The Externalities of Fire Sales: Evidence from Collateralized Loan Obligations[*]

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Abstract

This paper investigates how covenants, intrinsic to *Collateralized Loan Obligation* (CLO) indentures, provide a mechanism through which idiosyncratic shocks may amplify, imposing negative externalities on other unrelated firms in CLO portfolios. Exploiting cross-sectional variation in firms' exposures to the Oil & Gas (O&G) industry through CLOs, as well as the timing of the O&G price plunge in 2014, I study how non-O&G firms in CLO portfolios are affected. When CLOs are subject to idiosyncratic shocks that push them closer to their covenant thresholds, they fire-sell unrelated loans in the secondary loan market to alleviate these constraints. These fire sales exert price pressure across security markets. The market dislocations erode the liquidity positions of exposed firms, spilling into real economic activity. Contrary to traditional fire sale settings, I find CLOs fire-sell loans issued by riskier firms for *contractual arbitrage* purposes – exploiting loopholes in the design of covenants. The sample period for this study is 2013-2015, a relatively benign macroeconomic period. However, the results suggest the effects may be larger during times of stress, including the outset of the COVID-19 pandemic.

JEL Classification: E44, G23, E32

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1 Introduction

Financial contracts include provisions designed to align incentives and mitigate capital market imperfections. However, some provisions in contracts may also catalyze fire sales and trigger amplification, fomenting instability. This paper demonstrates how covenants, intrinsic to Collateralized Loan Obligation (CLO) managerial contracts, may kindle fire sales after adverse shocks, affecting firms whose creditworthiness is orthogonal to the shocks themselves. Covenants fulfill critical objectives of mitigating agency frictions and allocating control rights, ex-ante, facilitating the expansion of credit in the economy. However, covenants may also introduce and amplify fire sale risk in some states of the world, ex-post, reducing the amount of credit in these states.

CLOs are the largest purchasers of leveraged loans, and increasingly, a prominent source of credit to risky firms. Since the Great Financial Crisis of 2008, banks have diversified credit and liquidity risks to a multitude of investors, reflecting a broader shift from the "originate-to-retain" business model to the "originate-to-distribute" business model. CLOs are noteworthy among these investors. CLOs purchased nearly 75% of all syndicated institutional leveraged loans in 2019 and held 25% of all outstanding leveraged loans (pro rata and institutional) in 2020 (Leveraged Commentary and Data (2019); International Monetary Fund (2020)). While diversification has limited bank exposures to credit and liquidity risks, it has also contributed to the opacity and complexity of interconnections between the traditional banking and rising shadow banking sectors.[1] This paper explores these dynamics.

CLOs operate as special purpose vehicles which finance the purchase of leveraged loans through the issuance of tranched asset-backed securities or notes. The CLO notes are of two forms: debt tranches and an equity tranche. Debt tranches are paid a fixed spread above LIBOR based on seniority. The equity tranche receives the remaining spread after proceeds

[1]The Federal Reserve recently warned that the secondary market for leveraged loans is not liquid and during times of stress, price declines from CLO loan sales may be extreme: "Investors in CLOs ... face the risk that strains within the underlying loan pool will result in unexpected losses ... The secondary market is not very liquid even in normal times, and liquidity is likely to deteriorate in times of stress, which could amplify any price declines. It is hard to know with certainty how today's CLO structures and investors would fare in a prolonged period of stress" (Board of Governors (2019)). The Bank of England outlined the risk to financial institutions, emphasizing the high concentration of leveraged loans among bank and non-bank institutions with uncertain implications on firm financing: "Globally, banks account for more than half of the financial system's exposure to leveraged loans...Non-bank investors also have significant holdings of leveraged loans. Leveraged loan holdings by open-ended investment funds are significantly higher than pre-crisis, and large-scale redemptions during stress could amplify price falls. In a stress, the leveraged loan and high-yield corporate bond markets may not be sufficiently liquid to meet demand from borrowers, potentially restricting corporates from accessing funds" (Financial Policy Committee (2019)). The Financial Stability Board has raised questions about the risk to borrowers, stating: "Shocks arising from outside of the leveraged loan and CLO markets that place intermediaries under financial strain, could impair the supply of capital to leveraged borrowers or cause other intermediaries in the market to become unable to offload exposures to leveraged borrowers" (Financial Stability Board (2019)).

from the underlying loans have been distributed towards senior liabilities. The objective of the CLO is to maximize the excess spread between liabilities and assets. Without any contractual provisions, agency problems arise in CLOs like in other closed-end funds.[2] Specifically, CLO managers may be incentivized to risk-shift, as their interests are most aligned with the equity class; compensation consists of a fixed fee and subordinated fees that are proportional to the residual interest available to the equity class (Kundu (2022*a*)).[3] Open-ending is commonly viewed as a solution to this agency problem. While investor redemption in open-end funds serves as a disciplining device for depriving management of control over assets (e.g., Fama and Jensen (1983*a*); Fama and Jensen (1983*b*)), redemption can ignite fire sale risk (e.g., Coval and Stafford (2007); Mitchell, Pedersen and Pulvino (2007); Jotikasthira, Lundblad and Ramadorai (2012); Choi et al. (2020)). In contrast, closed-end funds are thought to be immune to fire sale risk because of stable funding. CLOs address the agency problem within the closed-end structure through alternative means: covenants. However, this paper provides evidence that the remediation that is designed to address the agency problem within the closed-end fund structure can create fire sale risk, like in open-end funds.

Underlying the CLO market is a set of legal indentures, mutually agreed upon by the core trinity of CLO participants: arranger, manager, and trustee. The CLO managerial indenture governs the operations and activities a CLO manager may undertake. The covenants therein designate control rights and the conditional allocation of control. These covenants are designed to mitigate agency costs and curtail against risk-shifting behavior. Violation of coverage covenants – which ensure that there is a specific level of coverage and subordination relative to the covenant triggers for each tranche – are punitive. In the event of coverage covenant breaches, proceeds intended for junior tranches, management fees, and equity distributions are diverted towards prematurely paying down liabilities in order of seniority or towards the purchase of higher-quality collateral until the CLO is in compliance with its constraints. Unlike in other settings, covenants in CLO indentures are not renegotiable, reducing the potential for the hold-up of investment decisions, ex-ante (Gârleanu and Zwiebel (2009)).

The objective of this paper is twofold: *(1)* to understand whether contracts impose externalities on asset prices, and if so, *(2)* to explore the mechanism through which firm distress can propagate to other firms through CLOs. I postulate that shocks can propagate through capital markets via CLO fire sales, induced by covenants. The markets for loans and corporate debt

[2] It has been shown that closed-end shares trade at a discount relative to NAV (*closed-end fund puzzle*). This has been attributed to the agency costs between fund managers and shareholders. These papers include Barclay, Holderness and Pontiff (1993); Malkiel (1977); Chay and Trzcinka (1999); Bradley et al. (2010); Wang and Nanda (2011).

[3] As the size of managers' residual claims increase, i.e., more skin-in-the-game, managers may have even greater incentives to risk-shift.

are relatively illiquid, hence, CLO sales affect the prices of debt securities, even if the credit-worthiness of issuers is unchanged. The increase in firms' effective cost of capital leads to an erosion of firm liquidity and spills over to real economic activity.

Figure 1 presents a microcosm of the empirical setting, demonstrating how idiosyncratic risk may amplify to systemic risk. In the diagram, CLOs purchase loans issued by firms, which are represented by the outer circles, and firms are connected to other firms through the CLO. The spokes are bidirectional as firm performance affects cash flow to CLOs, and CLO distress may also transmit to firms (left figure). If a firm experiences extreme distress, as represented by the red outer circle, a CLO's covenants may tighten, represented by the pink color (center figure). In this event, the CLO manager may loosen the covenants by preemptively selling loans issued by the distressed firm – thereby, disconnecting the red firm in the diagram. The CLO may also sell other unrelated risky loans, loans issued by innocent bystanders with no direct exposure to the source of distress, to generate more slack in the covenants – represented by the pink firms with dashed connections to the CLO (right figure). Hence, if a CLO is pushed against its covenant thresholds, the CLO manager may sell distressed loans as well as other loans issued by innocent bystanders. These sales may alleviate CLO covenants. However, they may also ultimately sow the seeds of future distress (bottom figure). This paper focuses on the impact of CLO actions on innocent bystanders. That is, covenants included in CLO indentures intended to protect CLO noteholders may impose externalities.

To study the externalities of fire sales, I employ a reduced-form instrumental variable (IV) strategy. The ideal empirical design compares the differences in outcomes between two virtually identical innocent bystanders, held in different CLO portfolios with differing degrees of covenant tightness. To this end, I use a Bartik-style difference-in-differences identification strategy, exploiting the timing of the oil and gas (O&G) price plunge in 2014, as well as cross-sectional variation in firms' exposures to oil and gas through CLOs before the shock. CLOs that had greater exposure to O&G before the shock experienced greater tightening of their capital covenants, relative to CLOs with lower exposure, after the shock. Hence, it is expected that the externalities of fire sales are salient for firms with greater exposure to O&G. I argue the O&G price plunge was exogenous, and conduct a battery of tests to assess selection concerns. This empirical design largely circumvents concerns about non-random matching between CLOs and portfolio firms.

I begin by showing that the O&G share is related to the distance to the capital covenants, indicating that the O&G share is a valid measure of covenant tightness. Specifically, a 1 pp increase in the O&G share is associated with a 0.35% decline in the distance to the most stringent capital covenant, after the shock. I then study how firms' exposures to CLO covenant tightness, as measured by OG exposure, affects firm outcomes. Firms with greater exposure to O&G prior to the shock report higher loan sales after the shock. I discover evidence of increased CLO sales following the shock. A 1 pp increase in a firm's exposure to O&G is associated with a decrease in the net transaction amount by 0.19 standard deviations, after the shock. CLO-induced sales of leveraged loans exert price pressure across security markets. I find that a 1 pp increase in a firm's exposure to O&G is associated with a decrease in the secondary loan price by 0.21 standard deviations, an increase in the primary loan spread by 0.12 standard deviations, an increase in the bond credit spread by 0.06 standard deviations, and a decrease in the monthly equity returns by 0.02 standard deviations, after the shock. The decrease in prices across different debt instruments is explained through a variation of a no-arbitrage argument that connects fire sales to credit crunch effects. In market equilibrium, the expected rate of return across debt instruments is equalized. Therefore, the effective cost of capital increases for the innocent bystanders.

The market dislocations erode the liquidity positions of exposed firms and spillover to real economy activity. Specifically, I find that a 1 pp increase in a firm's exposure to O&G is associated with a decrease (increase) in the change in the unused (drawn) line of credit by 0.03 standard deviations. As liquidity obtained from lines of credit may be insufficient to fully substitute from external sources of funding, firms make adjustments. A 1 pp increase in a firm's exposure to O&G is associated with a decline of 0.04 standard deviations in debt growth, 0.03 standard deviations in cash flow, 0.04 standard deviations in investment, 0.09 standard deviations in R&D, and 0.05 standard deviations in employment growth, after the shock.

These effects may be explained by *contractual arbitrage*. The piecewise nature of the accounting rules for the covenants incentivize constrained CLO managers to sell riskier loans. When a loan becomes sufficiently risky, it is no longer accounted at book value. If a loan experiences default, is a discount obligation, or puts the CLO in excess of its CCC/Caa1 limit, it is marked to the lower of its market value or recovery value, the purchase price until the loan trades above a specified threshold (typically 90 ¢/$) for more than 30 days, or, the lowest market value among the CCC/Caa1 loans, respectively. CLO managers can maximize improvements to the capital covenants by selling loans which exhibit higher market values than accounted values, in descending order of the differences.

I provide direct empirical evidence in support of the contractual arbitrage mechanism. The likelihood of selling a loan above (below) par decreases (increases) in O&G exposure, after the shock. In addition, sales and their associated effects are pronounced for loans issued by financially constrained firms. Moreover, CLO sales of riskier loans result in compositional changes across portfolios. A 1 pp increase in a firm's exposure to O&G is associated with a decline in the interest rate of the firm's debt by 0.05 standard deviations, after the shock. The likelihood that a loan is defaulted is lower by 0.04 standard deviations, after the shock. At the aggregate CLO level, I find that a 1 pp increase in a CLO's exposure to O&G is associated with a decline in the defaulted share of the portfolio by 0.06 standard deviations, after the shock. These findings are consistent with the motives established by contractual arbitrage – CLO managers derisk and deleverage upon experiencing a tightening of their covenants. Lastly, I show that the aggregate declines in debt prices and real economic activity are driven primarily by distressed firms, which experience effects that are five to seven times as large as the effects experienced by non-distressed firms.

I conduct a battery of additional tests to assess the robustness of the results. I demonstrate that the financial market dislocations are persistent and endure long enough for the real effects to materialize. Moreover, I use an IV strategy to show that CLO covenants are the source of cross-firm spillovers. I dispel hypotheses that the findings may reflect changes in firm fundamentals or bank constraints, using two falsification tests that exploit institutional differences across loan facilities. Additional tests are conducted to address concerns regarding measurement, omitted variable bias, and robustness of the empirical strategy. Lastly, I assess external validity using the COVID-19 shock. I show that the proposed mechanism has a larger impact during crisis periods.

1.1 Related Literature

This work has two novel contributions. First, I document negative effects of fire sales spillovers in closed-end funds through financial contracts. Second, I show that intermediaries that operate in a market setting may serve as a linchpin between financial markets and real economic activity – distinct from the standard credit supply shock channel of banks.

First, this paper is related to the literature on fund organizational structure. There is a large body of empirical evidence which demonstrates that closed-end shares trade at a discount relative to NAV because of agency costs (e.g., Barclay, Holderness and Pontiff (1993); Malkiel (1977); Chay and Trzcinka (1999); Bradley et al. (2010); Wang and Nanda (2011)). A solution to the agency problem is open-ending, allowing investors to withdraw their capital – "a form of partial takeover or liquidation which deprives management of control over assets" (Fama and Jensen (1983*a*); Fama and Jensen (1983*b*)). However, unlike closed-end funds which have stable funding, the redeemable nature of claims on demand makes open-end funds susceptible to fire sales as in Coval and Stafford (2007), Mitchell, Pedersen and Pulvino (2007), Jotikasthira, Lundblad and Ramadorai (2012), Choi et al. (2020). This paper joins Kundu (2022*b*) in demonstrating how fire sale risk can transpire in closed-end funds due to covenants, which are designed to address the fundamental agency problem in closed-end funds. Kundu (2022*b*) shows the primary impact of financial distress on CLOs, demonstrating how CLO covenants exacerbate the effects of shocks to a firm's own creditworthiness, i.e., if an O&G firm experiences distress, constrained CLOs sell that firm's loans, causing a fire sale for the O&G firm. In contrast, this paper highlights the *spillovers* of idiosyncratic shocks to other firms, e.g., if an O&G firm experiences distress, constrained CLOs sell a software company's loans, causing a fire sale for the software company. Hence, this work demonstrates that differences in fund organizational structure cannot fully eliminate the underlying risks. Moreover, in contrast to intermediaries selling their most liquid loans to minimize selling costs and fire sale discounts, I find that constrained CLOs sell the riskier segment of loans, explained by the piecewise design of covenants. Together, this work shows how covenants can foment financial instability.

Second, this paper contributes to the existing literature by providing evidence of how a source of market financing can affect firm financial decisions through covenants, standing in contrast to a rich literature base on credit supply shocks that has focused on bank lending relationships. Bank intermediaries are known to be more efficient at resolving informational asymmetries than the market by developing unique relationships with firms which allows them to closely monitor firms. If a bank collapses, naturally, dependent borrowers may also be in distress. Theoretical work emphasizes how shocks to bank capital affect real economic outcomes through the credit channel (e.g., Bernanke and Blinder (1988); Bernanke and Gertler (1989); Holmstrom and Tirole (1997)). Empirical work, exploiting variation through the use of instruments and natural experiments, investigates how changes in bank credit supply affect real economic outcomes with varying deductions.[4] In contrast, CLOs are intermediaries at arm's length. They are institutions that hold bank loans. CLOs are not directly involved with firms, nor do they possess any firm-specific private information about fundamentals (Kundu (2022*b*)). Thus, the finding that frictions in capital markets can transmit to firms is a novel contribution.

The roadmap for the paper is as follows. I explain the institutional setting and contrac-

[4] e.g., Kashyap, Lamont and Stein (1994); Gertler and Gilchrist (1994); Kashyap and Stein (2000); Peek and Rosengren (2000); Khwaja and Mian (2008); Paravisini (2008); Ivashina and Scharfstein (2010); Chava and Purnanandam (2011); Benmelech, Bergman and Seru (2021); Schnabl (2012); Chodorow-Reich (2014); Huber (2018); Amiti and Weinstein (2018); Kundu and Vats (2021); Kundu, Park and Vats (2021)).

tual arbitrage in Section 2. The data sources used in this study are described in Section 3. The empirical strategy used in this analysis is discussed in Section 4. I present the main results in Section 5. I explore the underlying mechanism in Section 6. I conduct and detail the findings of robustness tests in Section 7. Lastly, I conclude in Section 8.

2 Institutional Background

In this section, I provide a pithy summary of how CLOs function.[5]

CLO liabilities consist of debt tranches and an equity tranche. Debt investors do not benefit from excess risk or returns, because they are paid a fixed spread above LIBOR based on seniority. As monitoring a manager's investment decisions and verifying cash flows may be costly from the perspective of debt investors, covenants are in place to address the risk-shifting motives of CLO managers. Covenants serve as disciplining devices for managers to adequately screen and monitor their investments. Covenants allow investors to exert control when incentives conflicts. There are two classes of covenants: quality covenants and coverage covenants. Quality covenants are maintain-or-improve constraints. These constraints do not directly prescribe any action to the managers in the event of a breach. If a quality covenant is triggered, the manager must maintain the credit quality of the portfolio and cannot make trades that worsen the credit quality of the portfolio. In contrast to quality covenants, if coverage covenants are triggered, proceeds from the underlying loans may be diverted from junior tranches, junior management fees, and equity distributions towards paying down liabilities in order of seniority, prematurely or toward the purchase of "higher-quality" collateral. Coverage covenant violations are potentially costly to the manager in several ways. First, fees and payments may be siphoned off from the manager and other junior stakeholders. These constraints may hamper the manager in optimizing the portfolio. Second, investors may also lose confidence in the manager's ability to administer the CLO portfolio. If CLO failures persist, i.e., the manager serially breaches contractual provisions, the manager may be dismissed. Further, if the underlying loans default, equity holders may elect to not exercise the call until the defaulted loans rebound in price. These ramifications may result in a CLO operating well-beyond its expected call date until legal maturity.

Given the "course-correcting" nature of coverage covenants, I center my focus on these covenants. CLOs are typically subject to: overcollateralization (OC) covenants, interest diversion (ID) covenants, and interest coverage (IC) covenants. The OC and ID covenants are *capital covenants*, which ensure that there is sufficient coverage and subordination of tranches relative

[5]For a more detailed discussion, I refer readers to Kundu (2022*a*).

to the tranche-specific triggers. They are akin to various measures of leverage. The OC and ID covenants are measured similarly, with two caveats. First, the ID covenant has a lower threshold; hence, it is triggered before any of the OC covenants. Second, if the ID covenant is breached, proceeds are diverted towards the purchase of high-quality, value-increasing loans to eliminate the opportunity for asset substitution. This effect contrasts with the consequences of violating OC covenants, which force deleveraging. The IC covenants ensure that there is a specific level of coverage for interest due on tranches relative to the triggers. These are *liquidity covenants*. The IC covenants are similar to the OC covenants, insofar as they may also cause CLO managers to pay down liabilities early. Broadly, covenants create first-loss tranches, namely, cushions for principal losses for more senior tranches.

CLOs operate closest to the ID threshold. From 2009-2018, CLOs operated within a 4% margin of the ID threshold, a 5% margin of the Junior OC threshold, and a 9% margin of the Senior OC threshold. Given the variation in the degree of constraint across covenants, I narrow my attention to the capital covenants, and in particular, the ID covenant.

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

In the calculation of the capital covenants, loans are marked at par value and are not subject to market fluctuations unless, *(1)* a loan has experienced default, *(2)* a loan is rated CCC/Caa1 or below, putting the CLO in excess of its limit, or *(3)* a loan is a discount obligation. In these cases, the loan is marked to the lower of market value and recovery value, the lowest market values among loans in the CCC/Caa1 bucket, or the purchase price until the loan trades above a threshold (typically 90 ¢/$) for more than 30 days, respectively. I discuss the implications of these accounting rules next.

2.1 Contractual Arbitrage

The piecewise nature of the accounting of covenants can influence the incentives of CLO managers in their selling behavior. Consider the following illustration of how CLO managers can engage in *contractual arbitrage*. As an example, I focus on the accounting of CCC/Caa1 loans. The general framework may be extrapolated to the other cases of defaulted loans and discount obligations.

A CLO faces a limit on loans rated CCC/Caa1 or below, typically set to 7.5%. The loans in excess of this percentage are marked at the lowest market value of the loans in the CCC/Caa1 bucket.

Let τ denote the stipulated portfolio share of CCC/Caa1 loans, A denote total CLO assets, and L denote total CLO liabilities. Moreover, for simplicity, assume the portfolio has two types of assets – bad, risky assets, and good, risky assets – the sum of which counts toward the CCC/Caa1 limit, τ. The share of bad, risky assets is denoted by b, whereas the share of good, risky assets is denoted by g. This distinction is important; regardless of whether the risky assets are good or bad, they are marked to the lowest market value of the CCC/Caa1 share of loans – the market value associated with the bad assets, β. The market value of the good assets is γ.

Suppose the CLO breaches its limit on CCC/Caa1 loans, i.e., $b + g > \tau$. Consequently, the capital covenants will tighten and the OC/ID ratio is computed as follows.

$$OC/ID = \frac{(1 - (b + g - \tau))A + (b + g - \tau)\beta A}{L}. \tag{2}$$

Selling the good, risky assets, g from the portfolio at market price γ may loosen the capital covenants. If the CCC/Caa1 limit still binds, sales of good, risky assets can improve the capital covenants by $\frac{g(\gamma - \beta)A}{L}$.[6] The new OC/ID ratio is:

$$OC/ID = \frac{(1 - (b + g - \tau))A + (b - \tau)\beta A + g\gamma A}{L}. \tag{3}$$

2.1.1 Numerical Example

In this section, I illustrate how contractual arbitrage loosens the capital covenants. Let the initial book value of assets be 100 and the initial book value of liabilities be 100. Further, let τ the stipulated portfolio share of CCC/Caa1 loan be 7.5%. Assume that each loan is of equal amount. Now consider that distress settles in such that:

- Share of good risky assets, g, is 20%
- Share of of bad risky assets, b, is 10%
- Market price of good, risky assets, γ is 95 ¢/$
- Market price of bad, risky assets, β, is 20 ¢/$

Before distress settles in:

$$OC/ID = 1. \tag{4}$$

[6]The improvement to the covenant is lower from selling bad, risky assets under a binding CCC/Caa1 constraint, as shown in Appendix Section C.

Afterwards, the total share of (good and bad) risky assets sums to 30%, exceeding the 7.5% threshold. Consequently, the capital covenant will tighten. Specifically, the OC/ID ratio will be:

$$OC/ID = \frac{(1-(0.3-0.075))100 + (0.3-0.075)0.20 \times 100}{100} \tag{5}$$

$$OC/ID = 0.82 \tag{6}$$

Now, if the CLO sells all of the good, risky assets, the OC/ID ratio will be:

$$OC/ID = \frac{(1-(0.3-0.075))100 + (0.10-0.075)0.20 \times 100 + (0.20)0.95 \times 100}{100} \tag{7}$$

$$OC/ID = 0.97 \tag{8}$$

This illustrative example demonstrates how a CLO can maximize improvements to the capital covenants by selling CCC/Caa1 or risky loans from their highest dollar market value to their lowest dollar market value. Similarly, if the agency-projected recovery rate of a defaulted loan is below its market value, or, if the purchase price of a discount obligation is below its current market valuation, the CLO can build par by selling the defaulted or discounted loan.

