
-12	-0.0025	96	-0.5742	1	-0.1353	77	-2.6114
-11	-0.0142	90	-2.6462	2	-0.0770	74	-1.4241
-10	-0.0098	122	-1.4680	3	-0.0692	37	-1.0706
-9	-0.0180	117	-2.4404	4	-0.0787	75	-1.1318
-8	-0.0247	131	-2.4232	5	-0.0736	84	-1.0076
-7	-0.0310	89	-2.1535	6	-0.0622	47	-0.7332
-6	-0.0395	151	-2.6281	7	-0.0538	68	-0.6327
-5	-0.0548	131	-2.8828	8	-0.0530	122	-0.6045
-4	-0.0707	116	-3.3901	9	-0.0201	93	-0.2296
-3	-0.0910	125	-4.1438	10	-0.0342	108	-0.3917
-2	-0.0999	90	-3.5531	11	-0.0061	95	-0.0631
-1	-0.1029	177	-3.3078	12	-0.0046	76	-0.0477
0	-0.1210	126	-3.4603				

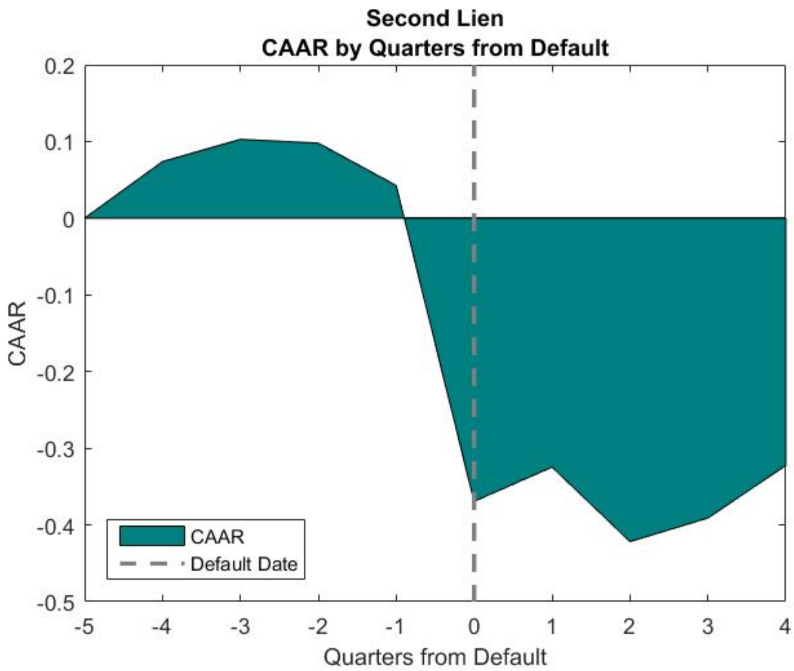
Notes: The figure plots the monthly cumulative average abnormal return (CAAR) by quarters from default. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. These abnormal returns are averaged by months from default, and accumulated. The CAAR, 5 months before default, is normalized to be 0. The x-axis plots months from default. The y-axis plots the CAAR. The associated table tabulates the main results. The CAAR, t-statistic, and number of issuers is listed by months from default. The gray shading indicates that the CAAR is statistically significant above the 10% threshold.

Figure A.5: Persistence in CAAR between Constrained and Unconstrained



Notes: The figure plots the quarterly cumulative average abnormal return (CAAR) by quarters from default for loans that belong to Interest Diversion constrained CLOs (red) and Interest Diversion unconstrained CLOs (blue). Constrained CLOs are CLOs that have a Interest Diversion result below the median. Unconstrained CLOs are CLOs that have a Interest Diversion result above the median. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. These abnormal returns are averaged by quarters from default, and accumulated. The CAAR, 9 months from default, is normalized to be 0. The x-axis plots quarters from default. The y-axis plots the CAAR for loans belonging to constrained and unconstrained CLOs. The red line indicates constrained CLOs. The blue line indicated unconstrained CLOs.

Figure A.6: Second-lien CAAR



Notes: The figure plots the quarterly cumulative average abnormal return (CAAR) by quarters around default for second-lien loans. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t} ln(S_{i,t}) - Q_{i,t-1} ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. These abnormal returns are averaged by quarters from default, and accumulated. Returns are winsorised at 1% level. The CAAR, five months from default, is normalized to be 0. The x-axis plots quarters from default. The y-axis plots the CAAR.

A.2 CAAR Standard Errors Computation

Assumptions:

1. For a given day, $AR^i_d \sim D^i(0, \sigma_i^2)$
2. Abnormal return for a given day is uncorrelated with the abnormal returns on another day, i.e., AR^i_d and $AR^i_{d\neq j}$ are uncorrelated in a given month
   - $\Rightarrow AAR^i = \frac{1}{N^d}\sum_{d=1}^{D} AR^i_d$
   - Asymptotically, $AAR^i \sim D(0, \frac{\sigma_i^2}{N^d})$
3. AAR^i is correlated with AAR^j where $j \neq 0$

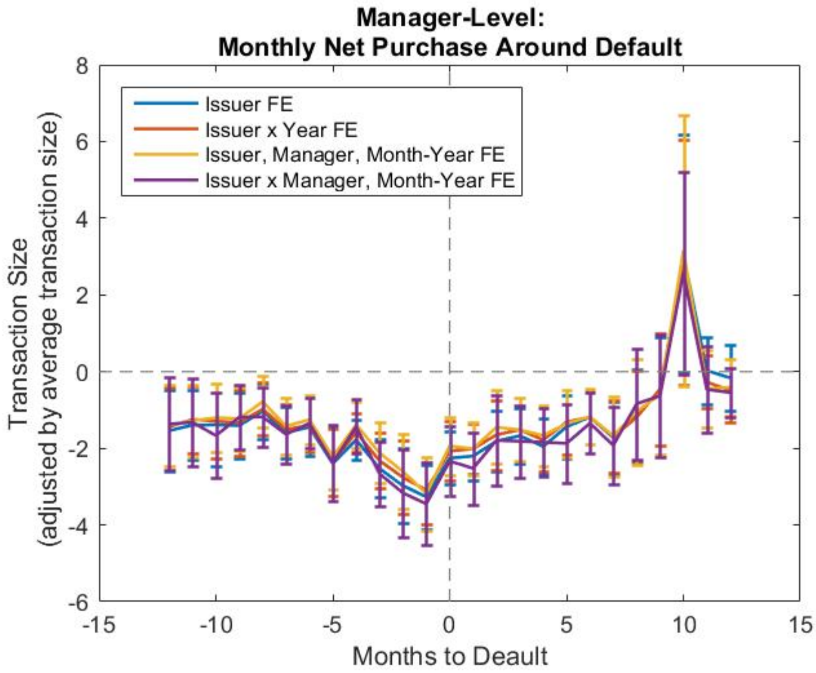
Estimating SE:

1. Estimate factor model for daily log returns at issuer-level
2. Take ARs and average them at the monthly or weekly level
3. Cumulate the AARs at monthly or quarterly level
4. Standard errors of AARs are $\frac{\sigma}{\sqrt{N-1}}$ of residuals
5. Standard errors of CAARs is standard errors of sum of means of data $X_1 \dots X_N$

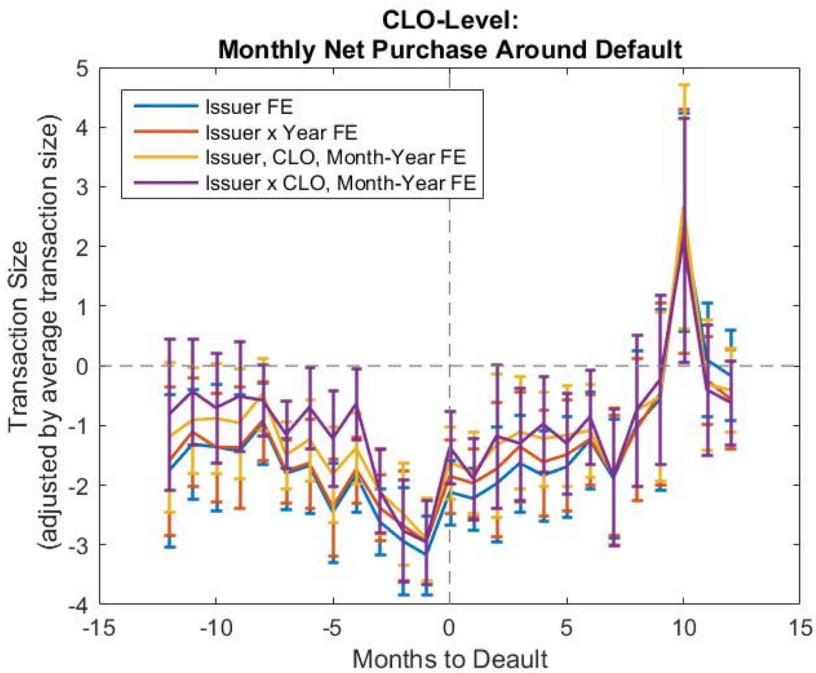
$$\boxed{SE(\sum_{i=1}^{N} AAR_i) = \sqrt{\sum_{i=1}^{N} SE(AAR_i)^2 + \sum_{\substack{j\neq i\\ j=1}}^{N}\sum_{i}^{N} \frac{cov(X_i, X_j)}{\sqrt{(N_i-1)}\sqrt{(N_j-1)}}}}$$

Appendix B Potential Confounders, Robustness, and Determinants of Trading Behavior

Figure B.1: Monthly Net Purchase around Default with Fixed Effects



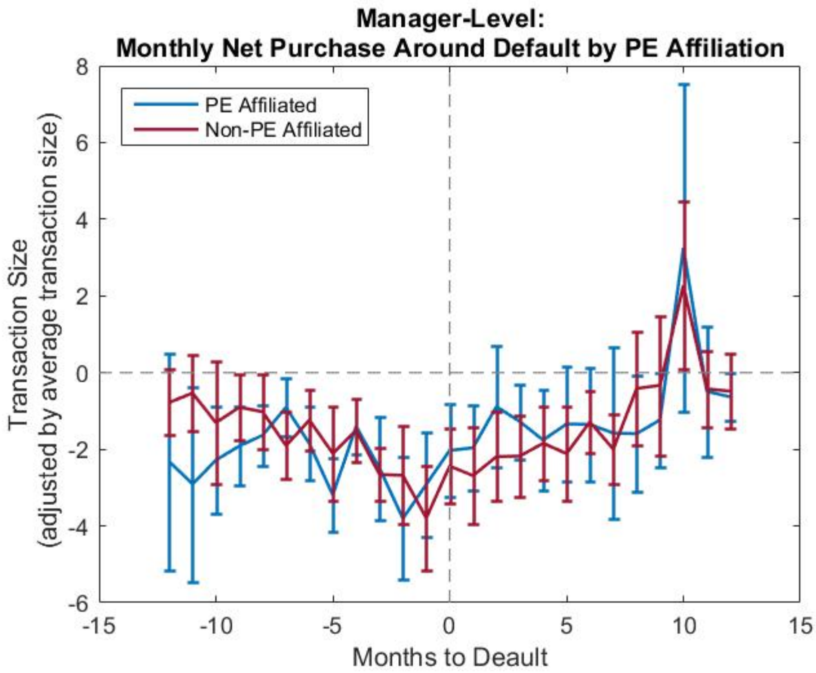
(a) Manager-level



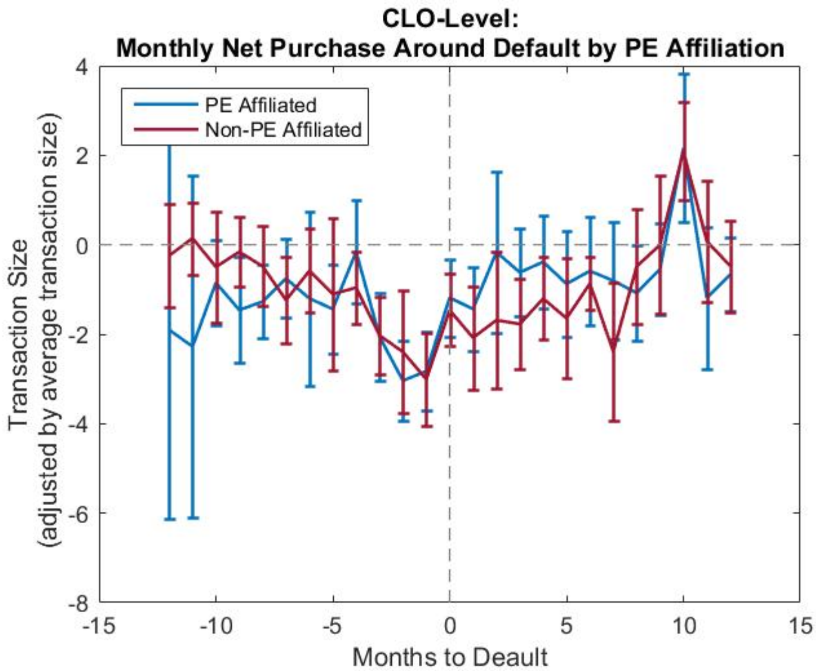
(b) CLO-level

Notes: The figures plot the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the manager-level (top figure) and CLO-level (bottom figure) on month dummy variables with fixed effects. In both figures, the blue line indicates the inclusion of issuer fixed effects; the red indicates issuer-year fixed effects. In the top figure, the yellow line indicates the inclusion of issuer, manager, and month-year fixed effects; purple indicates issuer-manager, and month-year fixed effects. In the bottom figure: the yellow line indicates the inclusion of issuer, CLO, and month-year fixed effects; purple indicates issuer-CLO, and month-year fixed effects. The x-axis indicates months to default. The y-axis indicates the monthly transaction size at the manager- or CLO-level, adjusted by the average transaction size. Standard errors are two-way clustered at the manager and month-year levels, and, CLO and month-year levels, in the top and bottom figures, respectively.