Contractual arbitrage provides an explanation behind one of the main findings of this paper, namely, among the risky loans, CLO managers sell the loans with the highest market prices, while keeping the loans with the lowest market prices. I discuss the implications of this trading in Section 6.1.

3 Data Sources

This paper aims to investigate whether contracts impose externalities on asset prices, and the mechanism through which firm distress may propagate to other firms in CLO portfolios. An empirical challenge in studying fire sale spillovers to other firms setting is the lack of granularity in data coverage. Granularity is important in three ways: for (1) identifying firm exposure to intermediary distress, (2) observing the connections between firms through financial intermediaries, and, (3) distinguishing fire sale transactions and the characteristics thereof. The CLO setting is the ideal laboratory to meet the research objectives because of the availability of comprehensive data on CLO portfolios.

There are a number of data sources used in this project, ranging from financial data to firm fundamental data. In this section, I describe the datasets used in this project. The sample period for this study is 2013 to 2015.

The primary data source is the *CreditFlux CLO-i Database*, which provides information from over 35,000 trustee reports, prospectuses, and, covers over 1,200 CLOs in the US. CreditFlux provides granular data on CLO transactions and their associated prices, holdings, covenants, tranches, and equity distributions. The CLO-i database reports a coverage of 52-68% of the market in the sample period.[7] On average, each issuer's loans are held in 125 CLOs, and total to $230 million. I restrict my analysis to firms that received a syndicated loan, as reflected in DealScan. The processed data covers a total of 1,631 distinct issuers.

To supplement the data on transaction prices reported in the CreditFlux CLO-i database, I collect additional financial data from WRDS-Thomson-Reuters' LPC DealScan, WRDS Bond Returns, and CRSP. I use data on primary issuance from WRDS-Thomson-Reuters' LPC DealScan. This database contains extensive and comprehensive data on the terms of loan pricing contracts that is sourced from both SEC filings and directly from lenders and borrowers. The processed data covers a total of 439 distinct issuers. In addition to primary issuance data, I use the WRDS Bond Database for retrieving information related to bond credit spreads and liquidity. The WRDS Bond Database provides comprehensive coverage of all traded corporate bond issues, sourced from TRACE Standard and TRACE Enhanced. The dataset includes information on bond types, monthly prices, returns, coupons, and yields. The processed dataset covers a total of 136 distinct issuers. I retrieve monthly equity returns from CRSP. CRSP provides information on individual securities, including identity information, price histories and trading volumes, delisting information, distribution history, and share outstanding values. The monthly Fama-French five factors used in my analysis are from Kenneth French's website. The processed data covers a total of 263 distinct issuers.

For firm characteristics, I use two databases from S&P Capital IQ: Compustat North America (Compustat) and Capital Structure. Compustat provides data on firm fundamentals from balance sheets, statements of cash flows, income statements, and supplemental data items. I describe the construction of firm-level variables in Section B. A limitation of my analysis is that Compustat only reports data for publicly held companies, whereas CLOs hold loans issued by both private and public firms. Hence, firm coverage is limited. The processed data covers a total of 300 distinct issuers. I use Capital Structure data to understand the dynamics of firm liquidity, specifically, data on lines of credit. This data is sourced from press releases, company websites, and stock exchanges as well as through direct feeds from SEC, SEDAR, ASX, and RNS. The processed dataset covers a total of 224 distinct issuers. Both datasets are collapsed to the quarterly frequency.

[7] I use the International Monetary Fund (2020)'s figures on total outstanding US CLOs from 2013 to 2015 to compute this.

Lastly, I use two time-series data series from FRED. I obtain WTI crude oil data from FRED. This data is used to track the start of the oil price plunge as well as price movements. I also use the GDP Implicit Price Deflator for adjusting nominal firm fundamentals.

A significant hurdle to this empirical analysis is matching firms across datasets. There is no identifying code in the Creditflux CLO-i database that allows for easy matching across databases. Case sensitivity, abbreviations, inconsistent syntax, punctuation, and the conflation of subsidiaries and holding companies are some of the issues that hinder automatic matching. For this reason, I manually encode the data and generate several crosswalks between the CLO-i database and other datasets and databases. For completeness and correctness, I have verified and supplemented matches through fuzzy string matching, matching on the first six characters of the firm's name, and the Roberts Dealscan-Compustat Linking Database (Chava and Roberts (2008)).

4 Empirical Strategy

The objective of this paper is to study how CLO covenants affect the transmission of idiosyncratic shocks. Empirical strategies that rely on explicit measures of CLO health through covenant measures, including the distance to the covenant thresholds, raise concerns regarding non-random matching between CLOs and firms. Specifically, the performance of CLO portfolios may be related to the characteristics of the firms they hold, confounding identification of the spillovers. To circumvent this concern, I use a reduced-form instrumental variable (IV) strategy. I exploit cross-sectional variation in firms' exposures to the O&G industry as a measure of risk that directly affects the capital covenants. I also exploit the timing of the O&G price plunge to analyze the impact of the shock. I discuss the comparison of the naïve regression results with the reduced-form IV and IV results in section 7.1.

To fix ideas, consider the following thought experiment, depicted in Figure 2. There are two CLOs: CLO A and CLO B. CLO A does not hold any firms operating in the O&G industry. CLO B has a sizeable exposure to firms in the O&G industry. With the exception of O&G exposure, both CLOs both hold similar portfolios of loans. When the O&G price plunge occurs, CLO A is unaffected because it is not exposed to O&G. However, CLO B's covenants tighten, as many O&G firms experience distress and fall back on interest/principal payments. If CLO A holds a loan issued by WidgetCo X and CLO B holds a loan issued by WidgetCo Y – both of which are vulnerable to fire sales – how does the distance to the covenant threshold impact these innocent bystanders' cost of financing and real economic activity? Broadly, how do idiosyncratic shocks propagate to other portfolio firms through CLO intermediaries?

This research question is motivated based on the finding that fire sales of distressed loans occur when the distressed loans are concentrated among covenant-constrained CLOs. Distressed loans held by constrained CLOs experience significantly lower cumulative returns relative to unconstrained CLOs – see Appendix Figure A.1 for evidence of price pressure (Kundu (2022*b*)). This finding motivates the study of how covenants affect CLO management of other loans – loans issued by innocent bystanders whose creditworthiness is orthogonal to the shocks.

4.1 Specification

The baseline specification is a Bartik-style difference-in-differences design. Non-O&G firms' (innocent bystanders') exposures to O&G are measured by weighting each CLO's exposure to O&G by the firm's exposure to the CLO, before the shock occurs in June 2014. The sample period of study is 2013-2015.

$$\text{Firm O\&G Exposure}_f = \sum_{c \in C} \underbrace{\left(\frac{\sum_{k \in K} \mathcal{L}_{f,k,c}}{\sum_{c \in C} \sum_{k \in K} \mathcal{L}_{f,k,c}} \right)}_{\text{Firm exposure to CLO}} \times \underbrace{\left(\frac{\sum_{f \in F} \sum_{k \in K} L_{O\&G,f,k,c}}{\sum_{i \in I} \sum_{f \in F} \sum_{k \in K} L_{i,f,k,c}} \right)}_{\text{CLO exposure to O\&G}} \tag{9}$$

The baseline empirical strategy is the following.

$$\begin{aligned} Y_{f,t} &= \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t \\ &\quad + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_f + \alpha_{m,y} + \epsilon_{f,t} \end{aligned} \tag{10}$$

$L_{i,k,f,c}$ denotes the loan amount for loan k ($k \in K$), issued by firm f ($f \in F$), in industry i ($i \in I$), held by CLO c ($c \in C$), and $\mathcal{L}_{k,f,c}$ is a function of $L_{i,k,f,c}$, keeping the industry fixed. Firm O&G Exposure$_f$ is measured before the shock occurs. Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. t indexes the time, and m, y denote the month and year, respectively. For simplicity, I refer to the *Oil Shock* variable as *Post*, hereafter. In addition, I use the phrase "a firm's exposure to O&G" as shorthand notation to refer to to a non-O&G firm's exposure to O&G through CLOs.

Several assumptions underlie this empirical specification. In the remaining section, I discuss these assumptions and address related concerns.

4.1.1 Addressing Exogeneity

A common concern with difference-in-differences specifications for causal inference is the exogeneity of shocks. If shocks are not exogenous, the policy may be correlated with the errors, causing the estimator to be inconsistent. I argue that the O&G price plunge is exogenous. Figure 3 exhibits the average crude oil price ($ per barrel) from 1960 through 2020.[8] The oil price precipitously dropped in June 2014. The plunge lasted until 2016, making the O&G price plunge one of the three largest declines since World War II, and the longest-lasting since the supply-driven price plunge of 1986 (Stocker, Baffes and Vorisek (2018)).[9]

Several major factors contributed to the price plunge. First, booming shale production in the US and improvements in fracking technology reduced the break-even prices of shale production. Specifically, post-crisis financing conditions facilitated developments in hydraulic fracking and horizontal drilling, improving oil extraction.[10] Moreover, given the shorter life cycle of these projects and lower capital cost, relative to conventional extracting methods, shale oil is more elastic to oil price changes than crude oil (Baffes et al. (2015); Krane and Agerton (2015); McCracken (2015)). Thus, shale production presented itself as a viable substitute to conventional crude production in the wake of the price plunge. Second, OPEC announced a shift in policy, renouncing price targeting, partly, in response to the increasing shale share of the global oil supply. Third, receding geopolitical tensions allowed oil production to function without disruption or conflict; hence, supply remained steady. Fourth, the appreciation of the dollar from June 2014 and June 2015 increased the local cost of oil in countries where the currency was not pegged to the dollar. This increase contributed to "weaker oil demand in those countries and greater supply from non-US dollar producers" (Baffes et al. (2015)).

A host of factors contributed to the oil price plunge. Although some demand shocks also occurred contemporaneously, for example, the stock market turbulence in China reduced demand for oil, consensus has formed around supply-driven factors as dominant contributors to the oil price plunge (e.g., Arezki and Blanchard (2014); Hamilton (2014)). Regardless of the exact source, the main point is that it is outside of the leveraged loan and CLO markets.

4.1.2 Addressing Selection and Matching

The second concern with the proposed identification strategy is that matching between CLOs and firms may not be as good as random. In other words, CLOs with higher O&G exposure may be structurally different from CLOs with lower O&G exposure. Specifically, CLOs with higher O&G exposure may employ different hedging strategies than CLOs with lower O&G exposure. This may manifest as differences in observable characteristics of portfolio firms, as

[8] See Figure A.2 for the monthly crude oil price trend.
[9] A plot of monthly crude oil prices from 2012-2018 is available in Figure A.2.
[10] Other developments that increased oil extraction include increased biofuel production and extraction from Canadian oil sands.

well as differences in the concentration of investment across industries and geographies. In this section, I conduct several tests to assess the magnitude of selection concerns.

First, I find that portfolios are largely overlapping across CLOs. While the total value of outstanding CLOs increased from 2007 through 2019 – from $308 billion to $606 billion (International Monetary Fund (2020)) – the number of issuers across CLOs experienced a rather meager increase from 4,229 to 4,659 over the same time horizon. The median issuer's loans were held in 78 CLOs in the aftermath of the Great Financial Crisis (Kundu (2022*a*)). CLO exposures are highly correlated; 90% of CLOs are exposed to the top 50 US borrowers, and 80% are exposed to the top five borrowers (Financial Stability Board (2019)).

Second, I do not find that the capital covenant threshold varies with O&G exposure before the shock. Loumioti and Vasvari (2019) contend that CLO test restrictiveness is related to (1) the size of CLO junior notes, positively, (2) favorability of market conditions and investor demand, negatively, and (3) CLO vintage (1.0/2.0/3.0), positively. In Table A.1, I study whether the ID threshold and sectoral exposure are related. Specifically, I examine the relationship between the ID threshold and O&G exposure before the shock. I use a within manager estimator to absorb all variation related to managerial style, risk appetite, specialization, taste, reputation and sophistication. I include CLO controls including age, size, CCC-share, and defaulted-share, in addition to arranger, trustee, and time fixed effects. I do not find stable or statistically significant point estimates. As the CLO covenant threshold cannot be renegotiated, it is unlikely to be endogenous to CLO subsequent investment decisions and trading behavior. These findings suggest that there is no relation between the covenant threshold and O&G exposure.

Third, Figure A.3 demonstrates that there are negligible differences in the distribution of investments across non-O&G industries before the shock. I compare CLOs with high O&G exposure – CLOs with O&G exposure above the 75^{th} percentile – to CLOs with low O&G exposure – CLOs with O&G exposure below the 25^{th} percentile. The difference in the industry share between CLOs with high O&G exposure and CLOs with low O&G exposure is greatest for the O&G industry, followed by the Printing and Publishing industry, which exhibits a difference that is half the difference in O&G between CLOs with high and low O&G exposures. On average, the difference in the industry share of non-O&G industries is more than 34 times smaller than the difference in O&G, between CLOs with high and low O&G exposures. The industry Herfindahl-Hischman Index (HHI) is 0.05409 for CLOs with high O&G exposure and 0.0552 for CLOs with low O&G exposure for non-O&G industries. Hence, the non-O&G industry distribution is comparable across CLOs of differing O&G exposures.

Fourth, in Figure A.4, I compare the geographic concentration of investment for CLOs with high O&G exposure – CLOs with above-median O&G exposure – to CLOs with low O&G exposure – CLOs with below-median O&G exposure, before the shock. The location of the firm is identified using the *State* identifier in DealScan. Geographic concentration is very similar between the two sets of CLO portfolios; the HHI is 0.0501 for CLOs with low O&G exposure and is 0.0493 for CLOs with high O&G exposure. Hence, the geography of investment is similar across the two sets of portfolios.

Fifth, I draw comparisons of observable firm characteristics between CLOs with high O&G exposure and CLOs with low O&G exposure. In Table A.2, I compare characteristics of firms that are held by CLOs with high O&G exposure – CLOs with above-median O&G exposure – to CLOs with low O&G exposure – CLOs with below-median O&G exposure, before the shock. The distribution of characteristics across firms held by CLOs with high O&G exposure is comparable to that of firms held by CLOs with low O&G exposure in several dimensions, including, size, Tobin's Q, leverage, market-to-book equity ratio, investment growth, investment, cash flow, and tangibility. Hence, there are not any material differences in firm characteristics across CLOs of differing O&G exposures.

Sixth, I directly test whether firm sensitivity to oil price affects CLO selection. In particular, there may be a concern that CLOs with high O&G exposure hold other loans which covary negatively with the price of oil. In Table A.3, I study whether the covariance between firms' profitability and oil price can predict which type of CLO (high or low O&G exposure) a firm's debt will be held in, prior to the shock. I use a within manager-arranger-trustee estimator to absorb all variation related to management style, risk appetite, specialization, taste, reputation and sophistication. In addition, I include several CLO and issuer controls, as well as time fixed effects. I do not find robust or statistically significant evidence that the covariance between oil price and firm profitability can predict CLO selection. Moreover, the R^2 associated with the simple OLS regression in column 1 is virtually nil. Hence, I rule out concerns about portfolio hedging with respect to O&G exposure.

Together, these results suggest that CLOs hold largely overlapping portfolios. Firm, sectoral and geographic characteristics of CLO portfolios with different O&G exposures are largely similar. Moreover, there is no strong relationship between CLO O&G exposure and the covenant threshold, before the shock, nor is there evidence that CLOs hedge against O&G exposure with the remaining allocation of the portfolio. As the O&G price plunge was not a foreseeable event, the O&G shares may be viewed as a random assignment. That is, a CLO portfolio may be considered a combination of two distinct portfolios: a portfolio of O&G exposures, and, the "market" portfolio – a portfolio of non-O&G loans.

4.1.3 First Stage: O&G as a Measure of Risk

In this section, I study whether CLO exposure to O&G is a relevant proxy for the distance to the capital covenant thresholds. As stated before, the O&G price plunge was one of the three largest declines since World War II, and the longest-lasting since the supply-driven price plunge of 1986 (Stocker, Baffes and Vorisek (2018)). In the aftermath, many O&G firms experienced distress. I posit that CLOs with larger O&G exposures experienced larger declines in asset values. This increased the likelihood that CLOs hit their covenant constraints.

Figure 4 shows a time series plot of the distance to the most stringent covenant threshold from 2009 through 2020. The most stringent capital covenant is identified as the capital covenant with the lowest threshold. The distance to the most stringent capital covenant threshold is measured as the as the ratio of the covenant result to the covenant threshold. The figure indicates that overall, CLOs experienced a tightening of the capital covenants after the O&G price plunge, denoted by the dotted gray lines, reaching levels that were last witnessed in the aftermath of the Great Financial Crisis of 2008. As the median CLO operates within 4% of the covenant threshold, hence, even small portfolio shocks can exert pressure at the CLO level.

I report summary statistics for the main variables used in this empirical analysis in Table 1. The median (mean) firm reports a median O&G exposure of 1.74% (2.06%), before the shock. The 25^{th} and 75^{th} percentile values are 0.0085% and 2.96%, respectively. The standard deviation associated with firms' O&G share is 1.97%. The median (mean) CLO has 1.05% (2.00%) of the portfolio invested in O&G, before the shock. The 25^{th} and 75^{th} percentile values are 0% and 2.84%, respectively. The standard deviation associated with the CLO O&G share is 4.25%. Variation in O&G exposure may seem limited. However, as CLOs operate closely to their ID constraints, the price plunge can produce material effects as examined in this section.

In Table 2, I study the relation between a CLO's exposure to the O&G industry and its distance from the ID threshold. Note, this is a CLO's exposure to O&G – not the firm's exposure to O&G. The empirical specification is the following.

$$ln(\frac{\text{Covenant Result}}{\text{Covenant Threshold}})_{c,t} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \gamma_0' X_c + \epsilon_{c,t} \quad (11)$$

c denotes the CLO, t denotes the time, and X denotes the vector of controls, consisting of age, size, defaulted share, and CCC-share. Covenant Result is the reported value of the covenant. Covenant Threshold is the threshold associated with the covenant. CLO O&G Exposure_c is the O&G share of CLO c, reported before the shock occurs, and Oil Shock_t is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise.

Differences in specialization, risk aversion, taste, reputation, sophistication, and style are accounted for through manager and CLO fixed effects. I use a within manager estimator in columns 1-4, and a within CLO estimator in columns 5 and 6. I include CLO controls in columns 2-4, as the control variables are measured prior to the price plunge and, therefore, absorbed by CLO fixed effects in columns 5 and 6. These include CLO age (columns 2-4), CLO size (columns 3-4), and share of CCC loans and defaulted loans (column 4). Further, I include time fixed effects to account for aggregate shocks – year fixed effects in columns 2 and 5, and month-year fixed effects in columns 3, 4, and 6. The results indicate that a 1 pp increase in the O&G share before the shock is associated with a 0.20% to 0.35% decline in the distance to the ID threshold, after the shock. This estimate is nontrivial, as CLOs operate within 5% of their thresholds (Table 1). The estimate is economically meaningful, statistically significant, and stable across all specifications.

Moreover, I compare the distribution of O&G loan ratings before and after the O&G price plunge. Appendix Figure A.5 indicates that there is a marked shift in the credit quality of O&G loans, before and after the O&G price plunge. Specifically, before the shock, approximately 40% of O&G loans report a double-B rating. 5% of O&G loans report a rating of Caa1 or below, while the remaining loans are rated single-B. After the shock, over 10% of O&G loans report a rating of Caa1 or below, and the share of double-B loans falls to 30%. Hence, a comparison of the ratings of O&G loans, before and after the shock, indicates that the credit quality of O&G loans markedly worsens after the shock. Furthermore, I compute the percent of O&G defaulted loans before and after the O&G price plunge. 3% of CLO defaulted loans are O&G loans after plunge, compared to 0.09% before.

Overall, these findings suggest that the O&G shock provides a quasi-exogenous source of variation that affects CLO covenants. Hence, O&G is a relevant proxy for portfolio risk.

4.1.4 Parallel Trends

This section examines whether any relationship between O&G exposure and firm outcomes may be driven by pre-trends, prior to the oil and gas price plunge. I study the relationship between: *(1)* the price of a secondary loan issued by a non-O&G issuer and the issuer's O&G exposure, and, *(2)* the distance to the ID threshold and CLO O&G exposure. For identification, the parallel trends assumption states that these relationships would have followed common trends both before and after the price plunge, in the absence of the price plunge. As I cannot assess the counterfactual scenario of what would have occurred in the absence of the price plunge, I study whether there is evidence of divergent trajectories across entities with differential O&G exposures before the shock, i.e., whether pre-trends are parallel prior to the shock. Relatedly, I also study whether there is a marked change in the trajectories of entities with greater/lesser O&G exposure after the shock. These results are presented in Figure 5.

I plot the estimated coefficients of β_i and the associated 95% confidence intervals from the following regression specifications.

In Figure 5a, the regression specification is:

$$P_{i,f,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{Firm O\&G Exposure})_f + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \delta_k \mathbb{1}_{k\leq t<k+6}$$

$$+ \theta_1 \text{Firm O\&G Exposure}_f + \alpha_f + \alpha_y + \epsilon_{i,f,t}. \tag{12}$$

In Figure 5b, the regression specification is:

$$ID_{c,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{CLO O\&G Exposure})_c + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \delta_k \mathbb{1}_{k\leq t<k+6}$$

$$+ \theta_1 \text{CLO O\&G Exposure}_c + \alpha_m + \alpha_y + \epsilon_{c,t}. \tag{13}$$

where $P_{f,t}$ is the secondary loan price (per \$100), $ID_{c,t}$ is the distance to the ID threshold ($ln(\frac{\text{Covenant Result}}{\text{Current Threshold}})$), c denotes the CLO, m denotes the manager, f denotes the (non-O&G) portfolio firm or issuer ($f \in c$), t indexes the date, and y denotes the year. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs. CLO O&G Exposure$_c$ is the O&G share of CLO c before the shock occurs. $\mathbb{1}_{k\leq t<k+6}$ is an indicator variable that takes a value of 1 if the time period corresponds to the six-month time period signified by k. Leads and lags of the shock are included, as well as their respective interactions with the measures of O&G exposure. I exclude the last pre-treatment month to avoid perfect multicollinearity.

Figure 5a presents the relation between the secondary price of a loan issued by a firm and its O&G exposure, in six-month increments surrounding the shock in Figure 5a. Figure 5b presents the relation between a CLO's distance to the ID threshold its O&G exposure, in six-month increments surrounding the shock.

The β_i estimates prior to the shock are akin to placebo treatments; each of the β_i coefficients is a placebo test for whether the treatment has an effect. Under the parallel trends assumption, no effect should occur before the treatment occurs. The findings are consistent with the assumption that prior to the shock, the relationships between the secondary price of loans issued by non-O&G issuers and the issuer's O&G exposure, and, distance to the ID threshold and CLO O&G exposure, are statistically indistinguishable from the last pre-treatment period – the 95% confidence intervals include the null in the period before the shock. Figure 5b indicates that before the shock, CLOs with greater exposure to O&G operated farther away from the Interest Diversion threshold, relative to CLOs with lower exposure to O&G. This is consistent with the findings of Appendix Figure A.6 and Appendix Figure A.7. Appendix Figure A.6 indicates that O&G loans exhibited higher ratings than non-O&G loans; 40% of O&G loans report a double-B rating compared to 21% of non-O&G loans. Moreover, Appendix Figure A.7 indicates that the O&G loans yield higher returns, relative to non-O&G loans for every rating category that O&G loans are active in. Together, these findings support that before the shock, CLOs with greater exposure to O&G operated farther away from the Interest Diversion threshold.