Figure B.2: Monthly Net Purchase around Default: Private Equity Comparison (FE inc.)



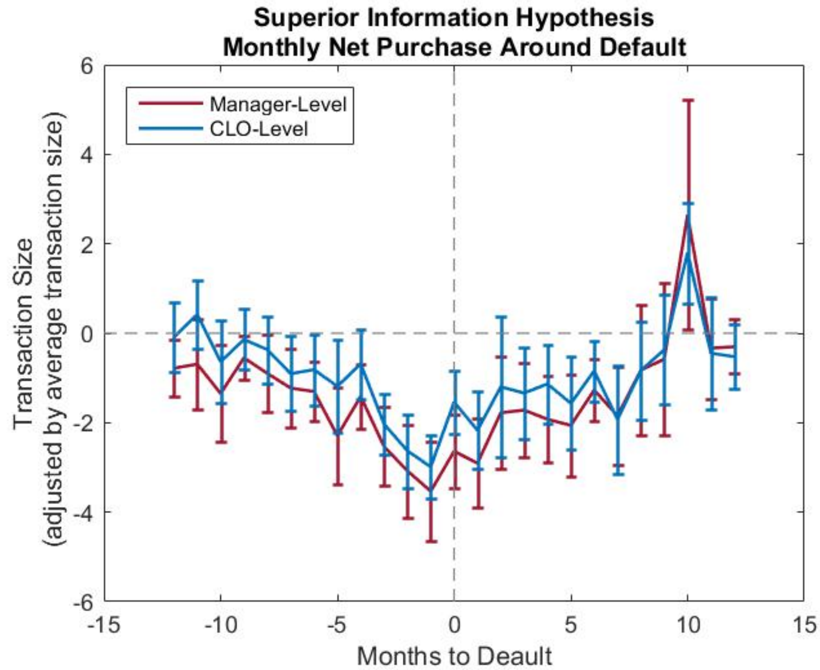
(a) Manager-level



(b) CLO-level

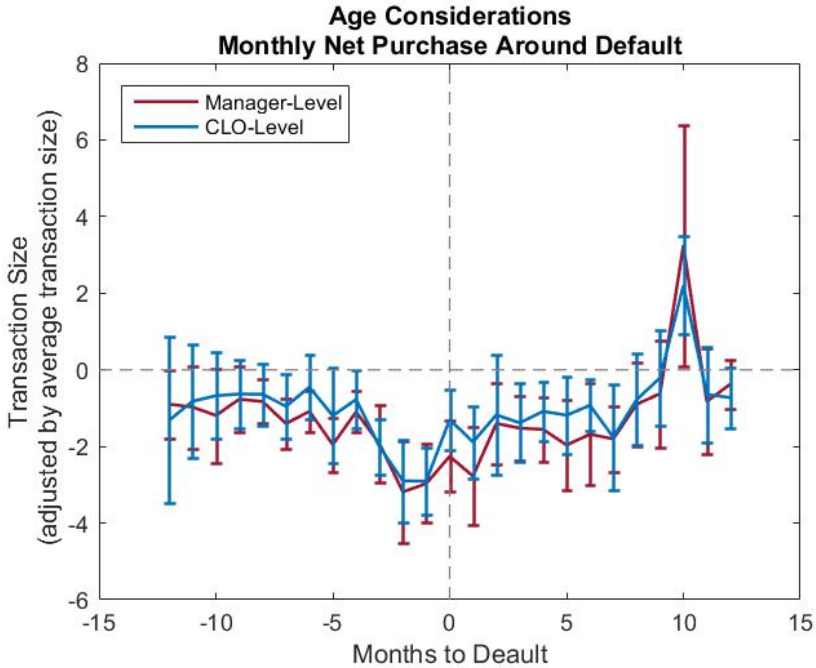
Notes: The top figure plots the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the manager-level on month dummy variables with issuer-manager, and month-year fixed effects. The bottom figure plots the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the CLO-level on month dummy variables with issuer-CLO, and month-year fixed effects. The blue line indicates if the CLO is affiliated with a private equity firm. The red line indicates if the CLO is not affiliated with a private equity firm. The x-axis indicates months to default. The y-axis indicates the monthly transaction size at the manager- or CLO-level, adjusted by the average transaction size. Standard errors are two-way clustered at the manager and month-year levels in top figure, and CLO and month-year levels in the bottom figure.

Figure B.3: Monthly Net Purchase around Default: Super Information Hypothesis (FE inc.)



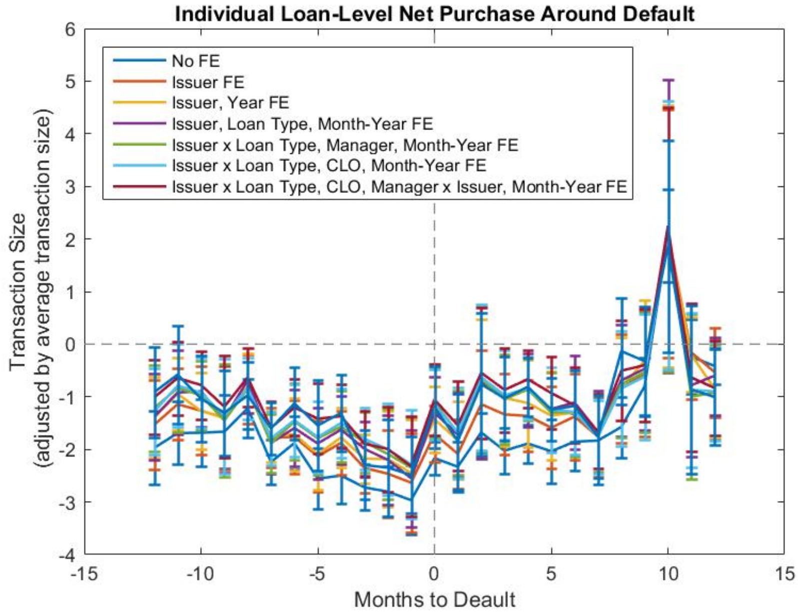
Notes: The top figure plots the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the manager- and CLO-level on month dummy variables with issuer-manager, and month-year fixed effects, and issuer-CLO, and month-year fixed effects, respectively. The red line indicates that the regression is at the manager-level. The blue line indicates that the regression is at the CLO-level. The x-axis indicates months to default. The y-axis indicates the monthly transaction size at the manager- or CLO-level, adjusted by the average transaction size. Standard errors are two-way clustered at the manager and month-year levels, and CLO and month-year levels for the manager-level and CLO-level regressions, respectively.