After the shock occurs, these relationships exhibit a marked change – the magnitude of β_i becomes economically meaningful, stable, and statistically significant. Hence, I reject the hypothesis that the relationships between the secondary price of loans issued by non-O&G issuers and the issuer's O&G exposure, and, distance to the ID threshold and CLO O&G exposure, are driven by pre-trends. As the shock does not exhibit similar effects before the shock, I attribute any variation after the event to the price plunge itself.

Furthermore, the depression in loan prices is temporary, as secondary loan prices exhibit a slow recovery towards their pre-plunge prices. The secondary loan price reaches a trough 18 months after the price plunge. Thereafter, the point estimate attenuates in magnitude and the confidence interval widens over time. These results suggest that the dislocation in the secondary loan price lasts for roughly 18 months, consistent with the linear projections presented in section 6.2 which show that there is an inflection in the trajectory of prices and spreads after roughly four quarters. Moreover, evidence of reversal supports the fire sale mechanism; if the results are driven by firm fundamentals, there would not be any reversal. Further, I reject the hypothesis that the findings can be explained by changes in firm fundamentals or bank constraints through two falsification tests in section 7.2.

5 Main Results

This section reports the main findings of the paper. I first provide evidence of CLO fire sales. I then demonstrate that the fire sales have extensive implications for asset prices across security markets as well as real economic activity. I argue that CLO fire sales are driven by contractual arbitrage – a practice in which CLO managers sell risky loans with higher market values than accounted values to loosen the capital covenants. However, it is difficult to identify, ex ante, which firms are risky and most vulnerable to fire sales. Hence, this section focuses on all loans held by constrained CLOs. In Section 6, I investigate the contractual arbitrage mechanism and CLO portfolio effects, presenting direct evidence in support of the mechanism.

I begin by providing evidence of fire sales of loans issued by innocent bystanders. I then study the price effects for various securities including secondary loans, primary loans, corporate bonds and equities. I show that the market dislocations erode the liquidity positions of firms, which are pushed to making operational changes that affect their real economic activity. Lastly, I assess the magnitude of these effects.

5.1 Fire Sales of Non-O&G Loans

This section compares loan sales based on firm O&G exposure, around the O&G price plunge. I examine the trades at the transaction, CLO-issuer, and issuer levels to identify systematic sales. I standardize the dependent variables for ease of interpretation.

5.1.1 Trading Effects

In Table 3, I present the relation between firm O&G exposure and the transaction amount around the O&G price plunge. The transaction amount is negative if the transaction is a sale, and positive if it is a purchase. In column 1, I do not include any fixed effects. In columns 2-6, I add additional fixed effects including manager, rating-industry, issuer-loan type, year, and month-year fixed effects. The point estimate remains negative, statistically significant, and economically meaningful across all columns. Specifically, I find a 1 pp increase in a firm's exposure to O&G is associated with a 0.1103 to 0.1865 standard deviations decline in the transaction amount, after the shock. Hence, the transaction amount declines in firms' exposures to O&G, after the shock.

Further, I estimate the relation between firm O&G exposure and the total amount transacted at the CLO-issuer level around the O&G price plunge. For each issuer in a given CLO, I aggregate across all transactions. These results are presented in Table A.4. In column 1, I do not include any fixed effects. In columns 2-6, I add additional fixed effects including manager, rating-industry, CLO-issuer, year, and month-year fixed effects. I find that a 1 pp increase in a firm's exposure to O&G is associated with a 0.1244 to 0.2377 standard deviations decline in the net transaction amount at the CLO-issuer level after the shock. These results remain statistically significant at the issuer-level as well. Table A.5 reports that a 1 pp increase in a firm's exposure to O&G is associated with a 0.0168 to 0.0295 standard deviations decline in the net transaction amount at the issuer-level, after the shock.

However, a reduction in the transaction amount and net transaction amount at the CLO-issuer and issuer levels are not necessarily tantamount to increased sales. That is, a decline in the purchase amount may also yield similar results. To disentangle whether the effect is driven by an increase in sales or a decrease in purchases, I conduct a subsample analysis. I study how the net transaction amount at the issuer level differs for purchases and sales around the O&G price plunge. These results are presented in Table A.6. The results in columns 4-6 corroborate the hypothesis that CLO selling pressure increases in the O&G exposure, after the shock. Concretely, a 1 pp increase in a firm's exposure to O&G is associated with a 0.0815 to 0.1095 standard deviations increase in net sales, after the shock. Columns 1-3 indicate that at the issuer-level, the purchase amount increases in the O&G exposure, albeit the estimates are statistically insignificant. The positive relation between purchases and O&G exposure counter the alternative hypothesis that the effect is driven by a decrease in purchases.

Hence, these tests provide a priori evidence that the amount of selling increases after the shock in the degree of constraint, as reflected by O&G exposure, after the shock.

5.2 Implications for Asset Prices

This section investigates the price impact of fire sales. First, I study how firm exposure to O&G through CLOs exerts price pressure on the securities issued by these firms. I begin by studying the effect on secondary loan prices. I then study how dislocations in the secondary loan market can pass through to other securities, namely, primary loans, corporate bonds, and equities.

The average leveraged loan issuer is highly indebted, has a borrower rating below investment grade, making issues of asymmetric information especially acute for these borrowers. As the "market for credit is suffused with imperfect and asymmetric information," banks are uniquely specialized in acquiring information, evaluating the performance of loans, and monitoring borrowers (Bernanke et al. (1993)). Dislocations in the secondary loan market can spur contagion across security market, including incomplete markets, characterized by incomplete information. This can lead to imperfect substitution. Concretely, a prospective investor who seeks exposure to a specific firm may purchase any form of debt: secondary issuance, primary issuance, bonds, etc. CLOs constitute marginal investors in the secondary loan market, which is illiquid relative to other capital markets. When they become constrained, CLOs sell loans issued by innocent bystanders to generate slack in their covenants. As the spreads associated with secondary loans widen, other forms of debt also experience a widening of spreads. The reason is that in market equilibrium, the expected rate of return for any form of debt issued by a firm is equalized. For the affected innocent bystanders, the secondary market spread becomes the effective cost of capital. Thus, the real costs of fire sales may exacerbate credit crunches by contracting credit as described in Diamond and Rajan (2011).

The identifying assumption for the subsequent analysis is that issuer fixed effects fully control for issuer demand throughout the sample period. This is plausible given the small T dimension of the panel. A weaker identifying assumption is that changes in firm demand are sticky, relative to changes in supply. When applicable, I account for non-price terms associated with the securities contracts as controls, i.e., maturity, secured status, seniority, etc. Time fixed effects are included to control for common shocks. Further, I conduct two falsification exercises in Section 7.2, confirming that the findings are not driven by changes in firm fundamentals or bank constraints.

5.2.1 Secondary Loans

First, I study how the secondary loan price (per $100 of notional par), varies with a firm's exposure to O&G around the O&G price plunge in Table 4. In column 1, I do not include any fixed effects. This column indicates that a 1 pp increase in a firm's exposure to O&G is associated with a decline in the secondary loan price by $1.81 (per $100 par), after the shock.[11] In columns 2-6, I add additional fixed effects including manager, rating-industry, issuer-loan-type, year, and month-year. The inclusion of these fixed effects is intended to account for variation across loan characteristics and time, in order to better identify the effect of the intermediary covenant on asset prices. Based on columns 2-6, I find that a 1 pp increase in a firm's exposure to O&G is associated with a decline in the secondary loan price by $0.61 to $1.79 (per $100 par), after the shock. The point estimates are economically meaningful and statistically significant across all specifications. Moreover, given the skewness of trading prices, I show that the results are robust to the natural log transformation of the transaction price in Table A.7 – a 1 pp increase in a firm's exposure to O&G is associated with a decline in the secondary loan price by 0.81%

[11] Before the shock, a 1 pp increase in a firm's exposure to O&G is associated with an *increase* in the secondary loan price by $1.86 (per $100 par). The nearly equal and opposite signs reflect the boom and bust of O&G – consistent with the trading patterns before and after the shock in Table 3. The prices of debt securities issued by innocent bystanders are expected to exhibit higher volatility when CLOs have larger exposure to more volatile sectors, such as O&G.

to 2.54%. Hence, after the shock, secondary loans issued by non-O&G firms with greater exposures to O&G, trade at lower prices, relative to non-O&G firms with lesser exposures to O&G.

5.2.2 Impact on Primary Loans

I study whether the dislocation in the secondary loan spread passes through to primary loans. In Table 5, I study how the spread associated with refinancing primary institutional loans varies with O&G exposure, after the shock. A term loan is deemed to be an *institutional* loan if it is not a term loan A facility. The outcome variable is the all-in-spread drawn, defined as the total annual spread above LIBOR for each dollar drawn from a loan.[12] In columns 1-6, I sequentially add fixed effects to account for variation in non-price contract terms that may confound the relationship between the loan price and intermediary covenant. These include issuer, secured status, purpose, distribution method, seniority, loan type, country of syndication, year, and month-year fixed effects. Across columns 1-5, I find that a 1 pp increase in a firm's exposure to O&G is associated with an increase in the primary loan spread by 18 to 22 bps, after the shock. In spite of the relatively small sample, I find strong significance across all specifications. This suggests firms that refinance after the shock face higher term loan spreads if they exhibited greater exposure to the O&G industry through CLOs before the shock.

Further, I study how the non-price terms of loan contracts vary with O&G exposure, after the shock. The relation between loan maturity and O&G exposure around the price plunge is studied in Table A.8. A 1 pp increase in a firm's exposure to O&G is associated with a decrease in loan maturity by four to five months, after the shock. This point estimate is negative, statistically significant, economically meaningful, and stable across all specifications. The relation between the loan amount and O&G exposure around the price plunge is studied in Table A.9. A 1 pp increase in a firm's exposure to O&G is associated with a decrease in the loan amount by 4.67% to 7.66%, after the shock. Although the point estimates associated with the loan amount are negative, economically meaningful and stable across all specifications, they are not statistically significant.

5.2.3 Impact on Corporate Bonds

The extant literature has demonstrated that banks are the main source of funding for riskier and more opaque firms, as banks' unique comparative advantages include economies of specialization, economies of scale, and economies of scope (e.g., Diamond (1984); Diamond (1991);

[12]The all-in-spread drawn consists of the upfront fee, annual fee, utilization fee, and spread above LIBOR.

Bernanke et al. (1993); Petersen and Rajan (1994); Petersen and Rajan (1995); Bolton and Freixas (2000)). CLO covenant-induced fire sales effectively reduce the supply of bank loans. As arms-length bond investors cannot discern a deterioration in firm fundamentals from a deterioration in CLO constraints, substitution of credit by non-bank participants is expected to be imperfect.

In Table 6, I examine the sensitivity of bond credit spreads to firm O&G exposure around the O&G price plunge. I include issuer and bond-type fixed effects across all columns. In columns 2-6, I account for various dimensions of bond heterogeneity including the time to maturity, security-level, rating, investment-grade status, and defaulted status, as well as time fixed effects to control for common shocks. I find that a 1 pp increase in a firm's exposure to O&G is associated with an increase in the bond credit spread by 28-36 bps, after the shock. Furthermore, I find that bond liquidity deteriorates in firms' exposures to O&G, after the shock. Table A.10 reports that a 1 pp increase in a firm's exposure to O&G is associated with an increase in the bid-ask spread by 0.0208 to 0.0241 bps, after the shock.

5.2.4 Impact on Equities

Thus far, the results suggest that the cost of debt increases in firms' exposures to O&G through CLOs. This section investigates whether there are tangible effects on firms' equity returns. In Table 7, I study how a firm's exposure to O&G through CLOs may affect its monthly equity returns. I include issuer fixed effects in all specifications. In columns 2-4, I include year fixed effects. The market model factors are included in column 3 – the risk-free rate and market risk premium. The Fama-French three factors are included in column 4, adding SMB and HML to the specification of column 3. The Fama-French five factors are included in column 5, adding RMW and CMA to the specification of column 4. Across all columns, I find that a 1 pp increase in a firm's exposure to O&G is associated with a decline of 0.2918 to 0.2976 pp in monthly equity returns, after the shock. This point estimate is economically meaningful, statistically significant, and very stable. Moreover, column 1 suggests that the timing of the O&G price plunge, along with cross-sectional variation in firms' exposures to the O&G industry, can explain 6.16% of variation in monthly equity returns. Together, the results suggest that firms' exposures to O&G and the timing of the shock can partly predict and explain monthly equity returns.

5.3 Implications for Firms

Thus far, it has been established that firms' exposures to O&G through CLOs have material effects on the prices of various securities. This section investigates how credit market dislocations may erode the liquidity positions of exposed firms and result in operational adjustments.

5.3.1 Impact on Firm Liquidity

As firms' effective cost of capital increases, the terms on which they can obtain external funds may deteriorate. This may induce firms to draw down their existing lines of credit. I investigate how firm liquidity is affected by firm O&G exposure around the O&G price plunge in this section. Firm liquidity is measured as the amount of credit available through lines of credit.

Table 8 reports the results. Columns 1-3 report the relation between the change in the unused line of credit and firms' O&G exposures around the O&G price plunge. Columns 4-6 report the relation between the change in the drawn line of credit and firm O&G exposure around the O&G price plunge. I include issuer fixed effects across all columns, year fixed effects in columns 2-4, and industry and month-year fixed effects in columns 3-6. I find that a 1 pp increase in a firm's exposure to O&G is associated with a 0.0325 standard deviations decline in the quarterly change in the unused line of credit and a 0.0375 standard deviations increase in the quarterly change in the drawn line of credit.

5.3.2 Impact on Firm Real Activity

In response to the credit crunch, firms draw down their existing lines of credit more aggressively, as demonstrated in the previous section. However, the liquidity obtained from lines of credit may be insufficient to fully substitute from other forms of credit. As a result, firms may be driven to making operational changes, including financial and real adjustments.

In Table 9, I examine how firms' exposures to O&G through CLOs can affect various financial and real outcomes of firms. Specifically, I examine the effect of firms' exposures to O&G on long-term debt growth in column 1, cash flow in column 2, real sales growth in column 3, acquisitions in column 4, investment in column 5, R&D growth in column 6, and employment growth in column 7. The construction of these variables is described in Section B. I include issuer, industry, and quarter-year fixed effects across all columns. I find that a 1 pp increase in a firm's exposure to O&G is associated with a 0.0430 standard deviations decline in long-term debt growth, a 0.0304 standard deviations decline in cash flow, a 0.0378 standard deviations decline in investment, a 0.0866 standard deviations decline in R&D growth, and a 0.0447 standard deviations decline in employment growth, after the shock. These estimates are economically meaningful and statistically significant. Furthermore, a 1 pp increase in a firm's exposure to O&G is associated with a 0.0001 standard deviation decline in real sales growth, and a 0.0007 standard deviations decline in acquisitions expenditures. The estimates associated with real sales growth and acquisitions expenditures, while statistically significant, are economically minute. Overall, the findings indicate that CLO constraints spillover to real economic activity.

5.4 Discussion on Magnitude

This section discusses the magnitude of the effects on asset prices and firm decisions. The difference in the reporting of prices and spreads across datasets is a key challenge that hinders a simple comparison of the point estimates across the tables. For inference, I convert the outcome variables in terms of standard deviations. This yields the following.

A 1 pp increase in a firm's exposure to O&G is associated with a decrease in the transaction amount by up to 0.19 standard deviations. An increase in firm exposure to O&G imposes price effects. A 1 pp increase in a firm's exposure to O&G is associated with a decrease in the secondary loan price by up to 0.21 standard deviations, an increase in the primary loan spread by up to 0.12 standard deviations, an increase in the bond credit spread by up to 0.06 standard deviations, and a decrease in the monthly equity returns of up to 0.02 standard deviations. The asymmetry of the effect across capital markets demonstrates that there is imperfect substitution of loans. Moreover, the dislocation in asset prices causes firms to aggressively draw down existing lines of credit and make operational changes. Specifically, I find that a 1 pp increase in a firm's exposure to O&G is associated with a decrease (increase) in the change in the unused (drawn) line by 0.03 standard deviations. The erosion of firms' liquidity positions spills over to firm real activity. Notably, in response to a 1 pp increase in a firm's exposure to O&G, firms face declines of 0.04 standard deviations in debt growth, 0.03 standard deviations in cash flow, 0.04 standard deviations in investment, 0.09 standard deviations in R&D, and 0.05 standard deviations in employment growth.

Firms are more exposed to cross-firm spillovers through CLO structures than bond mutual funds, but less than banks. Zhu (2021) finds that a one standard deviation increase in the bondholder flow is associated with a 5.55 bps decrease in the yield spread. Comparatively, I find that a one standard deviation increase in O&G exposure is associated with an increase of 55-71 bps.[13] In the bank lending setting, Chodorow-Reich (2014) finds that employment at precrisis clients of lenders at the 10^{th} percentile of bank health fell by 4-5 pp more than clients

[13] The assumption in this comparison is that a one standard deviation increase in a firm's O&G exposure is comparable to a one standard deviation increase in the bondholder flow. Even if this is not the case, the cross-firm

at the 90^{th} percentile. In contrast, I find that the employment of issuers at the 10^{th} percentile of CLO O&G exposure fell by 1.66 pp more than issuers at the 90^{th} percentile. Hence, the effect through CLOs is two to three times smaller than that of banks. These comparisons demonstrate that firms are more exposed to cross-firm spillovers through CLO structures than other arm's-length intermediaries, but less than banks.

However, the baseline estimates may understate the magnitude of the true effect for several reasons. I highlight two of the reasons. First, not all non-O&G portfolio firms are equal innocent bystanders. As I explain in the subsequent section, Section 6.1, CLOs can generate more slack in their constraints by selling assets with higher market values than accounted values. I show that firms that are more likely to be innocent bystanders, as reflected by their credit ratings, experience effects that are five to seven times as large as the baseline estimates. Second, I conduct my analysis for a relatively benign macroeconomic period – from 2013-2015. This is a period when financial markets were calm and relatively liquid. While the effects emanating from a financially tranquil period may be temperate, it raises concerns of what may occur when markets become more illiquid during times of stress. Moreover, given the overlapping nature of CLO portfolios, the effects may be especially deleterious if issuers simultaneously default. I replicate the baseline result in Section 7.6, using the COVID-19 shock for external validity, to study how the magnitude may change with more adverse shocks.

6 Mechanism: Contractual Arbitrage and CLO Portfolio Effects

This section investigates the underlying mechanism behind CLO fire sales, contractual arbitrage. Contractual arbitrage describes the practice in which CLO managers sell risky loans which exhibit higher market values than accounted values to avail of the differences in the measurement of the covenants. I present direct evidence that riskier firms experience larger effects. I then assess the persistence of the effects.

6.1 Contractual Arbitrage

The piecewise nature of the accounting of covenants has unintended effects on asset prices and corporate outcomes. When a CLO experiences adverse credit events, such as downgrades or default, its capital covenants tighten. The capital covenants effectively measure CLO leverage – the ratio of the total value of assets to the total value of liabilities. In most cases, assets are marked at book value. However, if a loan has experienced default, puts the CLO in excess

spillovers through CLO structures is larger than bond mutual funds, as long as a one standard deviation increase in a firm's O&G exposure is equivalent to less than a 10-13 standard deviation increase in bondholder flow.

of its CCC/Caa1 limit, or is a discount obligation, the loan is marked to the lower of market value and recovery value, the lowest of the market values of the CCC/Caa1 bucket, or the purchase price until the loan trades above a threshold (typically 90) for more than 30 days, respectively. Hence, adverse credit events can induce a departure from historical cost accounting and tighten a CLO's capital covenants.

Among the loans in the aforementioned exceptional categories, CLOs are incentivized to sell the best of the risky loans. Section 2.1 provides examples of this mechanism. For example, if the share of loans rated CCC/Caa1 or below exceeds its stipulated limit, all excess loans are marked at the *lowest* market value of all loans in this segment. The CLO manager can maximize improvements to the capital covenants by selling loans in the CCC/Caa1 category that exhibit higher market values than accounted values in descending order of market values.[14] Similarly, with regard to defaulted loans, if the projected recovery values of defaulted loans are lower than their market values, the loans are marked to their recovery values.[15] The CLO manager can maximize improvements to the capital covenants by selling these defaulted loans in descending order of the market value. CLOs can similarly exploit differences in the case of discount obligations, between the purchase price and market value to improve their capital covenants. Hence, nonlinearities in the accounting of covenants may be exploited to loosen these covenants.

I examine the distribution of prices for distressed loans to better study whether the conditions for a sale via contractual arbitrage are likely to be met. Figure 6 presents the cumulative distribution function (CDF) and probability density function (PDF) of CCC/Caa1 loan prices during the same period. These prices are reported in the holdings data, therefore, are less susceptible to selection and measurement issues that may arise with transactions data. The figures indicate that most CCC/Caa1 loans report a market price above 90 ¢/$. Further, I report the price distribution of the cheapest CCC/Caa1 loans reported by each CLO in each reporting period, and the price distribution of all CCC/Caa1 loans in the sample period. These numerical figures are reported in the table underlying the figure. The cheapest CCC/Caa1 loan held in each CLO is priced at 58 ¢/$ on average; the 25^{th} and 75^{th} percentile values are 34 ¢/$ and 85 ¢/$. In contrast, the average price of a CCC/Caa1 loans is 85 ¢/$; the 25^{th} and 75^{th} percentile values are 80 ¢/$ and 99 ¢/$. Hence, the vast majority of CCC/Caa1 loans are priced above the lowest CCC/Caa1 loan price in each CLO. The CDF and PDF of defaulted loans are reported

[14] Assuming there is heterogeneity in loan prices within the CCC/Caa1 bin.

[15] Often rating agencies provide corporate ratings in lieu of individual loan ratings. As leveraged loans are senior secured loans, the loan recovery rate may be higher than the recovery rate of of a company as a whole, hence, these loans may exhibit higher market values than accounted values.

in Appendix Figure A.10, providing further evidence that the market prices of distressed loans frequently exceed the projected recovery rate on bank loans.[16]

Next, I examine how the likelihood of selling risky loans varies with firm O&G exposure around the O&G price plunge. Panel A of Table 10 examines how the likelihood of selling a loan that trades above par changes in response to firm O&G exposure around the O&G price plunge. The outcome variable takes a value of 1 if the loan that is sold trades above $100 per $100 of notional par, and 0, otherwise. Panel B of Table 10 examines how the likelihood of selling a loan that trades below par changes in response to firm O&G exposure around the O&G price plunge. The outcome variable takes a value of 1 if the loan that is sold trades below $90 per $100 of notional par (typical threshold for discount obligations), and 0, otherwise. I include combinations of rating-industry, issuer-loan type, year, and month-year fixed effects in columns 1-5 to account for time-invariant heterogeneity associated with the loans as well as common shocks. The results indicate that the likelihood that a CLO sells risky loans, increases in the tightness of their covenants. In other words, CLOs are more likely to sell loans that trade below par than above par, upon experiencing a negative shock. A 1 pp increase in a firm's exposure to O&G is associated with a decrease in the probability of selling loans above par by 4% to 11%, after the shock. This is equivalent to a 0.1086 to 0.2642 standard deviations decline in the probability of selling loans above par, after the shock. A 1 pp increase in a firm's exposure to O&G is associated with an increase in the probability of selling loans below par by 2% to 4%, after the shock. This is equivalent to a 0.0786 to 0.1681 standard deviations increase in the probability of selling loans above par, after the shock. These findings rule out an alternative hypothesis which states that CLOs generate improvements to par by selling loans that trade above par. Appendix Section C.2 demonstrates that replicating the par gains generated by contractual arbitrage by selling non-distressed loans at a price above par may require a greater volume of transactions.