Figure B.4: Monthly Net Purchase around Default: Consideration of Age (all FE included)



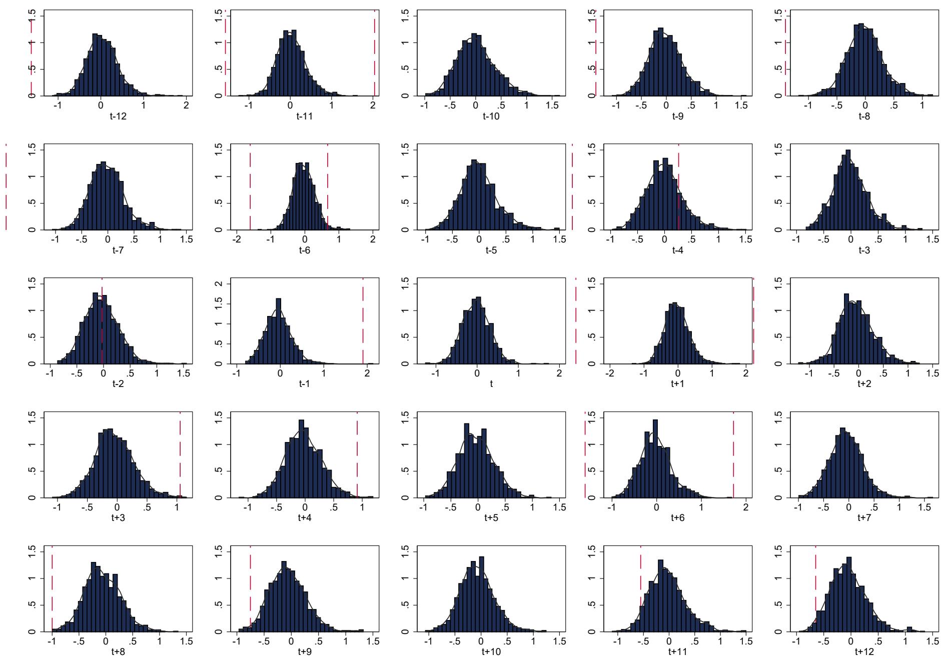
Notes: The top figure plots the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the manager- and CLO-level on month dummy variables with issuer-manager, month-year, and age decile fixed effects, and issuer-CLO, month-year, and age decile fixed effects, respectively. The red line indicates that the regression is at the manager-level. The blue line indicates that the regression is at the CLO-level. The x-axis indicates months to default. The y-axis indicates the monthly transaction size at the manager- or CLO-level, adjusted by the average transaction size. Standard errors are two-way clustered at the manager and month-year levels, and CLO and month-year levels for the manager-level and CLO-level regressions, respectively.

Figure B.5: Individual Transactions around Default

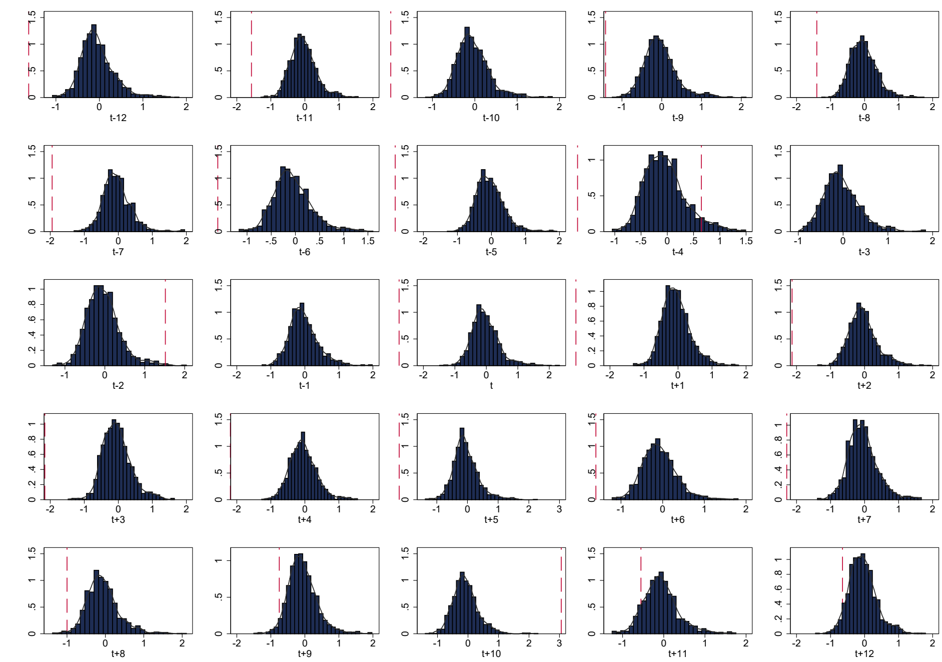


Notes: The figure plots the transactions βs and the associated 95% confidence interval from regressing the monthly transaction size at the manager- and CLO-level on month dummy variables with various levels of fixed effects. The blue line indicates there are no fixed effects. The red line indicates the inclusion of issuer fixed effects. The yellow line indicates the inclusion of issuer and year fixed effects. The purple line indicates the inclusion of issuer, loan type, and month-year fixed effects. The green line indicates the inclusion of issuer-loan type, manager, and month-year fixed effects. The cyan line indicates the inclusion of issuer-loan type, CLO, and month-year fixed effects. The magenta line indicates the inclusion of issuer-loan type, CLO, manager-issuer, and month-year fixed effects. The x-axis indicates months to default. The y-axis indicates the transaction size, adjusted by the average transaction size. Standard errors are two-way clustered at the manager and month-year levels.

Figure B.6: Placebo



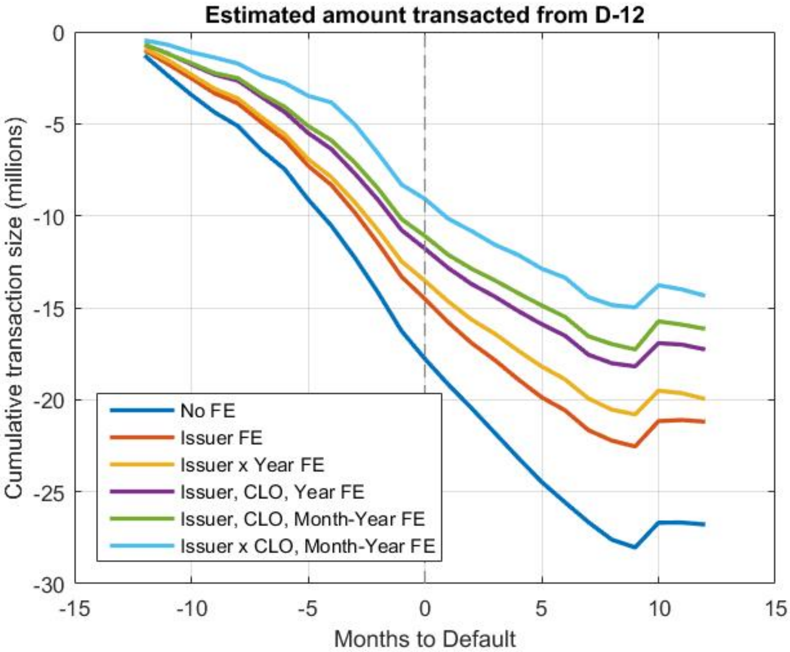
(a) Randomization of timing



(b) Randomization of distress

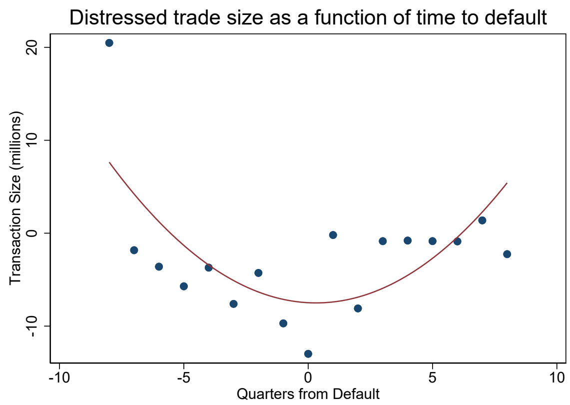
Notes: The figures show the distribution of βs for each month with placebo testing. In the top figure, I report the baseline regression results after randomizing the timing of default. In the bottom figure, I report the baseline regression results after randomizing the distressed issuers. The histogram of β values are plotted for -12/+12 months around bankruptcy, with 1000 repetitions. The dashed red line is the "true" β value from the baseline regression. Disclaimer: the red line may appear "off the chart."