High dependence on CLOs reflects a lack of alternative funding sources. That is, firms that exhibit a high share of debt held by CLOs are dependent on bank loans, and likely financially constrained. The financially constrained firms are more likely smaller, younger, and private, and, face greater informational frictions (e.g., Hadlock and Pierce (2010); Cloyne, Ferreira and Surico (2020); Begenau and Salomao (2019); Gertler and Gilchrist (1994)). I study whether the trading, price, and real effects are more pronounced for the segment of leveraged loan issuers which are smaller, younger, lack access to the bond market, and were late

[16] Chen, Wang and Zhang (2019) report that the overall recovery rate associated with leveraged loans is 59.5%. According to Figure A.10, almost 30% of defaulted loans report a market price above 60 ¢/$ in the sample period. Hence, defaulted loans frequently exhibit higher market values than recovery values.

refinancers. The findings of this analysis are presented in Tables A.11, A.12, A.13, and A.14, corroborating that financially constrained firms are impacted more by CLO covenants.

Thus far, I have shown evidence that CLO fire sales are concentrated among constrained firms. The widespread sales of riskier loans are expected to be associated with compositional changes to CLO portfolios. I examine these compositional changes next. First, I study whether the interest rate associated with individual loans held in CLO portfolios changes with firm O&G exposure around the shock. The results in the most conservative specification of Table 11, column 7, indicate that a 1 pp increase in a firm's exposure to O&G is associated with a decline in the interest rate by 9 bps or 0.05 standard deviations, after the shock. This estimator is a within CLO-issuer-loan type estimator that controls for loan tenor and the interest rate index, as well as common shocks through month-year fixed effects. The estimate is stable under less restrictive alternative specifications. Second, I directly test whether the incidence and amount of risky loans changes with the degree of CLO constraint. The relation between a firm's O&G exposure and the incidence of defaulted loans around the O&G price plunge is reported in Table 12. The outcome variable takes a value of 1 if the loan has defaulted, and 0, otherwise. Eighty-two percent of all defaulted loans have a rating of CCC/Caa1 or below; the non-CCC/Caa1 loans are mostly concentrated among single-B rated loans. The results indicate that a 1 pp increase in a firm's share of O&G is associated with a 0.18% to 0.43% decline in the probability that a loan is defaulted, after the shock. This is equivalent to a 0.0145 to 0.0362 standard deviations decline in the likelihood that a loan is defaulted, after the shock. Further, I examine whether these findings are consistent with aggregate changes that occur at the CLO-level with respect to the share of defaulted loans. The relation between a CLO's exposure to O&G and the share of defaulted loans around the O&G price plunge is reported in Table 13. In the most conservative specification, column 5, I account for time-varying heterogeneity at the monthly frequency for CLO managers, arrangers, trustees, and at the annual frequency for CLOs. This allows me to isolate the effect of a tightening of CLO covenants on the share of defaulted loans. While the R^2 increases by more than 20% between column 1 and column 5, the point estimate remains very stable. A 1 pp increase in a CLO's share of O&G is associated with a decline in the share of defaulted loans by 0.55 pp to 0.60 pp, or, 0.0544 to 0.0601 standard deviations, after the shock. Overall, the results suggest that covenants meet their purported aim of ensuring that CLOs that operate close to their covenant thresholds appropriately derisk.[17]

[17] An alternative story may be that CLOs "gamble for resurrection" by shifting their industry composition to the riskiest sector. I study this possibility by comparing the change in industry composition (non-O&G industries) among CLOs with high O&G exposure, before and after the shock. This change is shown in Figure A.11. The per-

Consistent with the motives established by contractual arbitrage, CLO managers derisk and sell distressed loans upon experiencing a tightening of their covenants. Therefore, it is predicted that the financial and real effects are pronounced for the segment of distressed firms. I define a firm as *distressed* if it has defaulted on a loan in the sample period. A firm is otherwise *non-distressed*. Table 14 studies how the secondary loan price, all-in-spread drawn, and investment differ for distressed and non-distressed firms. I find the aggregate declines in secondary loan price, the all-in-drawn spread, and investment are driven, primarily, by distressed firms. A 1 pp increase in a distressed firm's exposure to O&G is associated with a decline of $2.32 in the secondary loan price (per $100 par), a 56 bps increase in the all-in-drawn spread, and a 0.12 standard deviations decline in investment, after the shock. These point estimates are economically meaningful and statistically significant, and stand in contrast with the estimates produced for non-distressed firms; a 1 pp increase in a non-distressed firm's exposure to O&G is associated with an increase of $0.34 in the secondary loan price (per $100 par), an 11 bps increase in the all-in-drawn spread, and a 0.02 standard deviations decline in investment, after the shock. The statistical significance of the differences between these two sets of estimates is assessed in Table A.15.

Thus, the findings demonstrate that fire sales are concentrated among riskier firms, supporting the mechanism of contractual arbitrage.

6.2 What Causes Persistence?

Why do other investors not step in to eliminate excess returns? During periods of crisis, such as the O&G price plunge, the most natural buyers of leveraged loans – other CLOs – may be unable to absorb excess supply, due to similar constraints. 90% of CLOs are exposed to at least one of the top 50 borrowers and more than 80% of CLOs are exposed to the top five borrowers (Board of Governors (2019)). "Outsiders" or non-specialists may have valuations below that of CLOs, which can lead to depressed prices (Shleifer and Vishny (1992)). The limited investor base and illiquidity of the secondary loan market indicate that large-scale redemptions may produce potentially large, persistent price dislocations. Persistence arises from financial frictions that may magnify the time for the price to recover and the magnitude of deviation.[18] The total purchase by the limited pool of prospective buyers may be insufficient to offset the price decline. Moreover, in light of the regulatory and risk-based capital constraints

cent change in any given industry before and after the shock is $\leq$0.02%. Hence, this test suggests that gambling for resurrection is not a primary motive of CLO managerial decisions.

[18] Encumbrances to liquidity provision can arise from search costs or slow-moving capital (e.g., Duffie, Gârleanu and Pedersen (2007); He and Krishnamurthy (2012); Duffie and Strulovici (2012); Acharya, Shin and Yorulmazer (2009); Brunnermeier and Pedersen (2009)).

that banks, insurance, and pension funds are subject to, such investors may not be able to absorb excess supply despite the prospects of profitability. Less regulated financial institutions, including hedge funds and mutual funds that specialize in distressed loans, may face limits to arbitrage (Shleifer and Vishny (1997)). Performance-based arbitrage may be ineffective when arbitrageurs, including less regulated entities, fear further mispricing and are fully invested. This can explain why the effects persist.

Forced sales in the relatively illiquid secondary loan market can increase the effective cost of capital across debt markets in market equilibrium when the expected rate of return is equalized across securities. I assess the persistence of the shock to establish the plausibility of the link between financial market dislocations and real effects.

For assessing the persistence of the initial shock, I conduct several Jordà style linear projections, as shown in Figure 7. The coefficients in these figures are estimated from the following regression:

$$
\begin{aligned}
Y_{f,t+h} - Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure}_f \times \text{Post}_t) + \beta_2\text{Firm O\&G Exposure}_f \\
+ \beta_3\text{Post}_t + \alpha_f + \alpha_y + \epsilon_{f,t}. \qquad (14)
\end{aligned}
$$

The outcome variables ($Y_{f,t}$) I study are the secondary loan prices, bond yields, leverage, and capital expenditures. t denotes the quarter-year, h denotes the steps (quarters) of the projection, f denotes the (non-O&G) portfolio firm or issuer ($f \in c$), and y denotes the year. The x-axis indicates the quarters since the shock. The y-axis indicates the point estimate associated with the β_1 estimate along with the associated 95% confidence intervals.

The linear projections are shown in Figure 7. Figures 7a and 7b show the responses of the secondary loan price and bond credit spread. Figures 7c and 7d show the responses of leverage and investment. Figures 7a and 7b indicate that asset prices fall and spreads increase for four quarters. An inflection occurs after four quarters, at which point, prices start increasing and spreads start declining. Prices and spreads revert back towards zero after seven quarters. This pattern is consistent with the parallel trends shown in Figure 5, in which the secondary loan price reaches a trough 18 months after the price plunge, exhibiting a slow reversion thereafter. Moreover, firm characteristics respond after a lag. Leverage does not respond until four quarters after the initial shock, as shown in Figure 7c. It shows signs of reversal after seven quarters. Investment starts declining two months after the initial shock, and falls until the seventh quarter, after which, it reverts back towards zero, as shown in Figure 7d. These findings indicate that asset prices start declining from the outset of the shock, whereas firm outcomes react after a delay. All variables exhibit a consistent reversal.

Hence, market dislocations persist for long enough that real effects materialize. This finding suggests a temporary episode of distress can damage firms for a longer-term – an externality of "short-termist" damage control.

7 Robustness

I conduct a battery of tests to ensure the robustness of the findings. First, I employ an IV strategy to show that CLO covenants are the source of cross-firm spillovers. Second, I conduct two falsification tests to dispel the concern that the findings may reflect changes in firm fundamentals or bank constraints. Third, I report the results of a placebo test that addresses whether the results may be driven by omitted variable bias. Fourth, I verify that the findings are robust to alternative specifications, measures, definitions, and data sources. Lastly, I validate the proposed mechanism, using the COVID-19 shock.

7.1 Instrumental Variable Strategy

The objective of the paper is to show that CLO covenants induce cross-firm spillovers. The main empirical specification is a reduced-form IV strategy that exploits cross-sectional variation in firms' exposures to the O&G industry as well as the timing of the O&G price plunge. O&G is a measure of covenant tightness. Taken together, the first stage and second stage results indicate that CLO covenants induce cross-firm spillovers. However, this evidence is indirect. I have not directly shown that CLO covenants can induce cross-firm spillovers. Table A.16 presents direct evidence that covenants are the source of cross-firm spillovers. Column 1 presents the OLS regression results from regressing the transaction amount on a measure of exposure to the CLO ID covenant. Firm exposure to the CLO covenant is measured similarly to firm O&G exposure – the weighted average of the distance to the ID threshold across all CLOs. However, this naïve regression is plagued by issues of endogeneity, namely, firms' exposures to the CLO covenant are likely related to the characteristics of the firms that CLOs hold in their portfolios. Column 2 presents the IV result, presented in the baseline analysis. Columns 3 and 4 present the results from a 2SLS strategy. All specifications include issuer-loan type and month-year fixed effects. The identification assumptions underlying the 2SLS strategy are relevance – after the O&G price plunge, firms with greater exposure to O&G operate closer to the covenant thresholds – and exclusion – the instruments do not affect the transaction amount through any other channel other than the CLO covenants. I find that the relation between the firms' exposures to the CLO covenant and the transaction amount are statistically significant at the 1% level. Hence, this test supports the reduced-form IV strategy employed in the paper.

7.2 Do the Findings Reflect Changes in Firms' Fundamentals or Bank Constraints?

No. The findings neither reflect changes in firm fundamentals nor bank constraints. I dispel these hypothesis through two falsification tests.

The first falsification test identifies whether the findings are driven by changes in firm demand. Banks typically retain term loans A and revolving lines of credit on their balance sheet. If the findings are driven by changes in demand, the all-in-spread drawn associated with these facilities should exhibit a similar increase to that presented with term loans in Table 5, in response to changes in demand. If the findings are driven by CLO constraint, the all-in-spread drawn should not exhibit any sensitivity to firm O&G exposure, after the shock. The results of this exercise are presented in Table A.17. I do not find evidence of any increase in the all-in-spread drawn for revolving lines of credit and term loans A. Hence, I rule out that the findings are driven by changes in firms' fundamentals.

The second falsification test identifies whether firms' exposures to the CLO covenant may be confounded by firms' exposures to bank constraints. In this test, I study how a firm's all-in-spread undrawn varies with its O&G exposure. If firms' exposures to bank constraints are correlated with the firms' exposures to the CLO covenant via O&G, the all-in-spread undrawn associated with revolving lines of credit should exhibit sensitivity to firms' O&G exposure. The results of this exercise are presented in Table A.18. I do not find strong evidence of a change in the all-in-spread undrawn for revolving lines of credit. Hence, I rule out that the findings are confounded by bank constraints.

Moreover, any systemic effect of the O&G price plunge is reflected in the *Post* variable.

7.3 Placebo Tests and Omitted Variable Bias

This section examines the role of omitted variable bias (OVB). As long as the structure of omitted variables is identical across firms, a null result of the placebo test reflects a negligible role of OVB in driving the results.

I conduct a placebo test, randomizing the O&G share from a uniform distribution and running 1,000 Monte-Carlo simulations of the regression specifications in column 5 of Table 3, column 5 of Table 4 and column 4 of Table 5, respectively. A histogram of the point estimates of the interaction term are presented in Figure A.8. The outcome variable is the transaction amount in Figure A.8a, secondary loan price in Figure A.8b, and the all-in-spread drawn in Figure A.8c. The "true" point estimates lie outside of the figures. Specifically, the t-statistics for tests of the null hypothesis are -0.1022, -0.7503 and 0.7690 in Figures A.8a, A.8b, and A.8c, respectively. Hence, the null hypothesis that the mean is equal to zero cannot be rejected in any case. This confirms that OVB does not drive the results; firm exposure to O&G is important for the findings.

7.4 Mismeasurement of O&G Exposure

I investigate whether the results are sensitive to the exact measurement of O&G exposure. In Table A.19, I verify the results are robust to alternative measures of firm exposure to O&G. I present the results from running the regression specifications of column 5 of Table 3, column 5 of Table 4 and column 4 of Table 5 for various measures of firm exposure. In columns 1-3, a firm's exposure is measured as the equal-weighted average O&G share across all CLOs. These columns indicate that a 1 pp increase in a firm's exposure to O&G is associated with a decline in the transaction amount by 0.15 standard deviations, a decline in the secondary loan price by $0.66 (per $100 par), and an increase in all-in-spread drawn by 21 bps, after the shock. In columns 4-6, a firm's exposure is measured as the loan-frequency equal-weighted average O&G share across all CLOs.[19] Columns 4-6 indicate that a 1 pp increase in a firm's exposure to O&G is associated with a decline in the transaction amount by 0.15 standard deviations, a decline in the secondary loan price by $0.83 (per $100 par), and an increase in the all-in-spread drawn by 21 bps. In columns 7-9, a firm's exposure is measured as the loan-frequency value-weighted average O&G share across all CLOs. These columns indicate that a 1 pp increase in a firm's exposure to O&G is associated with a decline in the transaction amount by 0.15 standard deviations, a decline in the secondary loan price by $0.80 (per $100 par), and an increase in the all-in-spread drawn by 20 bps. Lastly, in columns 9-12, a firm's exposure is measured as the loan-amount value-weighted average O&G share across all CLOs. Columns 9-12 indicate that a 1 pp increase in a firm's exposure to O&G is associated with a decline in the transaction amount by 0.15 standard deviations, a decline in the secondary loan price by $0.83 (per $100 par), and an increase in the all-in-spread drawn by 21 bps. Hence, the results are robust to alternative measures of firm exposure.

Lastly, I consider how the results differ under an alternative empirical specification. In this alternative specification, I directly use the log-transformed oil price instead of an indicator for the price plunge. I plot the marginal effects – the slope of various outcome variables on price, while holding the value of the O&G share constant between 0 and 1 in Figure A.9. As the crude price is higher, firms with greater O&G exposure are expected to experience greater net purchases, higher secondary loan prices and lower all-in-spread drawn. Conversely, when the crude price is lower, firms with greater O&G exposure are expected to experience lower net

[19] Note, this differs from the definition used in columns 1-3 in which there is one entry for each issuer held in a CLO (collapsing across loans).

purchases, lower secondary loan prices and higher all-in-spread drawn. The plots of Figure A.9 are consistent with these hypotheses.

7.5 Consistency with Holdings Data

Thus far, using transactions data, this paper has presented evidence that shows that the amount of selling increases in the O&G exposure of CLOs, after the shock. This section employ holdings data to estimate the percent of the float the sales amount to, across all CLO portfolios.

I study the relationship between the growth in firms CLO debt and firms' exposures to the O&G industry around the O&G price plunge. The granular holdings are collapsed across CLO portfolios, and aggregated to the firm level in order to estimate the relation between the growth of a firm's CLO debt and its O&G exposure around the O&G price plunge. Table A.21 reports the results. I include firm fixed effects across all specifications and year and month-year fixed effects in columns 2 and 3, respectively. The relation between the growth of a firm's CLO debt and its O&G exposure is negative and stable across all columns. Specifically, a 1 pp increase in a firm's exposure to O&G is associated with a 3% decline in the growth of CLO debt, after the O&G price plunge. This estimate is statistically significant and economically meaningful.

Next, I exploit cross-sectional variation in the holdings data to study whether fire sales are pronounced for more vulnerable firms. I aggregate the holdings data across CLO portfolios to the firm level. Firm vulnerability is encapsulated through two measures: *(1)* firm exposure to O&G, and *(2)* dependence on CLOs. Taken together, these measures reflect the relative importance of CLO covenants to firms. Concretely, suppose there are two widget companies, WidgetCo A and WidgetCo B. If both WidgetCo A and WidgetCo B have the same exposure to O&G through CLOs, but 75% of WidgetCo A's debt is held by CLOs, and 1% of WidgetCo B's debt is held by CLOs, it is expected that the CLO fire sales will have a larger impact on securities issued by WidgetCo A, compared to WidgetCo B. I bin firms based on CLO dependence and exposure to O&G. A firm has low (high) dependence on CLOs if its share of total debt held by CLOs is below (above) the median. Total bank debt is computed by cumulating DealScan loan facility data. A firm has low (high) exposure to O&G if its exposure is below (above) the 75^{th} percentile. The results, presented in Table A.22, reflect two key findings. First, consistent with contractual arbitrage, the relation between the growth in firms' CLO debt and firms' O&G exposure is negative, economically large, and statistically significant among firms with high O&G exposure and high dependence on CLOs, as shown in column 4. This estimate is almost twice as large as the baseline estimate of Table A.21. Second, I find that firms that exhibit low

O&G exposure or low dependence on CLOs are virtually unaffected, thereby, providing a useful falsification test that validates that firms that are more exposed to CLO covenants and more dependent on CLOs for financing are most vulnerable to fire sales.

7.6 External Validity

This section examines whether the proposed mechanism has external validity. I primarily focus on a relatively benign macroeconomic period – from 2013-2015. During this period, financial markets were calm and relatively liquid. Although the effects emanating from a financially tranquil period are temperate, it raises concerns about what may occur when markets become more illiquid during times of stress. Ninety percent of CLOs are exposed to the top 50 US borrowers, and 80% are exposed to the top five borrowers (Financial Stability Board (2019)). This suggests that the effects may be especially damaging if borrowers simultaneously default and impose negative externalities on other unrelated firms held in CLO portfolios. Therefore, I replicate the baseline analysis using the COVID-19 shock, to study how the magnitude changes under more adverse shocks. The identifying assumption for this analysis is that COVID-19 is not an aggregate shock, but rather a series of industry-wide shocks across several vulnerable industries.

The time period for this analysis is from January 1, 2020 to May 6, 2020. I limit the analysis to this time period based on the analysis of Foley-Fisher, Gorton and Verani (2020) which highlights a structural break in the standard deviation of AAA-rated CLO prices after May 6, coinciding with the timing of several announcements, including the announcement of the Primary Corporate Credit Facility (PMCCF) and Secondary Market Corporate Credit Facility (SMCCF), and modifications to the LCR and SLR. The *Post* variable takes a value of 0 before March 1, 2020, and 1, afterwards. I study how the point estimate changes under different industry proxies for the ID covenant, as shown in Table A.20.[20] In Table A.23, I verify that CLO exposure to these most industries affects the distance to the ID threshold.

As in the baseline analysis, I study how the secondary loan price varies for firms that are not in the affected industry, as designated by the column header. In column 1, I find that a 1 pp increase in a firm's exposure to O&G is associated with a $0.91 decline in the secondary loan price, after the shock – 35% higher than during the O&G shock. In column 2, I find that a 1 pp increase in a firm's exposure to automobiles is associated with a $0.75 decline (per $100 par) in the secondary loan price, after the shock. The magnitude is higher when using consumer goods and retail as individual proxies for the capital constraint. Columns 3 and 4

[20]For a complete description of the industries, I refer readers to Moody's 35 Industry Categories

indicate that a 1 pp increase in a firm's exposure to retail and consumer goods is associated with respective declines of $1.42 and $2.04 (per $100 par) in the secondary loan price, after the shock. In columns 5 and 6, I study how the estimate differs using different measures of transportation: consumer and cargo respectively. I find a 1 pp increase in a firm's exposure to consumer transportation and cargo transportation is associated with respective declines of $0.84 and $3.15 (per $100 par) in the secondary loan price, after the shock. In columns 7, 8, and 9, I combine the O&G and auto exposures, retail and goods exposures, and all exposures, respectively, to study how the secondary loan price is affected for firms that are not in the industries that comprise the exposures. These columns indicate that a 1 pp increase in the exposure is associated with a $0.69 to $1.68 decline (per $100 par) in the secondary loan price, after the shock. The estimate across all columns is larger in magnitude than that of the baseline table. Hence, price pressure is expected to be larger during crisis periods.

8 Conclusion

This paper demonstrates how CLO covenants can amplify diffuse, idiosyncratic, and sectoral shocks. Upon experiencing shocks, CLO covenants tighten. The piecewise nature of the accounting associated with the covenants induces CLO managers to sell unrelated, riskier loans in their portfolio to alleviate the covenant constraints. This type of contractual arbitrage poses systemic concerns. Given the illiquidity of corporate debt markets, including the secondary loan market, forced sales may have substantial financial and real effects. Hence, fire sales originating from the CLO market may exacerbate credit crunches, by propagating shocks through capital markets.

The implication of this work is that covenants included in CLO indentures intended to protect CLO noteholders may create externalities that may justify policy intervention. CLOs may be characterized as shadow banking institutions which operate as unregulated financial intermediaries that are not subject to direct oversight. Given that regulatory bodies have limited supervisory authority to directly address the risks originating from CLOs and leveraged loans, future theoretical work on the design of optimal contracts with the consideration of welfare implications can inform the tradeoffs associated with different contractual and policy proposals. By the nature of their closed-end structure, CLOs are thought to be immune to fire sales due to stable funding. However, closed-end funds are susceptible to agency problems. Open-ending is viewed as a solution to the agency problem. However, open-end funds are susceptible to fire sales. This work shows that covenants – the remediation designed to address the agency problem – can generate price pressure, amplify fire sale risk, and potentially increase the social costs associated with fire sales. This work suggests that differences in the fund organizational structure cannot fully eliminate the underlying risks. However, the impact of CLO contractual reform on the provision of credit, ex-ante and ex-post, remains ambiguous. The joint consideration of fund organizational structure and welfare remains an avenue for future research for deepening our understanding of the role of covenants as both a latent source of amplification and a remediation designed to address the agency problem.

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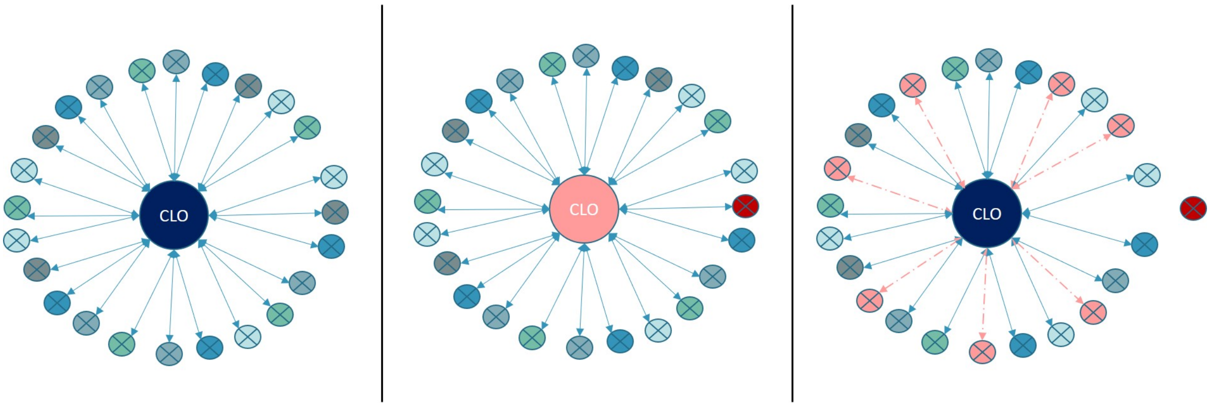
9 Figures and Tables

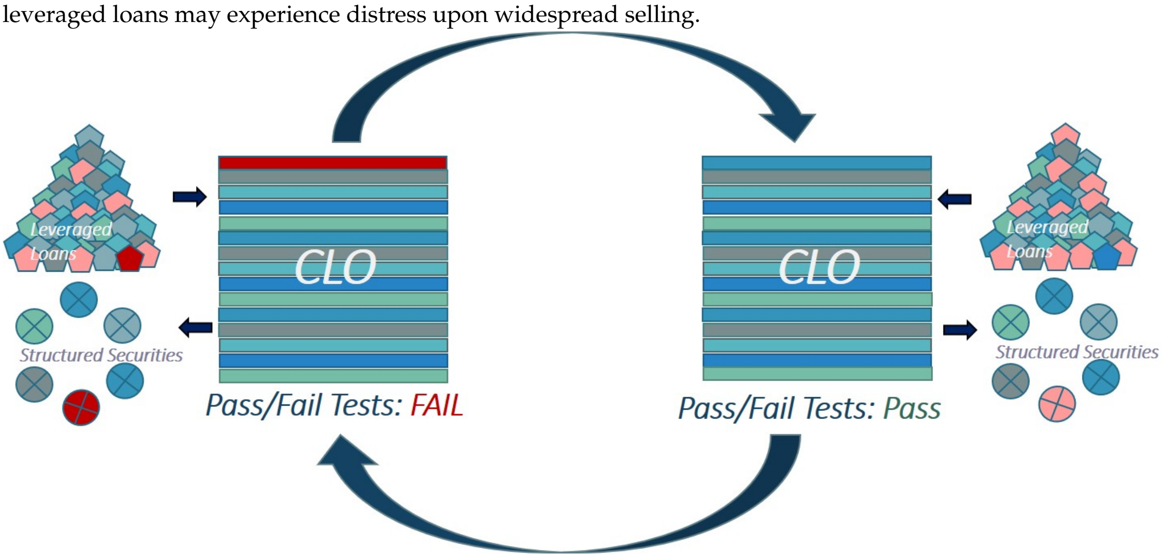
9.1 Figures

Figure 1: Research Setup: Potential for Financial Contagion



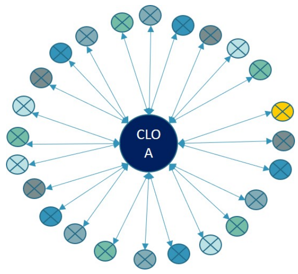
(a) Network of Firms and CLOs

Notes: The diagram consists of the three figures which represent CLO portfolios. The center circle of each diagram represents a CLO while the outer circles represent firms. The spokes represent connections between firms and CLOs. Firms are connected to each other through the intermediary, the CLO. The left figure shows a CLO portfolio without any distressed or defaulted assets. The middle figure shows that if a firm experiences distress (red color), the CLO may become constrained (pink color). The right figure shows that to alleviate constraints, the CLO may divest itself of the distressed firm, hence, there is no longer a spoke connected to it. The CLO may also sell other loans in the portfolio to generate more slack in the constraint (dashed spokes). The constrained issuers of these leveraged loans may experience distress upon widespread selling.

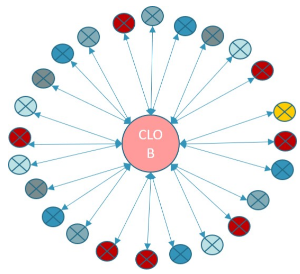


(b) Cycle of Distress

Notes: The figure demonstrates the link between CLO portfolio constraints and the quality of leveraged loans. The CLO is in violation of its covenant constraints, because of a loan that is near-default (left figure). To comply with the covenant, the CLO may generate slack in the covenant by divesting itself of the loan in distress and selling other, unrelated loans. This may allow the CLO to fulfill the covenants (right figure). However, in the process, as CLOs fire sales of assets may increase the cost of financing to innocent bystanders which may lead firms further into distress (left-figure).



(a) Unconstrained



(b) Constrained

Figure 2: Thought Experiment

Notes: The figure illustrates the thought experiment belying the empirical strategy. There are two CLOs: CLO A and CLO B. CLO A does not hold any firms operating in the Oil & Gas industry ("Unconstrained"). CLO B has a sizeable exposure to firms in the O&G industry ("Constrained"). When the O&G price plunge occurs, CLO A is unaffected. CLO B is operating closer to its covenant thresholds, as many O&G portfolio firms may be distress. The yellow circle denotes a similar firm held by both CLOs. The objective is to study how the two yellow firms may differ based on ownership.

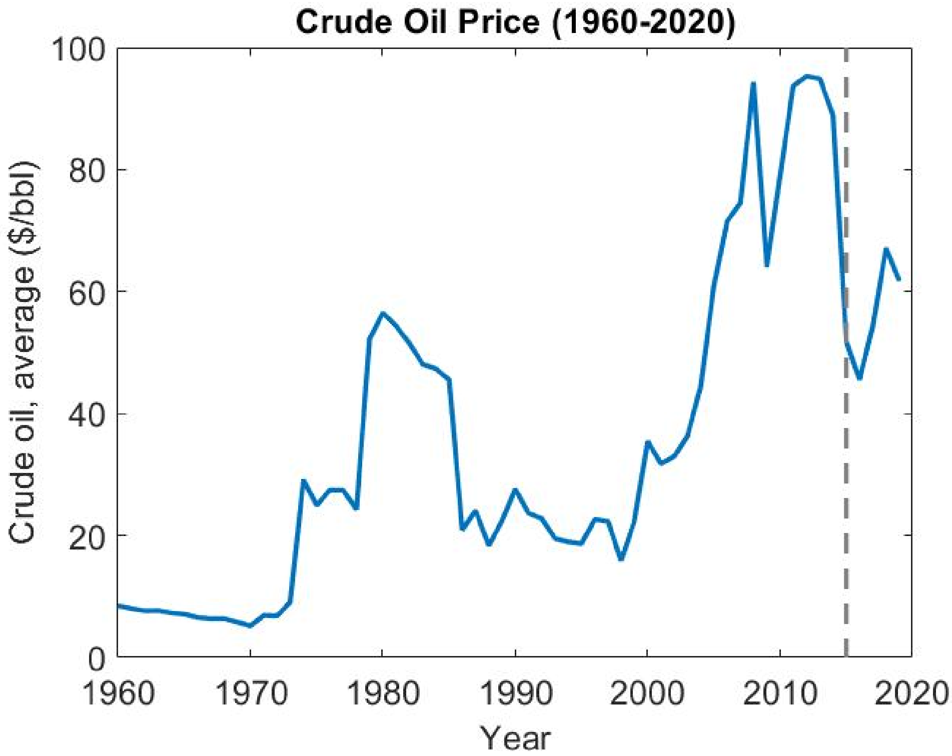


Figure 3: Crude Oil Price (1960-2020)

Notes: The figure shows the crude oil price from 1960-2020. The price is reported as the annual average $ per barrel. The x-axis reports the year. The y-axis reports the price. The dotted gray line denotes the price plunge. The monthly price around the price plunge is plotted in Figure A.2.

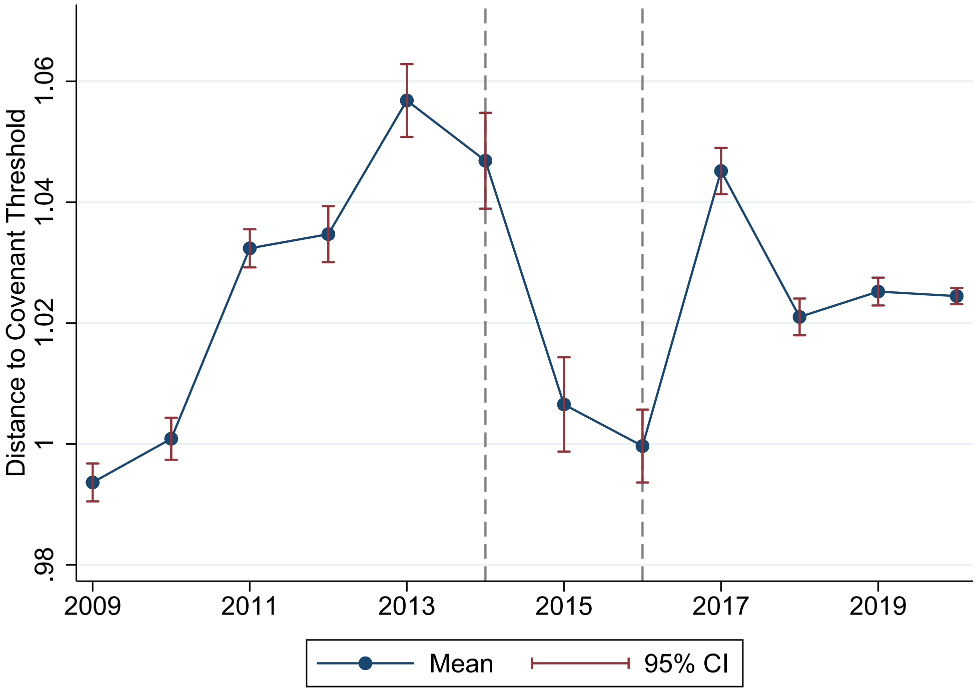
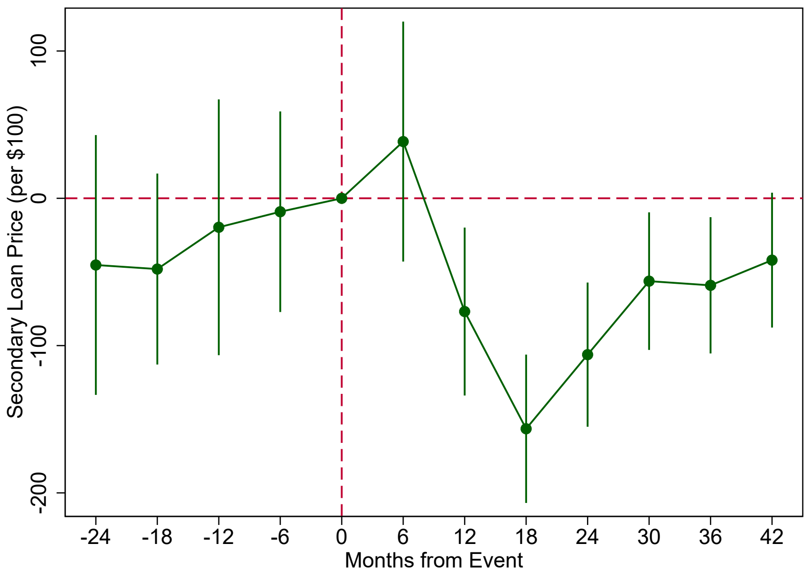
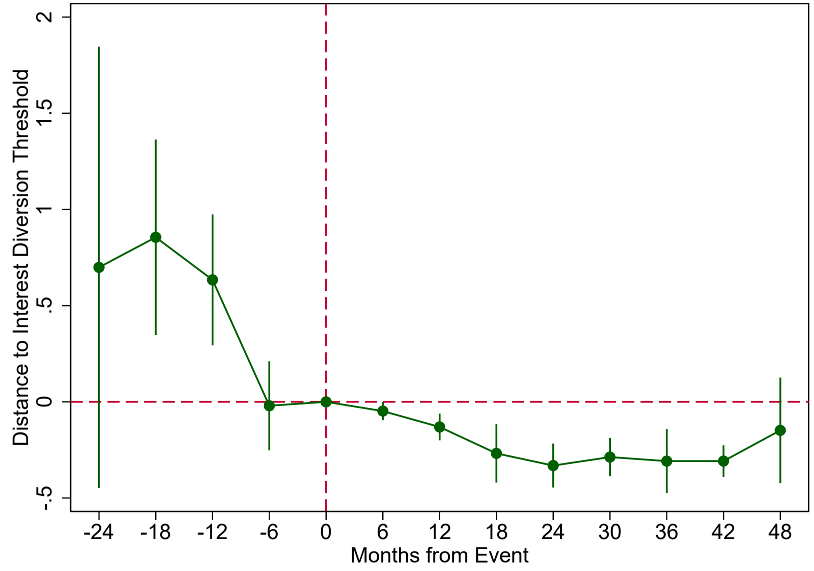


Figure 4: Time Series of Distance to Capital Covenant (2009-2020)

Notes: The figure shows the distance to the most stringent capital covenant from 2009 through 2020. The most stringent capital covenant is identified as the capital covenant with the lowest threshold. The distance to the most stringent capital covenant threshold is measured as the as the ratio of the covenant result to the covenant threshold. The dotted gray line denotes the price plunge. The x-axis reports the year. The y-axis reports the distance to the covenant threshold.



(a) Secondary Loan Price



(b) Distance to Interest Diversion Threshold

Figure 5: Assessment of Pre-Trends: Secondary Loan Price and Interest Diversion Constraint

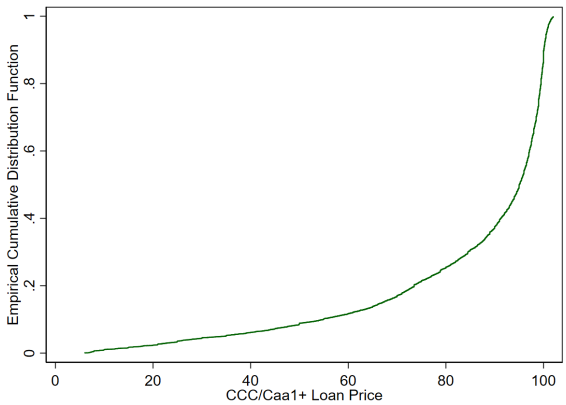
Notes: The figures present pre-trends. The baseline specifications of Figures 5a and Figure 5b take the following respective forms:

$$P_{i,f,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{42} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{Firm O\&G Exposure})_f + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{42} \delta_k \mathbb{1}_{k\leq t<k+6} + \theta_1 \text{Firm O\&G Exposure}_f + \alpha_{f,g} + \alpha_y + \epsilon_{i,f,t}$$

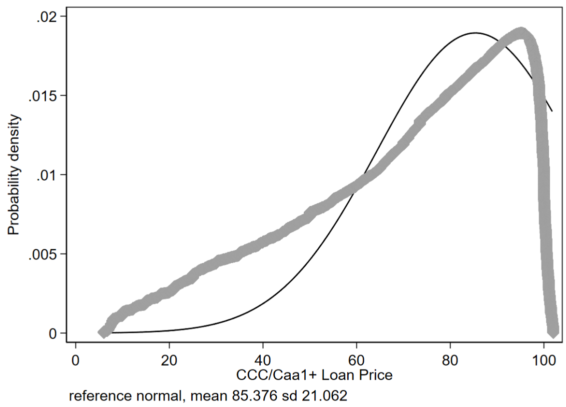
$$ID_{c,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{42} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{CLO O\&G Exposure})_c + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{42} \delta_k \mathbb{1}_{k\leq t<k+6} + \theta_1 \text{CLO O\&G Exposure}_c + \alpha_m + \alpha_y + \epsilon_{c,t}$$

where $P_{f,t}$ is the secondary loan price (per $100), $ID_{c,t}$ is the distance to the Interest Diversion threshold ($ln(\frac{\text{Covenant Result)}}{\text{Current Threshold}})$), c denotes the CLO, m denotes the manager, i denotes the loan, f denotes the (non-O&G) portfolio firm or issuer ($f \in c$), t indexes the date, g denotes the transaction type, and y denotes the year. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs. CLO O&G Exposure$_c$ is the O&G share of CLO c before the shock occurs. $\mathbb{1}_{k\leq t<k+6}$ is an indicator variable that takes a value of 1 if the time period corresponds to the six-month time period signified by k. Leads and lags of the shock are included, as well as their respective interactions with the O&G exposure measures. I exclude the last pre-treatment month to avoid perfect multicollinearity. The x-axis represents months around the O&G price plunge. The y-axis represents the secondary loan price per $100 of non-O&G issuers (Figure 5a) and distance to the Interest Diversion threshold (Figure 5b). Standard errors are two-way clustered by CLO $\times$ issuer and month-year in Figure 5a. Standard errors are two-way clustered by CLO and month-year in Figure 5b.

Figure 6: Distributions of CCC/Caa1 Loan Prices



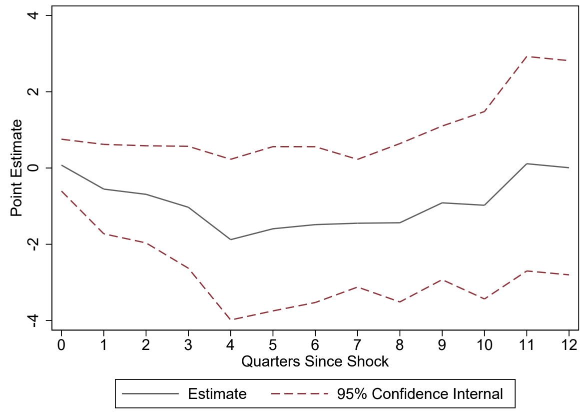
(a) CDF of CCC/Caa1 Loan Prices



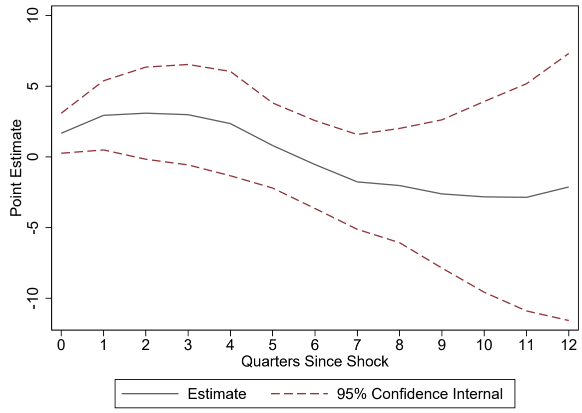
(b) PDF of CCC/Caa1 Loan Prices

	N	p25	p50	p75	Mean	Std. Dev.
CLO Min. CCC/Caa1+ Price	8,272	33.7120	62.5190	84.5000	58.6273	28.7113
CCC/Caa1+ Loan Price	125,274	79.5000	95.0500	99.0000	85.3762	21.0624

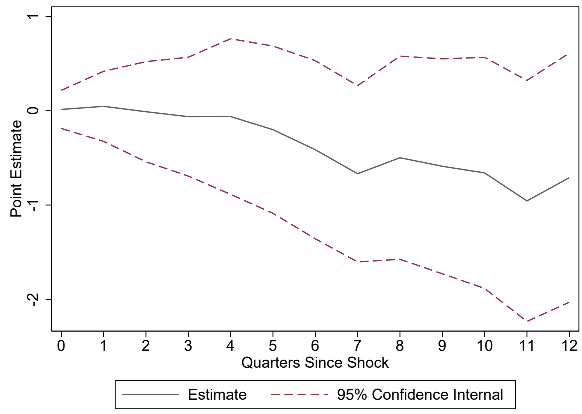
Notes: The figure presents the cumulative distribution function (CDF) and probability density function (PDF) of CCC/Caa1 loan prices. CCC/Caa1 refer to loans that have a rating of CCC/Caa1 or below. Figure 6a presents the CDF of CCC/Caa1 loan prices. Figure 6b presents the PDF of CCC/Caa1 loan prices. The table presents *(1)* the distribution of the CCC/Caa1 loan with the lowest market price in a CLO in each month, *(2)* the distribution of CCC/Caa1+ loan prices.



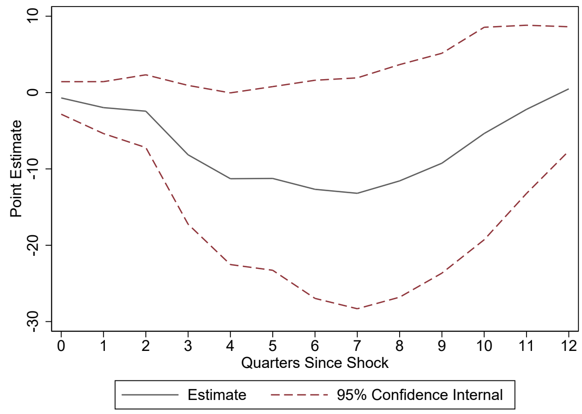
(a) Secondary Loan Price



(b) Bond Yield



(c) Leverage



(d) Investment

Figure 7: Heterogeneous Dynamics in Response to O&G Shock: Jordà Linear Projections

Notes: The figure plots the coefficients and the associated 95% confidence intervals of the interaction term from the following Jordà (2005) style projection regression: $Y_{f,t+h} - Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure}_f \times \text{Post}_t) + \beta_2\text{Firm O\&G Exposure}_f + \beta_3\text{Post}_t + \alpha_f + \alpha_y + \epsilon_{f,t}$ where $Y_{f,t}$ is natural log-transformed secondary loan price (top left), natural log-transformed bond yield (top right), leverage (bottom left), capital expenditures (bottom right) at quarter-year t, h denotes the steps (quarters) of the projection, f denotes the (non-O&G) portfolio firm or issuer ($f \in c$), and y denotes the year. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs. The x-axis indicates the quarters since the shock. The y-axis indicates the point estimate associated β_1 estimate. Standard errors are clustered by CLO in Figure 7a. Standard errors are clustered by issuer in Figures 7b, 7c. and 7d.