Figure B.7: Cumulative Results

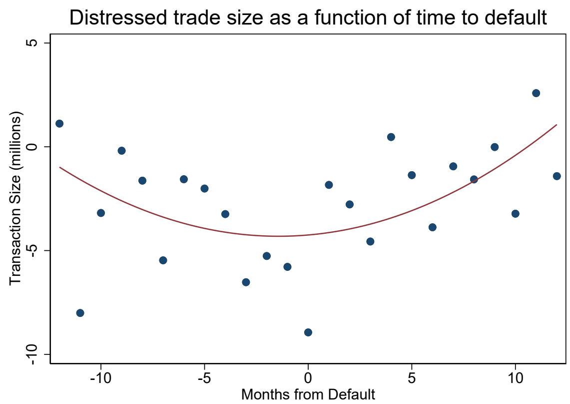


Notes: The figure reports the cumulative βs of the CLO-level regression, in consideration of various fixed effects. The blue line indicates no fixed effects. The red line indicates the inclusion of issuer fixed effects. The yellow line indicates the inclusion of issuer-year fixed effects. The purple line indicates the inclusion of issuer, CLO, and year fixed effects. The green line indicates the inclusion of issuer, CLO, and month-year fixed effects. The cyan line indicates the inclusion of issuer-CLO and month-year fixed effects. The x-axis indicates the months to default. The y-axis indicates the cumulative transaction size (millions).

Figure B.8: Binscatter of Managerial Trading Behavior around missed interest and principal payments



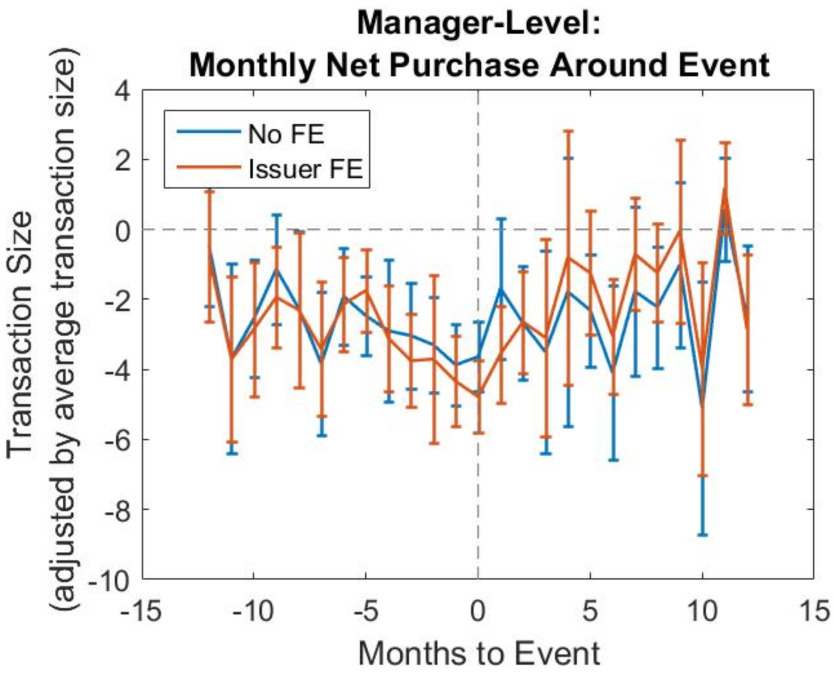
(a) Quarters



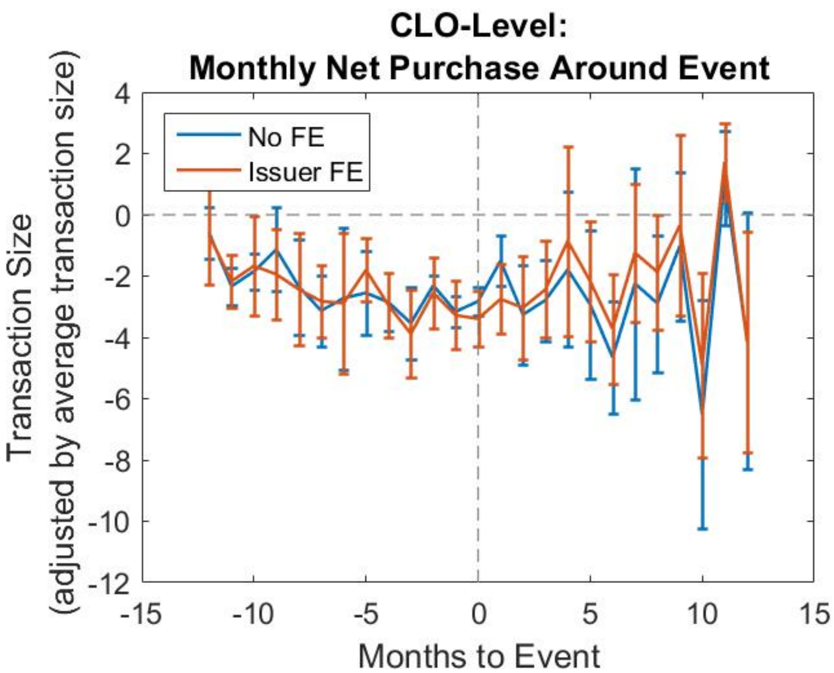
(b) Months

Notes: The binscatter diagrams show the net transaction size of distressed loans around other default events, namely, missed interest and principal payments – precursors of downgrades. The left diagram exhibits the binned estimates of the total amount transacted across all CLOs for each distressed issuer -8/+8 quarters around missed interest and principal payments. The right diagram exhibits the binned estimates of the total amount transacted across all CLOs for each distressed issuer -12/+12 months around missed interest and principal payments. The x-axis indicates the time from the default event. The y-axis indicates the net transaction size (in millions).