9.2 Tables

Table 1: Summary Statistics

	N	Q1	Median	Q3	Mean	Std. Dev.
Dist. to ID Constraint ($\frac{\text{Covenant Result}}{\text{Covenant Threshold}}$)	2,076	1.0334	1.0410	1.0513	1.0525	0.0457
Issuer O&G Exposure	6,638	0.0085	0.0174	0.0296	0.0206	0.0197
CLO O&G Exposure	728	0.0000	0.0105	0.0284	0.0200	0.0425
Transaction Amount	767,099	-333,333	174,694	964,286	306,403	1,344,868
Net Transaction Amount (CLO-Issuer)	492,242	-440,000	400,000	1,196,000	477,491.8	1,831,333
Net Transaction Amount (Issuer)	43,370	-1,875,345	748,110	4,588,151	5,419,449	34,569,201
Transaction Price	129,439	99	99.75	100	97.6138	9.4910
All-in-spread drawn (Term Loans)	1,515	325	400	500	431.2657	185.8061
Facility Maturity (Term Loans)	1,529	59	72	84	67.7620	19.9434
ln(Facility Amount) (Term Loans)	1,557	18.6030	19.3568	20.0499	19.2968	1.1747
Bond Credit Spread (%)	10,074	1.3643	2.2835	3.5152	3.3514	5.0587
Bond Avg Bid/Ask Spread (%)	16,211	0.0020	0.0033	0.0059	0.0047	0.0101
Equity Returns	6,543	-0.0433	0.0107	0.0639	0.0125	0.1143
ΔUnused Line	7,301	-0.0304	0	0.0320	0.0020	0.1367
Δ Drawn Line	7301	-0.0001	0	0	-0.0017	0.1088
Debt Growth (Long-term)	2,876	-0.0161	-0.0010	0.0257	0.0207	0.2203
Cash Flow	2,864	0.0911	0.1297	0.1871	0.1437	0.1609
Payout	2,874	0.0000	0.0049	0.0260	0.0217	0.0425
Real Sales Growth	3,106	-0.0008	0.0000	0.0006	-0.0001	0.0028
Acquisitions	2,895	0.0000	0.0000	0.0042	0.0277	0.1408
Investment	2,951	2.3889	3.6350	4.9624	3.6293	2.0316
R&D	1,054	0.0000	0.0030	0.0194	0.0181	0.0470
Investment Growth	2,863	-0.5396	0.3737	0.6084	0.0007	0.9948
R&D Growth	961	0.0000	0.0000	0.0255	0.0075	0.1424
ln(Employment)	2,958	0.8771	1.6605	2.8332	1.8675	1.2196
Interest Rate (%)	2,436,473	3.6938	4.2500	5.5000	4.7169	1.9335
Defaulted Share	9,961	0.0000	0.5455	1.9578	3.7893	12.5261

Notes: The table presents summary statistics for the outcome variables of interest used in this paper. The columns, left to right, denote the variable of interest, number of observations, 25^{th} value, median, 75^{th} quartile value, mean, and standard deviation in Columns 2-7.

Table 2: Distance to Interest Diversion Covenant and O&G Exposure

Distance to ID Threshold	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-0.3448***	-0.2845***	-0.3230***	-0.3328***	-0.2157***	-0.2045***
	(0.1108)	(0.0925)	(0.0746)	(0.0893)	(0.0693)	(0.0693)
O&G Share	-0.1760	-0.0509	0.0738	0.3013		
	(0.3739)	(0.2670)	(0.2083)	(0.2143)		
Post	0.0177***	0.0080*			0.0092***	
	(0.0060)	(0.0047)			(0.0028)	
CLO Controls		✓	✓	✓		
CLO FE					✓	✓
Manager FE	✓	✓	✓	✓		
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	2,071	2,071	2,071	2,071	2,071	2,071
R^2	0.3375	0.3763	0.4145	0.4352	0.6516	0.6590

Standard errors are two-way clustered by CLO and month-year in parentheses

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

Notes: The table presents the relation between CLO O&G exposure and distance to the Interest Diversion covenant. The baseline regression specification takes the form $Y_{c,t} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \gamma_0' X_c + \epsilon_{c,t}$ where $Y_{c,t}$ is the distance to the Interest Diversion constraint ($ln(\frac{\text{Current Performance}}{\text{Current Threshold}})$) of CLO c at time t, and X denotes the vector of controls, consisting of current CLO age (Columns 2-4) and CLO size (Columns 3-4), and CCC-share and defaulted-share (Column 4). CLO O&G Exposure$_c$ is the O&G share of CLO c before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO and month-year.

Table 3: Transaction-Level Trading Effects

Transaction Amount	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-11.0315***	-11.0705***	-11.0601***	-18.6549***	-14.6684***	-15.4259***
	(2.9353)	(2.9583)	(2.8208)	(2.6677)	(2.7987)	(2.7415)
O&G Share	9.0523***	9.1262***	9.0481***	18.6815***		
	(2.4353)	(2.4539)	(2.3858)	(2.1832)		
Post	0.1588*	0.2221**			0.2641***	
	(0.0821)	(0.0899)			(0.0854)	
Manager FE			✓			
Rating-Industry FE				✓		
Issuer-Loan Type FE					✓	✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	129,132	129,132	129,132	117,829	129,132	129,132
R^2	0.0041	0.0045	0.0357	0.0275	0.0758	0.0809

Standard errors are two-way clustered by CLO-issuer and trade date in parentheses

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

Notes: The table presents the relation between firm O&G exposure and transaction amount for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \gamma_0 Z_f + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{i,t}$ where $Y_{i,t}$ is the transaction amount of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, X is a vector of CLO controls including manager, m, y denote the month and year respectively, and Z is a vector of firm controls including rating and industry. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and trade date.

Table 4: Secondary Loan Price and O&G Exposure

Transaction Price (per $100 par)	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-180.8855***	-179.5377***	-165.6002***	-121.5321***	-73.2541**	-61.1373**
	(67.5569)	(67.3133)	(58.0911)	(38.7072)	(29.9952)	(30.1474)
O&G Share	186.7747***	185.3052***	163.0803***	28.6556		
	(63.9352)	(63.7052)	(54.4846)	(35.3086)		
Post	5.3804***	5.0854***			1.7307*	
	(1.8375)	(1.9121)			(0.8881)	
Manager FE			✓			
Rating-Industry FE				✓		
Issuer-Loan Type FE					✓	✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	57,593	57,593	57,587	52,583	57,593	57,593
R^2	0.0087	0.0088	0.0701	0.3955	0.6010	0.6098

Standard errors are two-way clustered by CLO-issuer and trade date in parentheses

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

Notes: The table presents the relation between firm O&G exposure and secondary loan price for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \gamma_0 Z_f + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{i,t}$ where $Y_{i,t}$ is the secondary loan price of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, X is a vector of CLO controls including manager, m, y denote the month and year respectively, and Z is a vector of firm controls including rating and industry. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and trade date.

Table 5: Primary Institutional Loan Spread and O&G Exposure

All-In-Drawn Spread	(1)	(2)	(3)	(4)	(5)
O&G Share $\times$ Post	1873.1918**	1952.6702**	2168.5713**	2011.9126***	1805.9003**
	(784.2323)	(819.0005)	(850.9114)	(719.3401)	(751.5813)
Post	-67.9276**	-57.8516	-44.3801	-50.9940	
	(28.2325)	(36.7830)	(37.1538)	(31.6905)	
Maturity				0.4590	0.4758
				(0.3479)	(0.3444)
Issuer FE	✓	✓	✓	✓	✓
Secured FE		✓	✓	✓	✓
Purpose FE				✓	✓
Distribution Method FE				✓	✓
Seniority FE			✓	✓	✓
Loan Type FE			✓	✓	✓
Country of Syndication FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	567	567	567	567	567
R^2	0.6774	0.6805	0.9114	0.9215	0.9328

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and primary institutional loan spread for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the all-in-spread drawn of loan i at time t, issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table 6: Bond Credit Spread and O&G Exposure

Bond Credit Spread	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	35.5512*	35.4183*	36.1588*	27.9393*	27.6554*
	(18.5585)	(18.4820)	(18.7908)	(14.4879)	(14.4997)
Post	-0.4466	-0.4590	-0.4721	-0.2478	
	(0.4029)	(0.4669)	(0.4621)	(0.3314)	
Time to Maturity				0.0450***	0.0459***
				(0.0099)	(0.0101)
Issuer FE	✓	✓	✓	✓	✓
Bond Type FE	✓	✓	✓	✓	✓
Security Level FE			✓	✓	✓
Rating FE				✓	✓
IG FE				✓	✓
Defaulted FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	9,876	9,876	9,876	9,876	9,876
R^2	0.5213	0.5298	0.5653	0.6904	0.6971

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and bond credit spread for non-O&G firms. Bond credit spread is measured relative to a treasury with corresponding maturity. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Time to Maturity} + \gamma_0 X_{i,t} + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the bond credit spread (%) of bond i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of controls associated with bond i including bond type, security level, rating, investment-grade indicator, and defaulted status, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table 7: Equity Returns and O&G Exposure

Equity Returns	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-0.2976*	-0.2948*	-0.2918*	-0.2921*	-0.2923*
	(0.1614)	(0.1610)	(0.1701)	(0.1705)	(0.1705)
Post	-0.0222*	-0.0035	-0.0017	-0.0021	-0.0026
	(0.0124)	(0.0188)	(0.0069)	(0.0059)	(0.0060)
R_f			-2.1825***	-1.2951**	-1.4222**
			(0.6329)	(0.4971)	(0.5846)
$R_m - R_f$			0.0111***	0.0109***	0.0108***
			(0.0009)	(0.0007)	(0.0007)
SMB				0.0036***	0.0035***
				(0.0008)	(0.0009)
HML				-0.0003	-0.0006
				(0.0009)	(0.0013)
RMW					-0.0005
					(0.0011)
CMA					0.0007
					(0.0022)
Issuer FE	✓	✓	✓	✓	✓
Year FE		✓	✓	✓	✓
N	6,543	6,543	6,543	6,543	6,543
R^2	0.0616	0.0670	0.1748	0.1815	0.1815

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and equity returns for non-O&G firms. The baseline regression specification takes the form $Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4 R_f + \beta_5(R_m - R_f) + \beta_6 SMB + \beta_7 HML + \beta_7 RMW + \beta_7 CMA + \alpha_y + \alpha_f + \epsilon_{f,t}$ where $Y_{f,t}$ is the equity return firm f at time t, ($f \in$ CLO c), and y denotes the year. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table 8: Firm Liquidity and O&G Exposure

	(1) ΔUnused	(2) ΔUnused	(3) ΔUnused	(4) ΔDrawn	(5) ΔDrawn	(6) ΔDrawn
O&G Share × Post	-3.2382*	-3.2361*	-3.2481*	3.7752**	3.7644**	3.7494**
	(1.6460)	(1.6460)	(1.6503)	(1.8465)	(1.8509)	(1.8497)
Post	0.0880*	0.0692		-0.0863	-0.1457*	
	(0.0526)	(0.0701)		(0.0656)	(0.0834)	
Issuer FE	✓	✓	✓	✓	✓	✓
Year FE		✓			✓	
Quarter-Year FE			✓			✓
N	2,088	2,088	2,088	2,083	2,083	2,083
R^2	0.0499	0.0505	0.0565	0.0532	0.0539	0.0591

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and changes in liquidity for non-O&G firms. The baseline regression specification takes the form $Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{q,y} + \alpha_f + \alpha_I + \epsilon_{f,t}$ where $Y_{f,t}$ are various measures of liquidity (standardized) for firm f at time t ($f \in$ CLO c), I denotes the industry, and q, y denote the quarter and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Liquidity is defined as $\Delta ln(\frac{\text{Unused}}{\text{Total Firm Liquidity}})$ in Columns 1-3, and $\Delta ln(\frac{\text{Drawn}}{\text{Total Firm Liquidity}})$ in Columns 4-6, where *Total Firm Liquidity* is defined as the sum of the total line of credit and cash and cash equivalents. Standard errors are clustered by issuer.

Table 9: Firm Adjustments and O&G Exposure

	(1) Debt Growth	(2) Cash Flow	(3) Real Sales Growth	(4) Acquisitions	(5) Investment	(6) R&D Growth	(7) Emp. Growth
O&G Share × Post	-4.2969*	-3.0319*	-0.0107**	-0.0672**	-3.7776*	-8.6594***	-4.4707**
	(2.5110)	(1.5647)	(0.0046)	(0.0322)	(2.1020)	(2.9319)	(2.1782)
Issuer FE	✓	✓	✓	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓
N	2,867	2,860	3,098	2,883	2,981	518	2,899
R^2	0.1117	0.8981	0.0738	0.3236	0.1736	0.0586	0.1974

Standard errors are clustered by issuer in parentheses

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

Notes: The table presents the relation between firm O&G exposure and firm characteristics for non-O&G firms. The baseline regression specification takes the form $Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{q,y} + \alpha_f + \alpha_I + \epsilon_{f,t}$ where $Y_{f,t}$ are various firm characteristics (standardized) for firm f at time t ($f \in$ CLO c), I denotes the industry, and q, y denote the quarter and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. The dependent variables are long-term debt growth (Column 1), cash flow (Column 2), real sales growth (Column 3), acquisitions (Column 4), investment (Column 5), R&D growth (Column 6), and employment growth (Column 7). Standard errors are clustered by issuer.

Table 10: Selling Propensity by Secondary Loan Price Relative to Par and O&G Exposure

Panel A					
$\mathbb{1}_{(\text{loan price}>100)}$	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-4.4748**	-4.5895**	-10.8858***	-10.1198***	-8.2741***
	(2.2264)	(2.2445)	(1.6793)	(1.7474)	(1.6686)
O&G Share	5.1143**	5.1387**	10.5889***		
	(2.0667)	(2.0828)	(1.6086)		
Post	0.0337	-0.0213		0.0800	
	(0.0601)	(0.0623)		(0.0535)	
Rating-Industry FE			✓		
Issuer-Loan Type FE				✓	✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	57,594	57,594	52,584	57,594	57,594
R^2	0.0107	0.0144	0.1687	0.2567	0.3234

Panel B					
$\mathbb{1}_{(\text{loan price}<90)}$	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	4.2994***	4.2892***	2.8659***	2.3389***	2.0049**
	(1.4838)	(1.4859)	(0.8775)	(0.7916)	(0.7943)
O&G Share	-4.1703***	-4.1625***	0.0552		
	(1.3750)	(1.3784)	(0.7277)		
Post	-0.1214***	-0.1217***		-0.0696***	
	(0.0401)	(0.0424)		(0.0235)	
Rating-Industry FE			✓		
Issuer-Loan Type FE				✓	✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	57,594	57,594	52,584	57,594	57,594
R^2	0.0062	0.0062	0.3238	0.5565	0.5656

Standard errors are two-way clustered by CLO-issuer and trade date in parentheses

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

Notes: The table presents the relation between firm O&G exposure and propensity to sell loans issued by non-O&G firms by price categorization. The baseline regression specification takes the form $\mathbb{1}_{(price \leqslant p)_{i,t}} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{f,l} + \gamma_0 Z_f + \alpha_{m,y} + \epsilon_{i,t}$ where $\mathbb{1}_{(price \leqslant p)_{i,t}}$ is an indicator that takes a value 1 if the transacted price of secondary loan price issued by firm f at time t ($i \in f \in$ CLO c) is greater than \$100 (per \$100 par) in Panel A, and below \$90 (per \$100 par) in Panel B, Z is a vector of firm controls including rating and industry, m, y denote the month and year respectively, l denotes the loan-type. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and trade date.

Table 11: Interest Rate of Loans and O&G Exposure

Interest Rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)
O&G Share × Post	-8.5242***	-8.5850***	-8.8786***	-9.5662***	-9.4623***	-8.9912***	-8.8636***
	(2.5064)	(2.4112)	(2.2225)	(2.1779)	(2.5493)	(2.5278)	(2.4733)
Post	0.2378***	0.2276***	0.1947***	0.2136***	0.2201***		
	(0.0693)	(0.0674)	(0.0641)	(0.0620)	(0.0732)		
Tenor							0.0004***
							(0.0000)
Issuer FE	✓	✓	✓	✓			
Manager FE		✓					
CLO FE			✓	✓			
CLO-Issuer FE					✓		
Loan Type FE				✓	✓		
CLO-Issuer-Loan Type FE						✓	✓
Year FE	✓	✓	✓	✓	✓		
Month-Year FE						✓	✓
Index FE	✓	✓	✓	✓	✓	✓	✓
N	2,477,250	2,477,250	2,477,250	2,477,250	2,477,250	2,477,250	2,477,250
R^2	0.7300	0.7326	0.7371	0.8291	0.9148	0.9440	0.9459

Standard errors are two-way clustered by CLO-issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and the interest rate of loans issued by non-O&G firms. The baseline regression specification takes the form $\text{Interest Rate}_{i,c,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 Z_i + \gamma_0 X_c + \alpha_{l,f,c} + \alpha_{m,y} + \epsilon_{i,c,t}$ where where Interest Rate$_{i,t}$ denotes the interest rate (%) of loan i issued by firm f and held in CLO c at time t ($f \in$ CLO c), l denotes the loan-type, m, y denote the month and year respectively, r denotes the index name, Z is a vector of loan controls including loan type and issuer, and X is a vector of CLO controls including manager and CLO indicator variables. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and month-year.

Table 12: CLO Defaulted Loans and O&G Exposure

$\mathbb{1}_{\text{defaulted loan}}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
O&G Share × Post	-0.3688***	-0.3819***	-0.3553***	-0.4344***	-0.2935***	-0.1740*	-0.1780**
	(0.1101)	(0.1089)	(0.0976)	(0.0964)	(0.0956)	(0.0894)	(0.0875)
Post	0.0069**	0.0072**	0.0089***	0.0113***	0.0090***		
	(0.0027)	(0.0027)	(0.0024)	(0.0024)	(0.0025)		
Tenor							-0.0000***
							(0.0000)
Issuer FE	✓	✓	✓	✓			
Manager FE		✓					
CLO FE			✓	✓			
CLO-Issuer FE					✓		
Loan Type FE				✓	✓		
CLO-Issuer-Loan Type FE						✓	✓
Year FE	✓	✓	✓	✓	✓		
Month-Year FE						✓	✓
N	3,363,184	3,363,184	3,363,184	3,363,184	3,363,184	3,363,184	3,363,184
R^2	0.6012	0.6034	0.6110	0.6171	0.7906	0.8144	0.8145

Standard errors are two-way clustered by CLO-issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and transaction amount for non-O&G firms. The baseline regression specification takes the form $\mathbb{1}_{(\text{defaulted loan})i,c,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \alpha_{l,f,c} + \alpha_{m,y} + \epsilon_{i,c,t}$ where $\mathbb{1}_{(\text{defaulted loan})i,t}$ denotes whether loan i issued by firm f and held by CLO c at time t has defaulted ($f \in$ CLO c), l denotes the loan type, m, y denote the month and year respectively, and X is a vector of CLO controls including manager and CLO indicator variables. $\mathbb{1}_{(\text{defaulted loan})i,t}$ is standardized. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and month-year.

Table 13: CLO Defaulted Share and O&G Exposure

Defaulted Share	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-54.6402**	-53.9716**	-53.9716**	-59.6632***	-58.4631**
	(20.4091)	(20.3927)	(20.5037)	(21.3325)	(27.1247)
Post	3.5181***	2.6031***	2.6031***	3.1842***	
	(0.8327)	(0.8830)	(0.8878)	(0.9732)	
CLO FE	✓	✓	✓		
Manager FE			✓		
Arranger FE			✓		
Trustee FE			✓		
Year FE		✓	✓		
CLO-Year FE				✓	✓
Manager-Year FE				✓	
Arranger-Year FE				✓	
Trustee-Year FE				✓	
Manager-Month Year FE					✓
Arranger-Month Year FE					✓
Trustee-Month Year FE					✓
N	8,522	8,522	8,522	8,522	8,522
R^2	0.6292	0.6307	0.6307	0.7860	0.8575

Standard errors are two-way clustered by CLO and month-year in parentheses

$^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Notes: The table presents the relation between CLO O&G exposure and percent of defaulted assets. The baseline regression specification takes the form $Y_{c,t} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \alpha_{c,y} + \alpha_{g,m,y} + \alpha_{a,m,y} + \alpha_{t,m,y} + \epsilon_{c,t}$ where $Y_{c,t}$ is the percent of distressed loans in CLO c at time t, m, y denote the month and year respectively. The manager, arranger, and trustee associated with CLO c are denoted by g, a, and t, respectively. CLO O&G Exposure$_c$ is the O&G share of CLO c before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO and month-year.

Table 14: Comparison of Effects by Risk and O&G Exposure

	Secondary Loan Price		All-In-Drawn Spread		Investment	
	Non-Distressed	Distressed	Non-Distressed	Distressed	Non-Distressed	Distressed
O&G Share × Post	33.7732	-232.3941***	1088.0890	5648.7368*	-2.1211	-12.1223**
	(31.3956)	(84.2303)	(732.2927)	(2883.8527)	(2.0926)	(5.0355)
Issuer-Loan Type FE	✓	✓				
Issuer FE			✓	✓	✓	✓
Primary Loan Controls			✓	✓		
Firm Controls					✓	✓
Month-Year FE	✓	✓	✓	✓		
Quarter-Year FE					✓	✓
N	29,892	27,701	347	198	2,158	417
R^2	0.3858	0.6534	0.9474	0.9396	0.1871	0.2175

Standard errors are clustered in parentheses

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

Notes: The table presents the relation between firm O&G exposure and firm characteristics. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity}_{i,t} + \gamma_0 X_{i/f} + \alpha_{m/q,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the secondary loan price per $100 par in Columns 1 and 2, all-in-spread drawn in Columns 3 and 4, and investment growth in Columns 5 and 6 for firm f at time t ($f \in$ CLO c). X is the vector of non-time varying controls associated with loan i in columns 3 and 4, including secured status, purpose, distribution method, seniority, loan type, and country of syndication. X is the vector of non-time varying controls associated with firm f in columns 5 and 6, including industry and rating. *Maturity* denotes the maturity of loan i at time t. $m/q, y$ denote the month/quarter and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. In Columns 2, 4, 6, I restrict the analysis to *distressed* firms which defaulted on a loan at some point in the sample period. The results for *non-distressed firms* are reported in Columns 1, 3, and 5. Standard errors are two-way clustered by CLO × issuer and month-year (Col. 1, 2), issuer and month-year (Col. 3, 4), and issuer (Col. 5, 6) in parentheses.

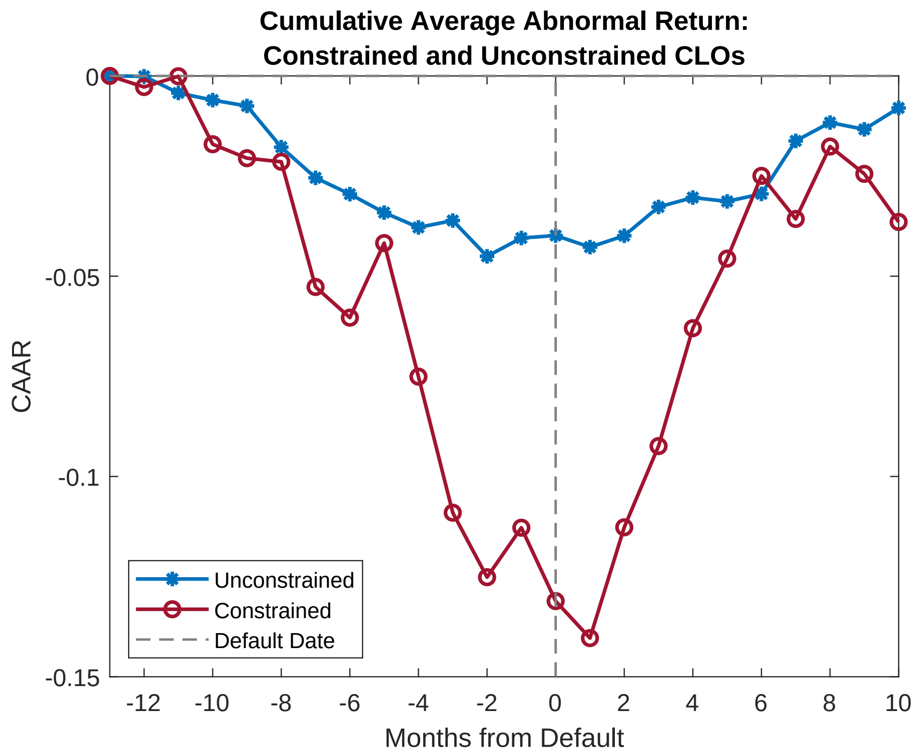
Internet Appendix for:

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

Appendix A Figures and Tables

A.1 Figures

Figure A.1: Cumulative Average Abnormal Return: Constrained and Unconstrained CLOs (Kundu (2022*b*))



Notes: The figure compares the monthly cumulative average abnormal return (CAAR) for loans issued by borrowers with above/below median CLO debt held by constrained CLOs around default, as shown in Kundu (2022*b*). A borrower is *constrained* if its share of CLO debt (amount) held by constrained CLOs is greater than the median, and *unconstrained*, otherwise. Abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \beta_{r,q} + \beta_{d,q} + \beta_{r,d,y} + \theta_m + \epsilon_{i,t-1,t}$ where P is the observed price, Z is a vector of fundamental value, Q is a purchase indicator, S is the trade size, i denotes the loan, r denotes the rating, d denotes the industry, t denotes the date, q denotes the quarter, m indexes the month-year, y denotes the year, and ϵ is the error.