Figure B.9: Preemptive Selling for Missed Interest and Principal Events



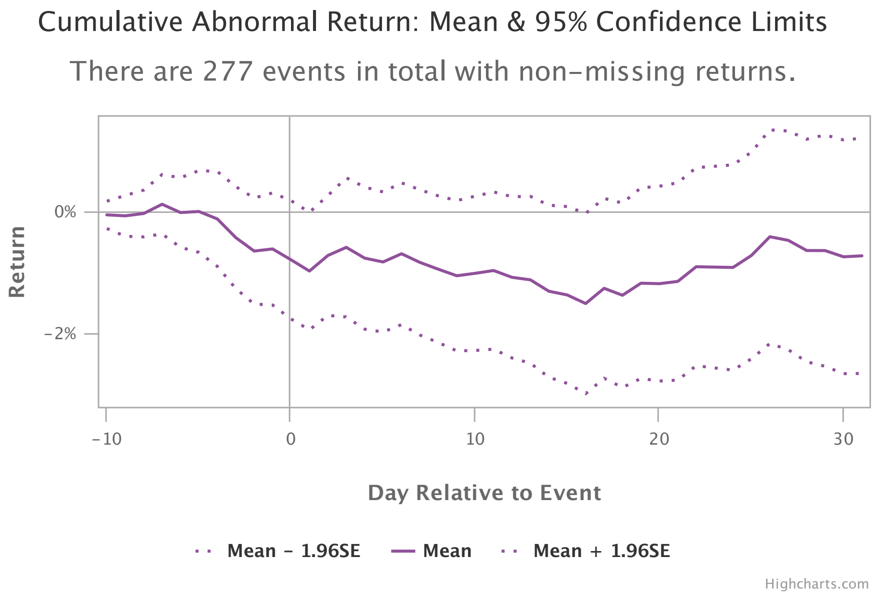
(a) Manager-level



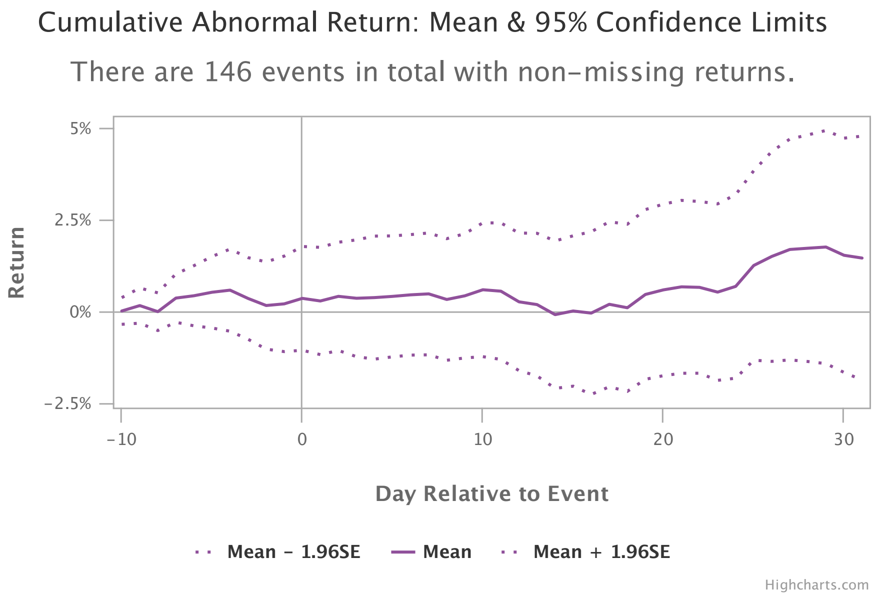
(b) CLO-level

Notes: The top figure plots the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the manager level on month dummy variables. The bottom figure plots the month βs and the associated 95% confidence interval from regressing the monthly transaction size at the CLO level on month dummy variables. The red line indicates the inclusion of fixed effects in the regression. The blue line indicates that the there are no fixed effects. The x-axis indicates months to default. The y-axis indicates the monthly transaction size at the manager- or CLO-level, adjusted by the average transaction size. Standard errors are two-way clustered at the manager and month-year levels, and CLO and month-year levels for the manager-level and CLO-level regressions, respectively.

Figure B.10: Cumulative Abnormal Stock Returns around Large Sale Events



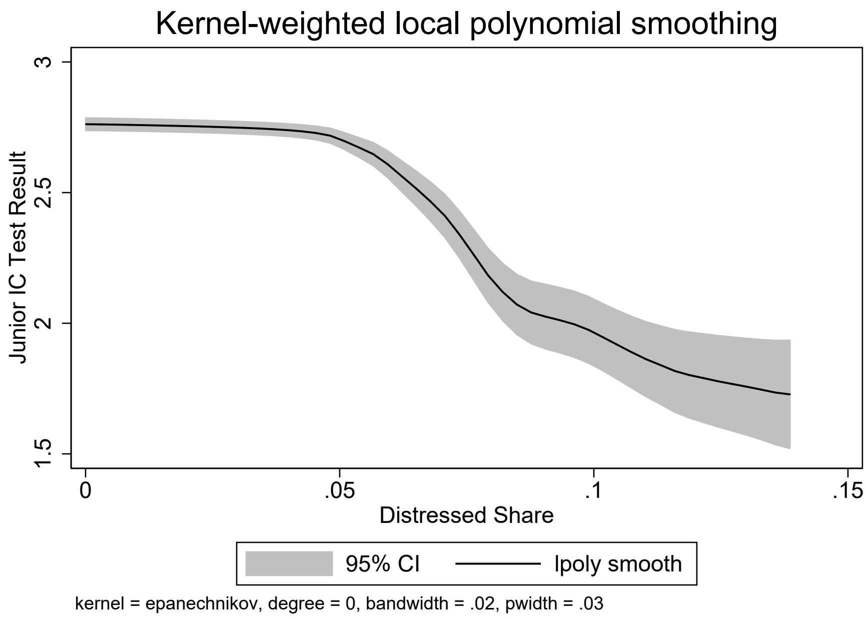
(a) Individual Transactions



(b) Daily Issuer Transactions

Notes: The top figure shows the cumulative abnormal stock returns around large sale events, which is defined by an issuer-date pair, signifying that the transaction size of an issuer's loans on a given date exceeded the >=99th percentile of all sales across the sample period. The bottom figure shows the cumulative abnormal stock returns around large sale events, which is defined by an issuer-date pair, signifying that that the total volume of an issuer's loans on a given date exceeded the >=99th percentile of all daily volumes across all issuers in the sample period. The estimation window is 30 days, minimum number of valid returns is 70 days, gap is 50 days, the event window start date is 10 days before the sale, and the event window end date is 30 days after the sale.

Figure B.11: Distressed Share and Junior IC Covenant Result



Notes: The figure shows the kernel-weighted local polynomial of the Junior IC result as a function of the share of distressed loans. A loan is designated as distressed if its issuer files for bankruptcy in the sample period. The gray shading denotes the 95% confidence interval. The solid black line plots the estimate.

Table B.1: Extensive Margin: Risky Loans and Covenant Results

Risky Sale and Covenant Result							
	$\mathbb{1}_{\text{Defaulted Sale}}$		$\mathbb{1}_{\text{CCC Sale}}$		$\mathbb{1}_{\text{Risky Sale}}$ (Leave-one-out)		
	Low OC	Senior OC	Low OC	Senior OC	Interest Diversion	Junior OC	Senior OC
Covenant Result	8 -0.0384***	-0.0255***	-0.0234***	-0.0268***	-0.2495***	-0.1102***	-0.0242***
	(0.0054)	(0.0035)	(0.0056)	(0.0048)	(0.0631)	(0.0353)	(0.0071)
Size Control					✓	✓	✓
Performance Control					✓	✓	✓
Age Control					✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	18,355	14,957	18,355	14,957	1,707,657	3,381,091	3,769,093
R^2 0.1403	0.1292	0.1025	0.0907	0.2557	0.2205	0.2047	

Standard errors in parentheses, and two-way clustered at the manager and month-year levels.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the relation between a CLO's decision to sell risky loans, defaulted loans, and CCC loans, and, quality and coverage covenant results. The regression specification follows a linear probability model: $\mathbb{1}_{defaulted/CCC,ct} = \alpha + \beta \times \Delta Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. $\mathbb{1}_{risky,ct}$ takes on the value 1 if there is a decline in the share of defaulted loans (Columns 1-2), decline in the share of CCC loans (Columns 3-4), and decline in share of risky loans using the leave-one-out methodology, in which I iterate through each firm and recompute the covenant result in the absence of that particular firm (Columns 5-7). Z contains all control variables, including size, performance, and age, ϵ is the error, c denotes CLO, t denotes the month-year pair, m denotes CLO manager, y denotes the year, a denotes the arranger, and w denotes the trustee. The columns denote different covenant results (standardized): Interest Diversion/Junior OC covenant, Senior OC covenant, Interest Diversion/Junior OC covenant, Senior OC covenant, Interest Diversion covenant, Junior OC covenant, and Senior OC covenant (Column 1-8, respectively).

Table B.2: Defaulted Loans and Covenant Results

Panel A: Defaulted Share_{t} and Covenant Result_t

Default Share	(1) WAS	(2) WA Life	(3) Interest Div.	(4) Junior IC	(5) Junior OC	(6) Senior IC	(7) Senior OC
Covenant Result	0.1063	-0.1945	-0.0446	-1.0752***	-0.3517	-0.3801	0.3501
	(0.3650)	(0.2344)	(0.1051)	(0.2672)	(0.3330)	(0.2764)	(0.3081)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,533	4,453	1,598	4,142	4,137	4,443	4,860
R^2	0.5739	0.4979	0.5051	0.6162	0.5183	0.5884	0.4772

Panel B: Δ Defaulted $\text{Share}_{\text{t+1}}$ and Covenant Result_{t}

ΔDefault Share	(1) WAS	(2) WA Life	(3) Interest Div.	(4) Junior IC	(5) Junior OC	(6) Senior IC	(7) Senior OC
Covenant Result	-0.2826	-0.0989	-0.0851	-0.2821	-0.0767	-0.2408*	0.0147
	(0.2395)	(0.1237)	(0.2386)	(0.2138)	(0.1039)	(0.1288)	(0.1760)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,988	3,915	1,428	3,659	3,664	3,927	4,279
R^2	0.2066	0.1297	0.1539	0.1558	0.1379	0.1265	0.1318

Panel C: Δ Covenant Result_{t} and Δ Defaulted Share

Δ Covenant Result	(1) WAS	(2) WA Life	(3) Interest Div.	(4) Junior IC	(5) Junior OC	(6) Senior IC	(7) Senior OC
ΔDefault Share	0.0069	-0.0002	-0.0008	-0.0095**	-0.0015	-0.0044*	0.0037
	(0.0053)	(0.0003)	(0.0005)	(0.0045)	(0.0024)	(0.0023)	(0.0052)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,207	3,132	1,027	2,820	2,885	3,059	3,425
R^2	0.1667	0.1787	0.1990	0.1742	0.2063	0.1516	0.1786

Standard errors in parentheses, and two-way clustered at the manager and month-year levels.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the relation between defaulted loans and quality and coverage covenant results. Panel A tests the relation between the defaulted share and standardized covenant result. The regression specification is: $Defaulted_{ct} = \alpha + \beta \times Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. Panel B tests the relation between the change in defaulted share in the subsequent period and current standardized covenant result. The regression specification is: $\Delta Defaulted_{ct+1} = \alpha + \beta \times Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. Panel C tests the relation between the change in defaulted share and change in standardized covenant result. The regression specification is: $\Delta Defaulted_{ct} = \alpha + \beta \times \Delta Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. $Defaulted_{ct}$ is the defaulted share, $\Delta Defaulted_{ct+1}$ is the change in the defaulted share in the subsequent period, $\Delta Defaulted_{ct}$ is the change in the defaulted share in the current period, $Result$ denotes the covenant result, Z contains all control variables, including size, performance, and age, ϵ is the error, c denotes CLO, t denotes the month-year pair, m denotes CLO manager, y denotes the year, a denotes the arranger, and w denotes the trustee. The columns denote different test restrictions; Weighted Average Spread covenant, Weighted Average Life covenant, Interest Diversion covenant, Junior IC covenant, Junior OC covenant, Senior IC covenant, and Senior OC covenant (Column 1-7, respectively).

Table B.3: CCC Loans and Covenant Results

Panel A: CCC Share_t and Covenant Result_t

CCC Share	(1) WAS	(2) WA Life	(3) Interest Div.	(4) Junior IC	(5) Junior OC	(6) Senior IC	(7) Senior OC
Covenant Result	0.2524	2.3219***	-0.2553	-0.6207***	0.1800	-0.3331	0.3350*
	(0.2312)	(0.1818)	(0.1907)	(0.1848)	(0.2046)	(0.2070)	(0.1978)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4553	4781	1607	4160	4153	4460	4879
R^2	0.6501	0.7411	0.7029	0.6853	0.6650	0.6495	0.6252

Panel B: Δ CCC Share_{t+1} and Covenant Result_t

ΔCCC Share	(1) WAS	(2) WA Life	(3) Interest Div.	(4) Junior IC	(5) Junior OC	(6) Senior IC	(7) Senior OC
Covenant Result	-0.1962**	0.0752	-0.1202	-0.6676***	0.2707**	-0.2064**	0.2840***
	(0.0915)	(0.0855)	(0.0771)	(0.1454)	(0.1151)	(0.0832)	(0.0829)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3765	3664	1324	3438	3459	3682	4038
R^2	0.3263	0.3251	0.5030	0.3629	0.3555	0.3299	0.3124

Panel C: Δ Covenant Result_t and Δ CCC Share

Δ Covenant Result_t	(1) WAS	(2) WA Life	(3) Interest Div.	(4) Junior IC	(5) Junior OC	(6) Senior IC	(7) Senior OC
ΔCCC Share_t	0.0221*	-0.0001	0.0055	-0.0024	-0.0022	-0.0055	-0.0051
	(0.0129)	(0.0012)	(0.0035)	(0.0029)	(0.0019)	(0.0037)	(0.0045)
Size Control	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓
Manager-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3222	3147	1036	2830	2894	3069	3437
R^2	0.1800	0.1763	0.1999	0.1669	0.2146	0.1713	0.1739