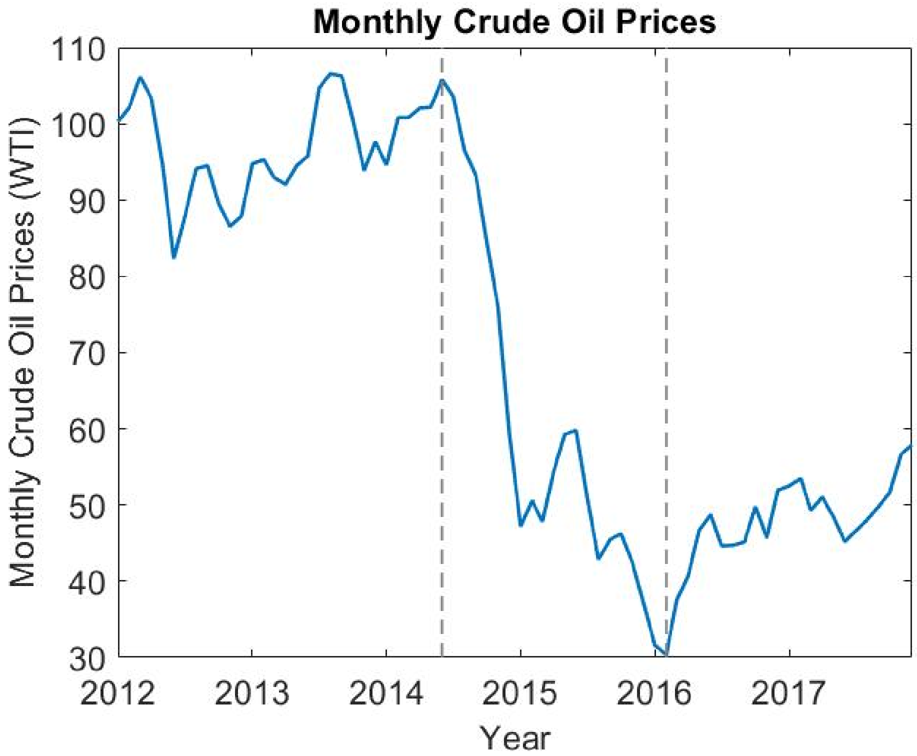


Figure A.2: Monthly Crude Oil Prices (2012-2018)

Notes: The figure shows the crude oil price from 2012-2018. The price is reported as the monthly average $ per barrel of crude oil (WTI). The x-axis reports the year. The y-axis reports the price. The dotted gray line denotes the price plunge period.

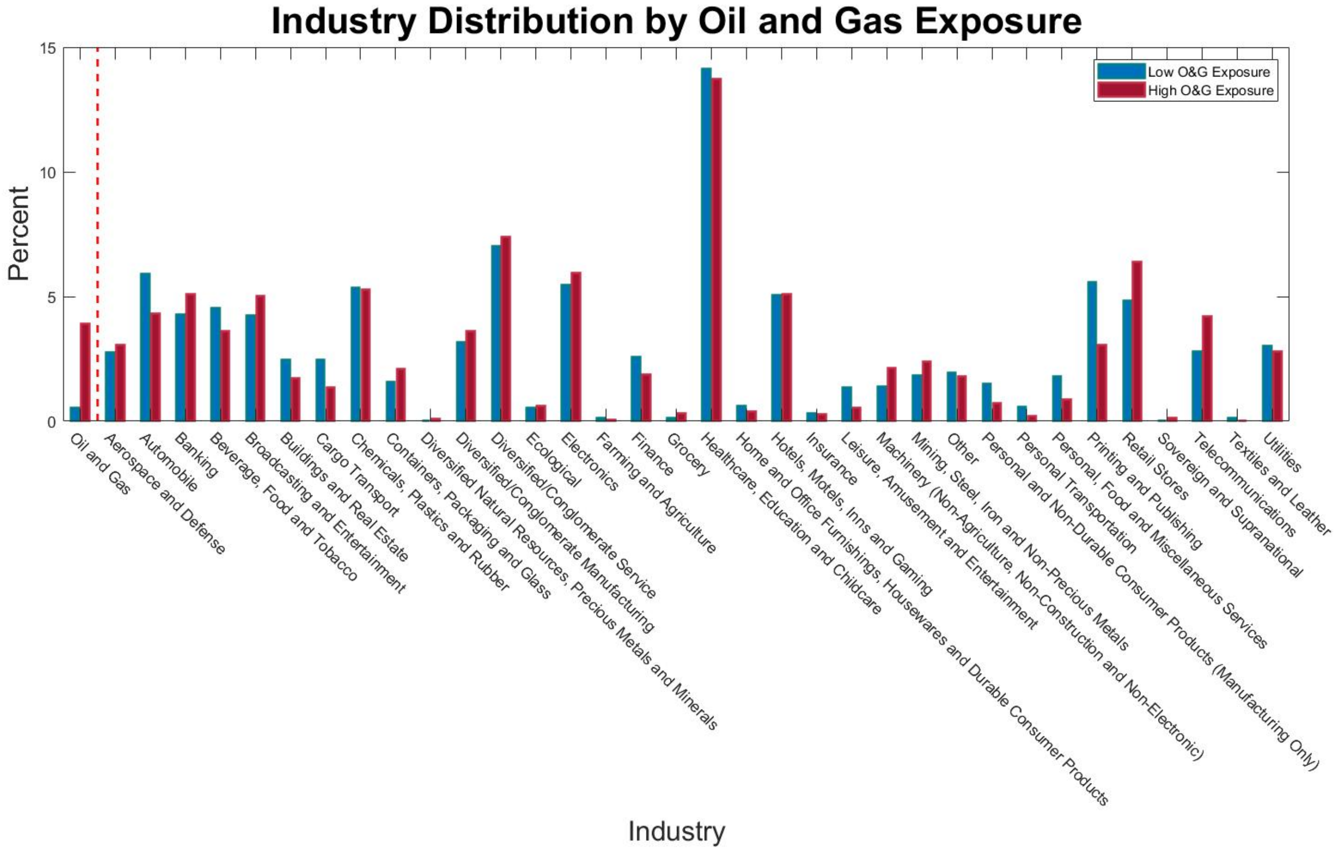
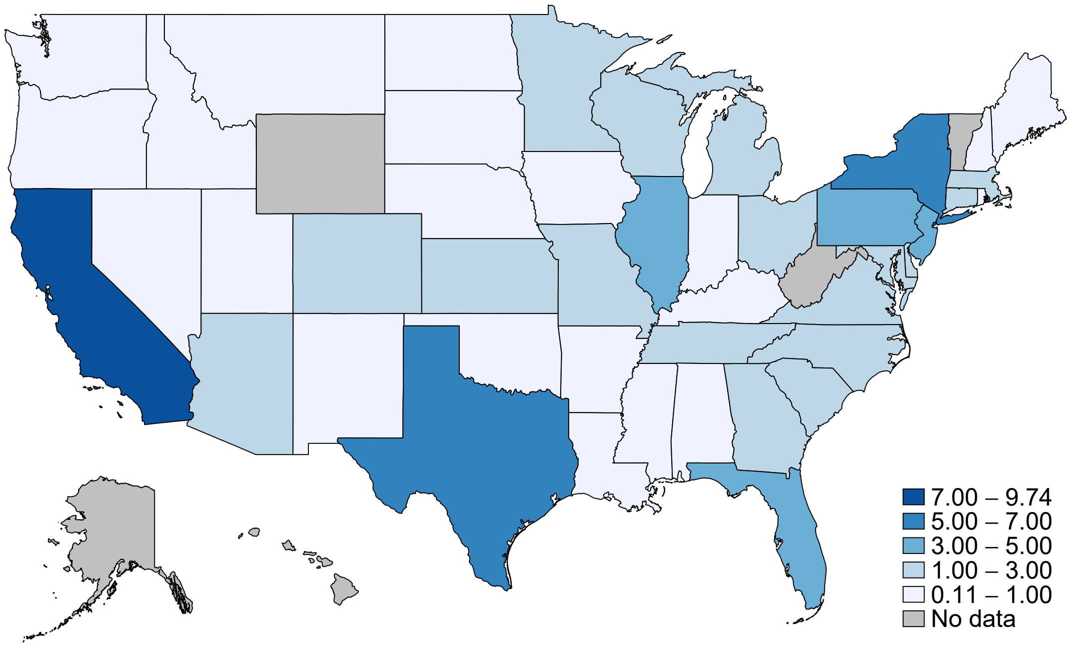
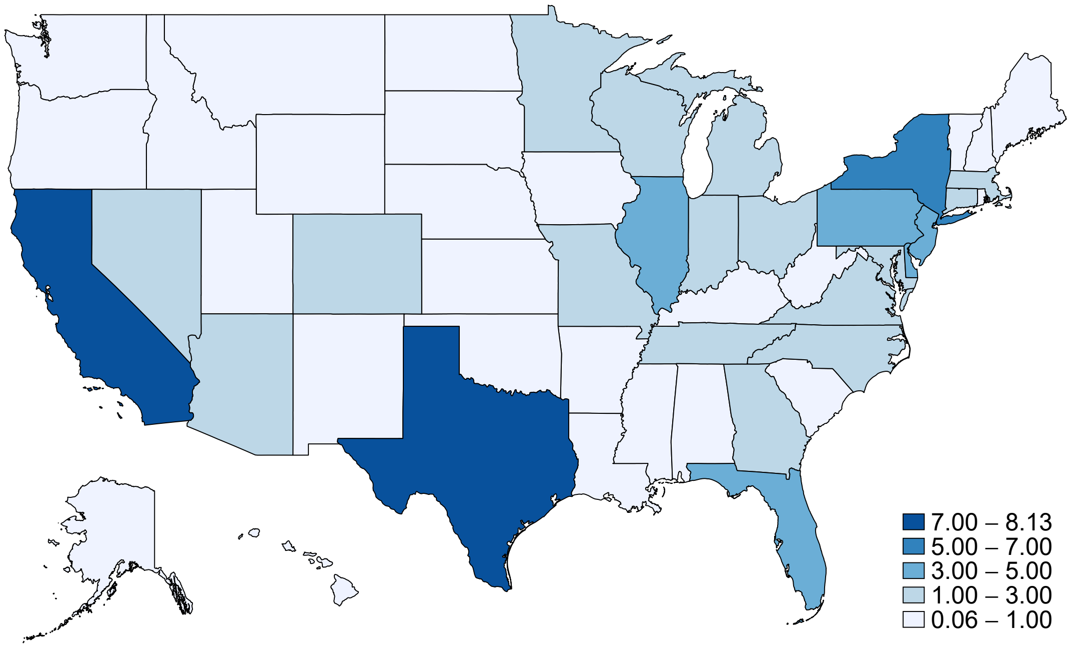


Figure A.3: Industry Composition by CLO O&G Exposure

Notes: This figure compares the industry distribution for CLOs with high O&G exposure to CLOs with low O&G exposure, before the shock. CLOs with O&G exposure above the 75^{th} percentile of all O&G exposures have *high* O&G exposure, while CLOs with O&G exposure below the 25^{th} percentile have *low* O&G exposure. The bar graph presents the industry share of loans for CLOs with low O&G exposure in blue, and high O&G exposure in red. The industry Herfindahl-Hischman Index (HHI) is 0.0552 for CLOs with low O&G exposure and 0.05409 for CLOs with high O&G exposure (not accounting for O&G industry). Industries are listed across the y-axis. The y-axis denotes the percent of a CLO portfolio in a given industry.



(a) Low O&G Exposure



(b) High O&G Exposure

Figure A.4: Geographic Composition by CLO O&G Exposure

Notes: This figure compares the geographic concentration of non-O&G firms for CLOs with high O&G exposure to CLOs with low O&G exposure. CLOs with above-median O&G exposure have *high* O&G exposure while CLOs with below median O&G exposure have *low* O&G exposure. The plots present the share of firms headquartered in each state. Gray shading signifies that data is unavailable for that state. Darker blue shading reflects a greater share of firms in that state. The top figure shows the geographic distribution of firm headquarters for CLOs with low O&G exposure. The bottom figure shows the geographic distribution of firm headquarters for CLOs with high O&G exposure. For CLOs with low O&G exposure, the Herfindahl-Hirschman Index is 0.0501, while it is 0.0493 for CLOs with high O&G exposure.

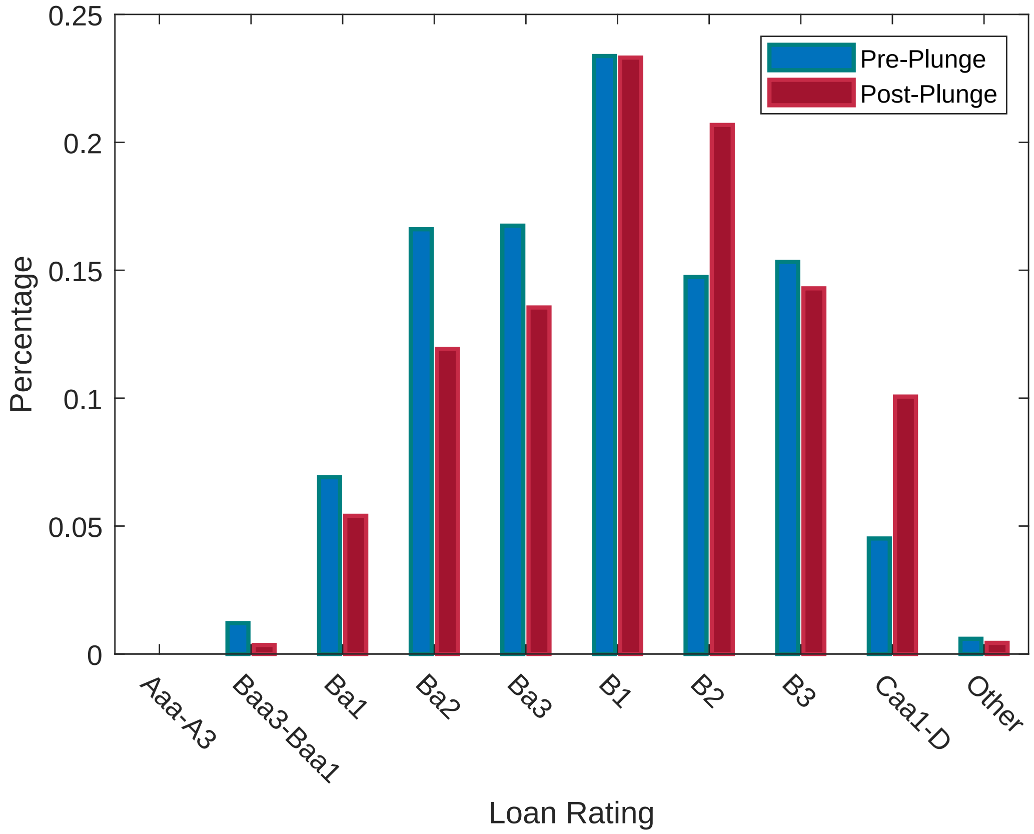
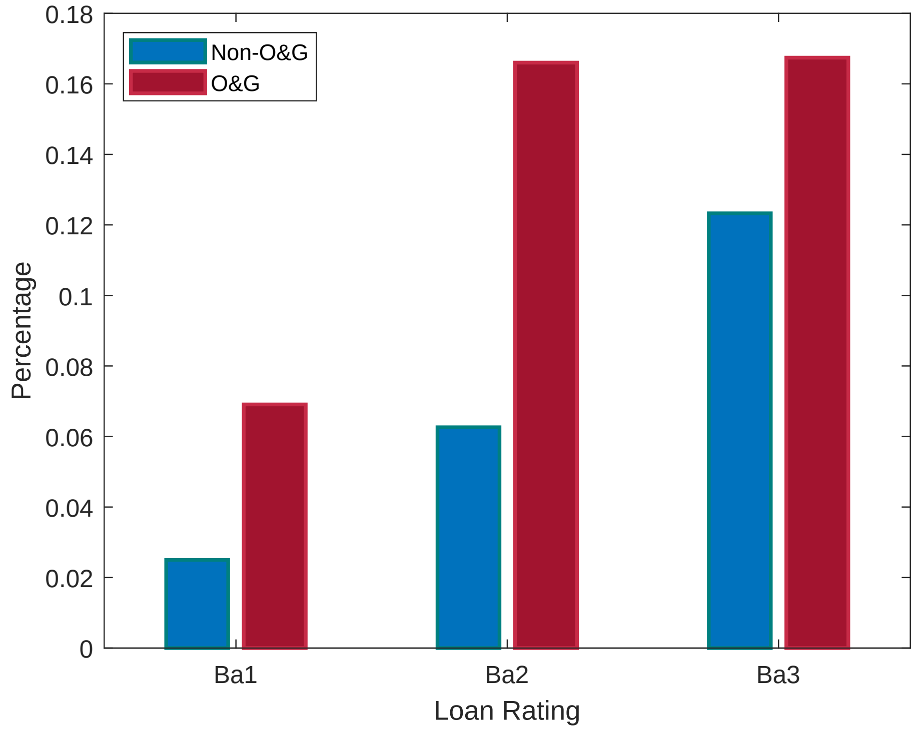
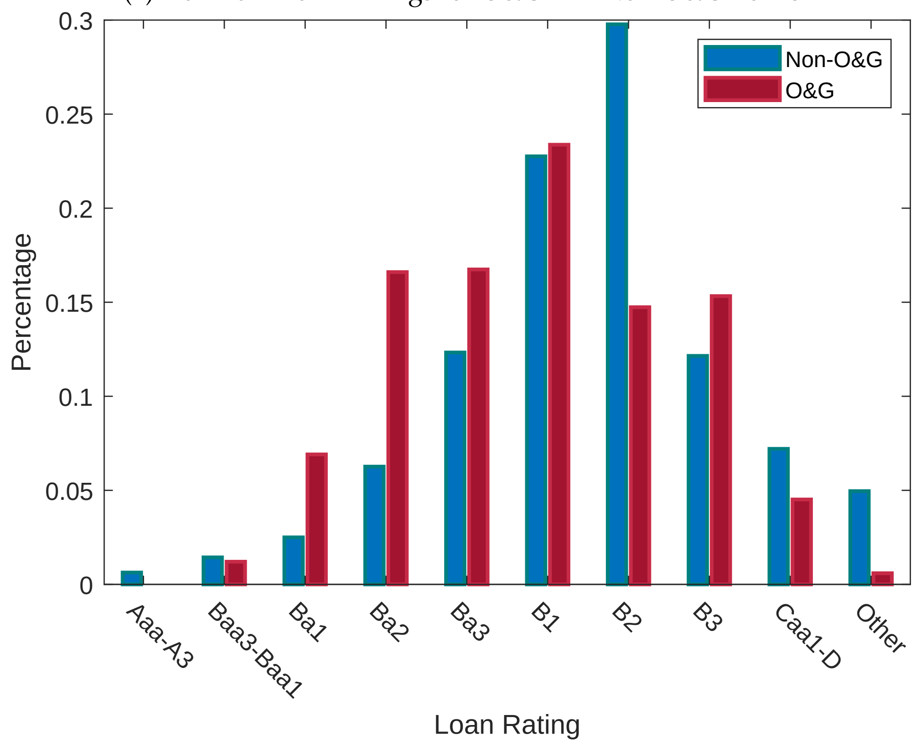


Figure A.5: O&G Ratings Pre- and Post- Plunge

Notes: The figure shows the distribution of loan ratings before and after the O&G price plunge. The x-axis indicates the Moody's loan rating. The y-axis indicates the frequency of O&G loans of each rating category. The blue bars indicate the frequency of O&G loans of the corresponding rating bin before the O&G price plunge. The red bars indicate the frequency of O&G loans of the corresponding rating bin after the O&G price plunge.



(a) Double-B Loan Ratings for O&G and Non-O&G Loans



(b) O&G and Non-O&G Loan Ratings

Figure A.6: Ratings Distribution of O&G and Non-O&G Loans

Notes: This figure compares the ratings distribution for O&G and non-O&G loans before the shock. Appendix Figure A.6a compares the frequency of double-B rated (Ba1, Ba2, and Ba3) loans among O&G and non-O&G loans before the shock. Appendix Figure A.6b compares the distribution of loan ratings for O&G and non-O&G loans before the shock. The x-axis denotes the loan rating. The y-axis denotes the percentage. The red bar indicates O&G loans. The blue bar indicates non-O&G loans.