Standard errors in parentheses, and two-way clustered at the manager and month-year levels.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the relation between CCC loans and quality and coverage covenant results. Panel A tests the relation between the CCC share and standardized covenant result. The regression specification is: $CCC_{ct} = \alpha + \beta \times Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. Panel B tests the relation between the change in CCC share in the subsequent period and current standardized covenant result. The regression specification is: $_{ct+1} = \alpha + \beta \times Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. Panel C tests the relation between the change in CCC share and change in standardized covenant result. The regression specification is: $\Delta CCC_{ct} = \alpha + \beta \times \Delta Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$. CCC_{ct} is the CCC share, ΔCCC_{ct+1} is the change in the CCC share in the subsequent period, ΔCCC_{ct} is the change in the CCC share in the current period, *Result* denotes the covenant result, Z contains all control variables, including size, performance, and age, ϵ is the error, c denotes CLO, t denotes the month-year pair, m denotes CLO manager, y denotes the year, a denotes the arranger, and w denotes the trustee. The columns denote different test restrictions; Weighted Average Spread covenant, Weighted Average Life covenant, Interest Diversion covenant, Junior IC covenant, Junior OC covenant, Senior IC covenant, and Senior OC covenant (Column 1-7, respectively).

Table B.4: Leave-one-out Junior IC ratio

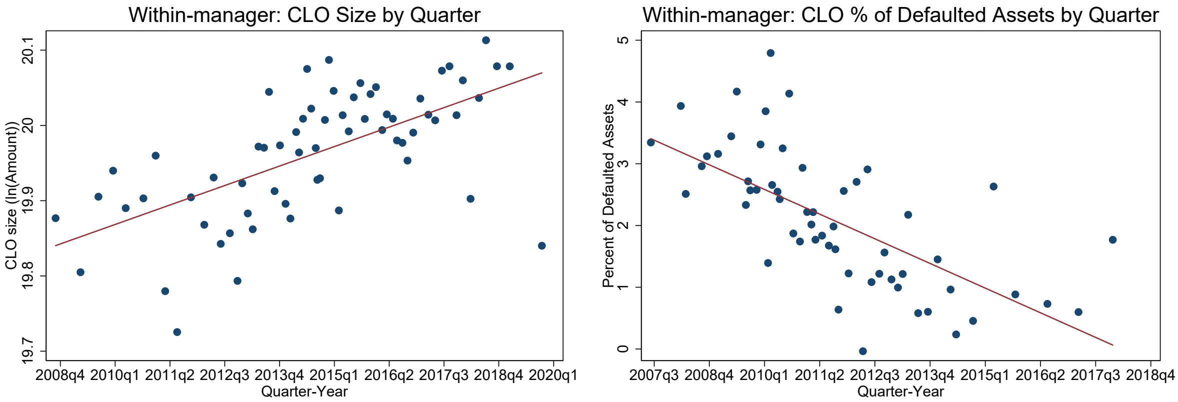
	Manager-level				CLO-level			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Risky share	Δ Risky	Default Share	CCC Share	Risky Share	Δ Risky	Default Share	CCC Share
Junior IC Test	-0.5537***	-0.5848***	-0.5897***	-0.2319	-0.3823**	-0.3282**	-0.2741***	-0.2816**
	(0.1838)	(0.1184)	(0.1174)	(0.1611)	(0.1685)	(0.1481)	(0.0992)	(0.1399)
Size Control	✓	✓	✓	✓	✓	✓	✓	✓
Performance Control	✓	✓	✓	✓	✓	✓	✓	✓
Age Control	✓	✓	✓	✓	✓	✓	✓	✓
CLO-Year FE	No	No	No	No	Yes	Yes	Yes	Yes
Manager-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Arranger FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trustee FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	978,914	843,738	978,914	983,756	978,913	843,738	978,913	983,755
R^2	0.7237	0.5101	0.3055	0.6838	0.9018	0.7460	0.5740	0.8703

Standard errors in parentheses, and double clustered at the Manager Month-Year Level

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents the results from the "leave-one-out" methodology. I iterate through each firm and recompute the Junior IC ratio in the absence of that particular firm. The baseline regression specification (Column 1-4) is as follows: $Y_{ct} = \alpha + \beta \times Result_{ct} + \Gamma Z_{ct} + \gamma_{my} + \delta_a + \delta_w + \epsilon_{ct}$ where Y is the outcome variable: risky change (Columns 1, 5), change in risky share in the subsequent period (Columns 2, 6), default share (Columns 3, 7), CCC share (Columns 4, 8), $Result$ is the Junior IC covenant result, Z contains CLO controls including size, performance, and age, ϵ is the error, c denotes CLO, t denotes month-year pair, y denotes year, m denotes manager, a denotes arranger, and w denotes trustee. In Column 5-8, a CLO-year FE (γ_{cy}) is included in lieu of the manager-year (γ_{my}) fixed effect.

Figure B.12: CLO default rate and subsequent size of CLO for a given manager



	(1)	(2)	(3)	(4)	(5)
	$\ln(\text{Amount})_t$	Defaulted Share_t	$\ln(\text{Amount})_{t+1}$	$\ln(\text{Amount})_{t+1}$	$\ln(\text{Amount})_{t+1}$
Quarter-Year Trend	0.0052***	-0.0798***			
	(0.0015)	(0.0215)			
Defaulted Share			-0.0142*	-0.0060**	-0.0055*
			(0.0069)	(0.0022)	(0.0030)
CCC Share					-0.0036
					(0.0047)
Manager FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes
N	1,634	453	413	413	406
R^2	0.2724	0.4747	0.2353	0.2937	0.2982

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The left figure shows the relation between the initial CLO deal size and time trend for a given manager. The right figure shows the relation between the percent of defaulted loans and time trend. The table codifies these relations through regressions in Columns 1-2. In Columns 3-5, the percent of a CLO's defaulted loans is related to the manager's subsequent initial CLO deal size. Manager fixed effects are included in Columns 1-5, and year fixed effects in Columns 4-5.

Online Appendix for:

"The Externalities of Fire Sales: Evidence from Collateralized Loan Obligations"

Table B.5: Summary Statistics of Covenants (Table 3 of Kundu (2020*a*))

	N	Q1	Median	Q3	Mean	Std. Dev
Interest Diversion	7,482	1.0245	1.0320	1.0378	1.0320	0.0198
Junior IC	16,742	1.7011	2.0957	3.6171	2.7282	1.4409
Junior OC	16,701	1.0343	1.0429	1.0551	1.0525	0.0400
Senior IC	18,516	2.0941	2.8731	5.8178	4.0742	2.5709
Senior OC	20,905	1.0767	1.0881	1.1519	1.2052	0.3595
WA Life	18,997	0.7108	0.8880	1.0358	1.1961	1.6459
WARF	19,545	0.8780	0.9358	0.9872	0.9471	0.1203
WAS	18,358	1.0757	1.2067	1.4033	1.2723	0.2572

Notes: The table reports the summary statistics of the constraints – a distance to the constraints, measured as the ratio of covenant performance to covenant trigger. The covenants are listed in the first column. 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.