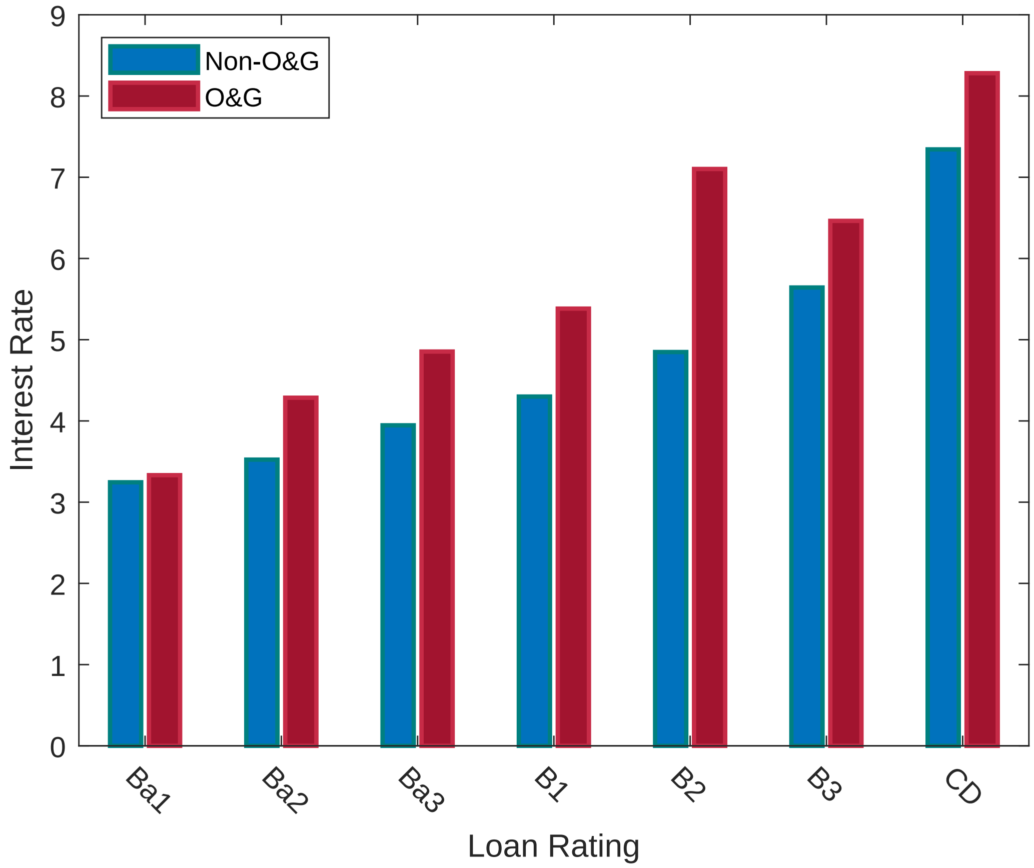
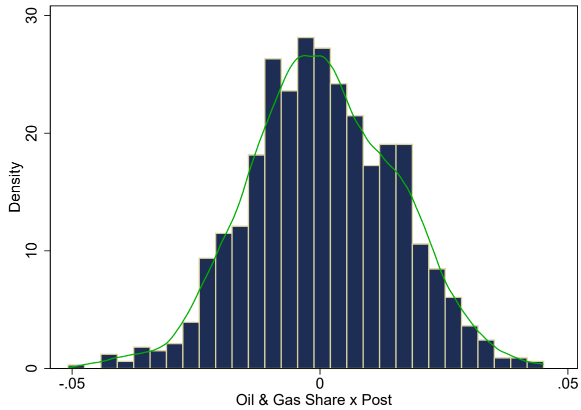
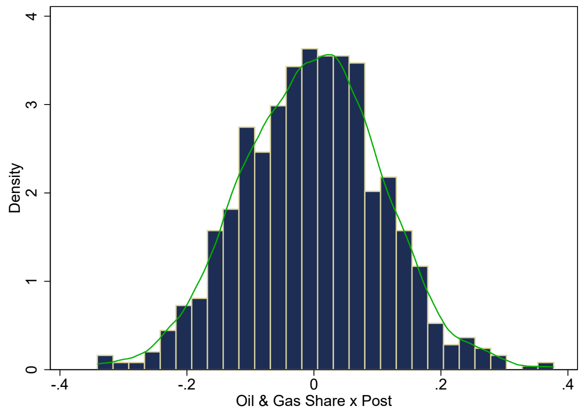


Figure A.7: O&G and Non-O&G Loan Yield

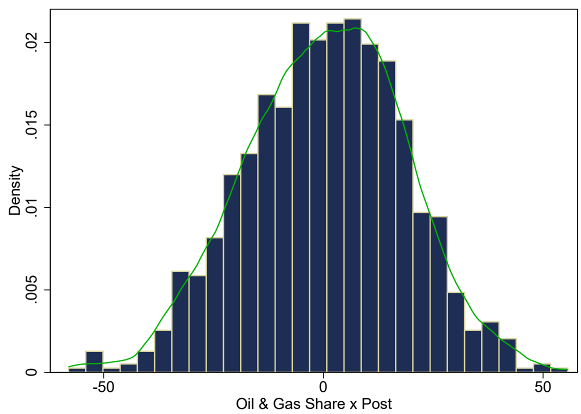
Notes: The figure shows the average interest rate associated with non-O&G loans and O&G loans by loan rating before the shock. The x-axis denotes the loan rating. The y-axis indicates the interest rate. The red bar indicates O&G loans. The blue bar indicates non-O&G loans.



(a) Transaction Amount



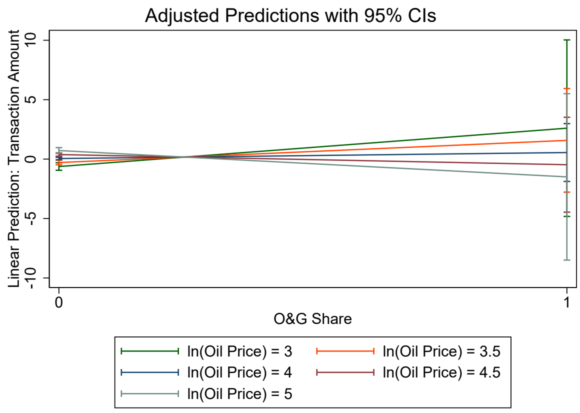
(b) Secondary Loan Price



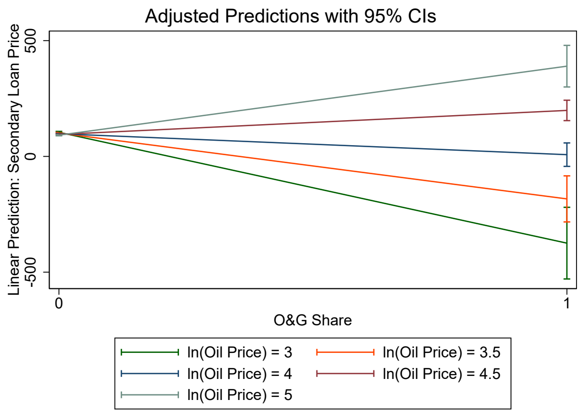
(c) All-in-spread drawn

Figure A.8: Placebo Tests

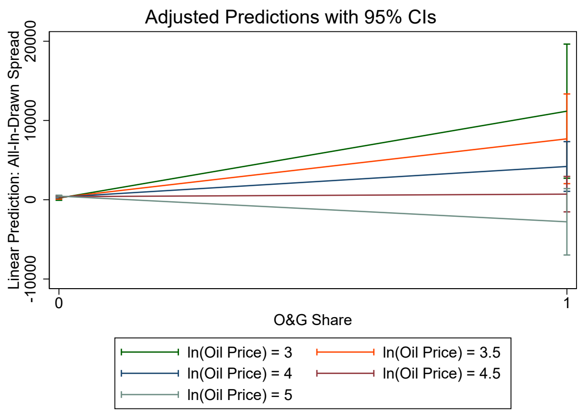
Notes: I plot the histograms from 1,000 Monte-Carlo simulations of the baseline results using two placebo tests. I randomize the O&G share from a uniform distribution. β_3 is plotted from the following specifications: $Y_{f,t} = \beta_0 + \beta_1(\text{Placebo O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Placebo O\&G Exposure}_{f,t} \times \text{Oil Shock}_t) + \alpha_f + \alpha_{m,y} + \epsilon_{f,t}$ where $Y_{c,f,t}$ is the secondary loan amount (figure A.8a), secondary loan price (figure A.8b), f denotes the portfolio firm ($f \in$ CLO c), t indexes the time, m denotes the month, and y denotes the year, and $Y_{i,t} = \beta_0 + \beta_1(\text{Placebo O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Placebo O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity}_{i,t} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the all-in-spread drawn (figure A.8c) of loan i at time t, issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Oil Shock_t is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. The t-statistics for figure A.8a, A.8b and A.8c are 0.1022, -0.7503 and 0.7690, respectively, hence, the null hypothesis that the average difference is equal to zero cannot be rejected in any of the cases.



(a) Transaction Amount



(b) Secondary Loan Price

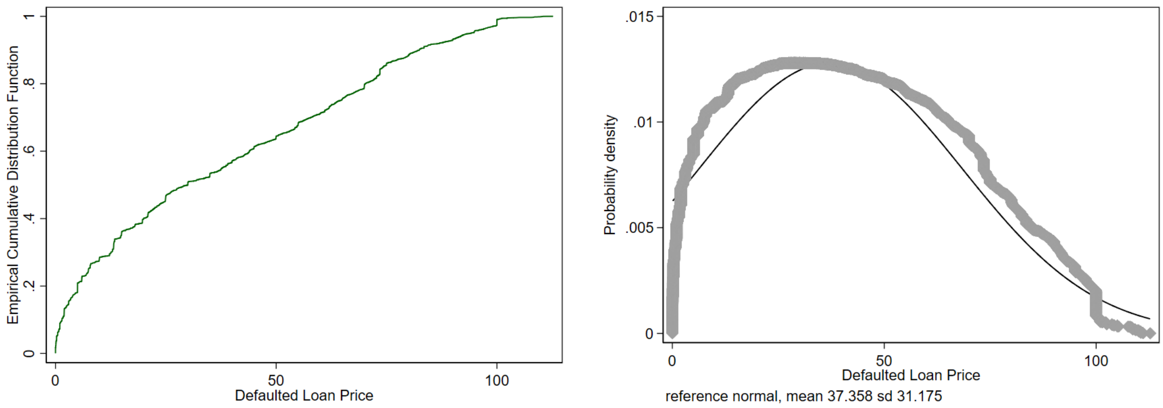


(c) all-in-spread drawn

Figure A.9: Alternative Empirical Specification

Notes: This figure plots the marginal effects – the slope of the secondary loan price (top) and all-in-spread drawn (bottom) on the price, while holding the value of the O&G share constant between 0 and 1. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2 ln(\text{Oil Price}_t)) + \beta_3(\text{Firm O\&G Exposure}_f \times ln(\text{Oil Price}_t)) + \alpha_y + \epsilon_{i,t}$ where $Y_{i,t}$ is the secondary loan amount (figure A.9a) and secondary loan price (figure A.9b) of loan i at time t issued by firm f ($i \in f \in$ CLO c), and y denotes the year for the top figure. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2 ln(\text{Oil Price}_t)) + \beta_3(\text{Firm O\&G Exposure}_f \times ln(\text{Oil Price}_t))) + \alpha_y + \epsilon_{i,t}$ where $Y_{i,t}$ is the all-in-spread drawn of loan i at time t, issued by firm f ($i \in f \in$ CLO c), and y denotes the year respectively in the bottom figure. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs. Temporal variation comes from the log oil price.

Figure A.10: Distributions of Defaulted Loan Prices



(a) CDF of Defaulted Loan Prices (b) PDF of Defaulted Loan Prices

Notes: The figure presents the cumulative distribution function (CDF) and probability density function (PDF) of defaulted loan prices. Figure A.10a presents the CDF of defaulted loan prices. Figure A.10b presents the PDF of defaulted loan prices.

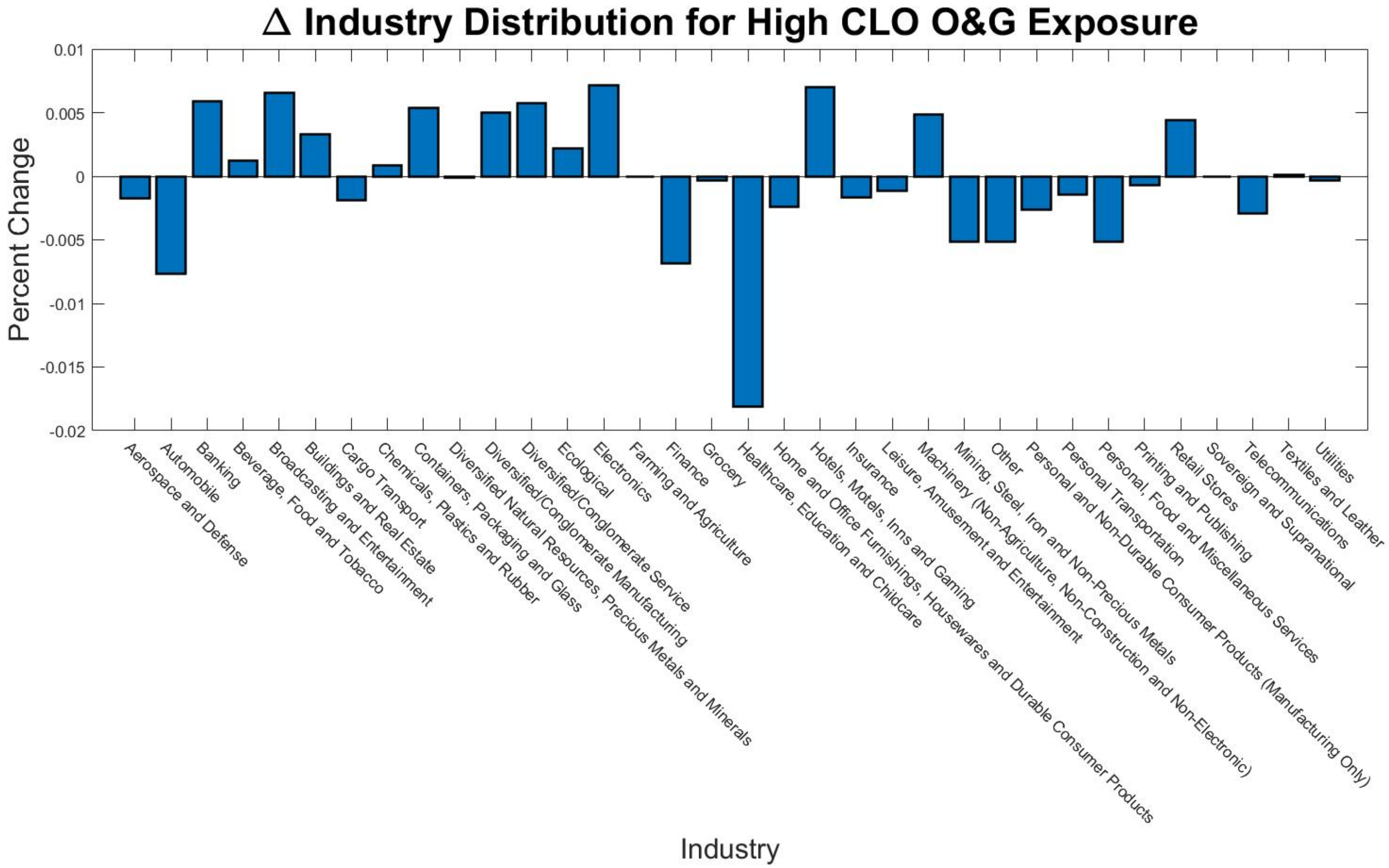


Figure A.11: Change in Industry Composition for Constrained CLOs

Notes: The figure presents the change in the industry share of loans before and after the shock for constrained CLOs – CLOs with high O&G exposure. CLOs with O&G exposure above the 75^{th} percentile of all O&G exposures have *high* O&G exposure. I list industries on the x-axis and percent change on the y-axis.

A.2 Tables

Table A.1: Interest Diversion Threshold and O&G Exposure

ln(ID Threshold)	(1)	(2)	(3)	(4)
O&G Share	-0.1919	-0.0942	-0.2992	-0.2853
	(0.3167)	(0.3913)	(0.4285)	(0.4239)
Constant	4.6494***	4.1968***	4.1998***	3.9129***
	(0.0137)	(0.2409)	(0.4480)	(0.7631)
CLO Controls		✓	✓	✓
Manager FE	✓	✓	✓	✓
Arranger FE				✓
Trustee FE				✓
Year FE		✓		
Month-Year FE			✓	✓
N	65	65	65	65
R^2	0.5723	0.6132	0.8136	0.9684

Robust standard errors in parentheses

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

Notes: The table presents the relation between CLO O&G exposure and the Interest Diversion covenant threshold (ln(Current Threshold)) before the shock occurs. The baseline regression specification takes the form $Y_c = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \gamma_0' X_c + \epsilon_c$ where Y_c is the (standardized) Interest Diversion covenant threshold of CLO c, and X denotes the vector of controls, consisting of current CLO age (Columns 1-4), CLO size (Columns 2-4), CCC-share and defaulted-share (Columns 3-4). $\text{CLO O\&G Exposure}_c$ is the O&G share of CLO c measured when the CLO is first reported in the sample. Standard errors are robust.

Table A.2: CLO Comparison based on Observable Firm Characteristics

Low O&G Exposure	N	Q1	Median	Q3	Mean	Std. Dev.
Size	1,431	6.3807	7.3028	8.9143	7.7381	2.0111
Tobin's Q	990	1.1037	1.3940	1.7702	1.5796	0.8715
Leverage	1,332	0.2747	0.4135	0.5828	0.4654	0.3678
Market-to-Book Ratio	1,146	0.4228	1.4718	3.2270	2.4440	15.0618
Investment Growth	1,202	0.0429	0.3937	0.6453	0.0486	0.9826
Investment	1,338	1.8339	3.2718	4.7791	3.3062	2.1519
Cash Flow	1,018	0.0863	0.1362	0.1851	0.1500	0.1522
Tangibility	1,264	0.1339	0.3529	0.5989	0.4611	0.4203
High O&G Exposure	N	Q1	Median	Q3	Mean	Std. Dev.
Size	5,115	6.5671	7.5376	8.6334	7.6158	1.5024
Tobin's Q	3,735	1.0939	1.3542	1.8497	1.6564	1.0089
Leverage	4,763	0.2611	0.4156	0.5870	0.4495	0.3183
Market-to-Book Ratio	4,090	0.5429	1.4884	3.2773	2.8796	17.7412
Investment Growth	4,414	0.0538	0.3876	0.6348	0.0540	0.9809
Investment	4,880	1.9311	3.2139	4.5520	3.2086	2.0509
Cash Flow	3,673	0.0918	0.1346	0.1956	0.1564	0.1862
Tangibility	4,592	0.1330	0.4403	0.8494	0.5131	0.4318

Notes: This table compares characteristics of firms with high CLO O&G exposure to firms with low CLO O&G exposure, before the shock. CLOs with above-median O&G exposure have *high* O&G exposure while CLOs with below median O&G exposure have *low* O&G exposure. The characteristics of interest are: size, Tobin's Q, leverage, marke-to-book ratio, investment growth, investment, cash flow, and tangibility. The number of observations, first quartile, median, third quartile, mean, and standard deviation associated with each variable are in Columns 2-7, respectively.

Table A.3: CLO Selection by Covariance of Oil Price and Firm Profitability

$\mathbb{1}_{\text{High CLO O\&G Share}}$	(1)	(2)	(3)	(4)	(5)
Covariance(Oil Price, Firm Profitability)	0.7980	-0.7324	-3.2345	0.8194	0.7756
	(9.0995)	(4.1633)	(4.6340)	(1.1214)	(0.8615)
Constant	0.7734***				
	(0.0244)				
CLO Controls			✓		✓
Issuer Controls				✓	✓
Manager-Arranger-Trustee FE				✓	✓
Rating-Industry FE			✓		✓
Manager FE		✓			
Year FE		✓	✓	✓	
Month-Year FE					✓
N	5,700	5,700	5,700	5,700	5,700
R^2	0.0000	0.3450	0.2381	0.8572	0.9234

Standard errors are two-way clustered by CLO and issuer in parentheses

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

Notes: The table presents the relation between the covariance of firm profitability and oil price, and, an indicator of whether the CLO portfolio that holds firm f has a high share of O&G before the shock occurs. CLOs with above-median O&G exposure have *High* O&G exposure. The baseline regression specification takes the form: $\mathbb{1}_{(f \in c \text{ with high O\&G exposure})c,f} = \alpha + \beta(\text{Covariance(Oil Price, Profitability)})_f + \gamma_0 X_c + \gamma_1 Z_f + \alpha_{m,y} + \epsilon_{c,f}$ where $\mathbb{1}_{(f \in c \text{ with high O\&G exposure})c,f}$ indicates whether firm f is held in a CLO c with high O&G exposure, f denotes the portfolio firm ($f \in c$), t denotes the time – m and y denote the month and year respectively, X is a vector of CLO controls and Z is a vector of issuer controls. CLO controls include size, and, CCC-share and defaulted-share (Columns 3, 5). Issuer controls include size, tangibility, leverage, net worth, and market-to-book ratio (Columns 4-5). Standard errors are two-way clustered by CLO and issuer.

Table A.4: CLO-Level Trading Effects

Transaction Amount	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-12.5698***	-12.4389***	-13.0086***	-15.3984***	-14.8014***	-23.7717***
	(2.7884)	(2.7723)	(2.7046)	(3.0424)	(3.3766)	(6.0871)
O&G Share	7.5841***	7.5756***	8.5205***	13.7541***		
	(2.4206)	(2.3975)	(2.4556)	(3.0794)		
Post	0.0893	0.1998**			0.2283**	
	(0.0901)	(0.0911)			(0.1085)	
Manager FE			✓			
Rating-Industry FE				✓		
CLO-Issuer FE						✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	55,203	55,203	55,203	50,766	55,203	55,203
R^2	0.0119	0.0140	0.0441	0.0420	0.0648	0.4329

Standard errors are two-way clustered by CLO-issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and net transaction amount for non-O&G firms. The baseline regression specification takes the form $Y_{c,f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \gamma_0 Z_f + \alpha_{c,f} + \alpha_{m,y} + \epsilon_{c,f,t}$ where $Y_{c,f,t}$ is the net transaction amount of firm f by CLO c at time t ($f \in$ CLO c), X is a vector of CLO controls including manager, m, y denote the month and year respectively, and Z is a vector of firm controls including rating and industry. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and month-year.

Table A.5: Issuer-Level Trading Effects

Transaction Amount	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-1.6833*	-1.6738*	-2.9533**	-2.3576*	-2.5800*
	(0.9391)	(0.9367)	(1.0861)	(1.3210)	(1.3358)
O&G Share	0.8848	0.8813	2.3788**		
	(0.7162)	(0.7126)	(0.9532)		
Post	0.0331	0.0212		0.0356	
	(0.0294)	(0.0308)		(0.0419)	
Issuer FE				✓	✓
Rating-Industry FE			✓		
Year FE		✓		✓	
Month-Year FE			✓		✓
N	12,464	12,464	10,813	12,322	12,322
R^2	0.0004	0.0005	0.0336	0.0743	0.0818

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and net transaction amount for non-O&G firms. The baseline regression specification takes the form $Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 Z_f + \alpha_f + \alpha_{m,y} + \epsilon_{f,t}$ where $Y_{c,f,t}$ is the net transaction amount of firm f across all CLOs c at time t ($f \in$ CLO c), m, y denote the month and year respectively, and Z is a vector of firm controls including rating and industry. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.6: Issuer-Level Effects by Transaction Type

Total Transaction Amount	(1)	(2)	(3)	(4)	(5)	(6)
	Purchases			**Sales**		
O&G Share × Post	0.2243	1.1255	0.5331	8.1515***	10.9487***	9.6185***
	(1.6497)	(1.9370)	(1.8573)	(2.6452)	(3.1875)	(2.9268)
O&G Share	-3.4125**			-14.0377***		
	(1.5670)			(3.1174)		
Post		-0.0781			-0.3705***	
		(0.0655)			(0.1189)	
Rating-Industry FE	✓			✓		
Issuer FE		✓	✓		✓	✓
Year FE		✓			✓	
Month-Year FE	✓		✓	✓		✓
N	8,384	9,418	9,418	7,911	8,875	8,875
R^2	0.0606	0.1213	0.1365	0.0920	0.1723	0.1955

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and total selling amount for non-O&G firms. The baseline regression specification takes the form $Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 Z_f + \alpha_f + \alpha_{m,y} + \epsilon_{f,t}$ where $Y_{c,f,t}$ is the total selling amount of firm f across all CLOs c at time t ($f \in$ CLO c), m, y denote the month and year respectively, and Z is a vector of firm controls including rating and industry. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.7: Natural Log of Secondary Loan Price and O&G Exposure

ln(Transaction Price per $100 par)	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-2.5372***	-2.5195***	-2.3232***	-1.5368**	-0.9656**	-0.8084*
	(0.9794)	(0.9757)	(0.8356)	(0.5983)	(0.4574)	(0.4600)
O&G Share	2.7005***	2.6803***	2.3369***	0.3129		
	(0.9310)	(0.9275)	(0.7874)	(0.5566)		
Post	0.0812***	0.0766***			0.0265*	
	(0.0268)	(0.0278)			(0.0136)	
Manager FE			✓			
Rating-Industry FE				✓		
Issuer-Loan Type FE					✓	✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	57,593	57,593	57,587	52,583	57,593	57,593
R^2	0.0099	0.0100	0.0701	0.3958	0.5894	0.5958

Standard errors are two-way clustered by CLO-issuer and trade date in parentheses

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

Notes: The table presents the relation between firm O&G exposure and secondary loan price for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \gamma_0 Z_f + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{i,t}$ where $Y_{i,t}$ is the natural logarithm of secondary loan price of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, X is a vector of CLO controls including manager, m, y denote the month and year respectively, and Z is a vector of firm controls including rating and industry. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and trade date.

Table A.8: Primary Institutional Loan Maturity and O&G Exposure

Maturity (Months)	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-402.9248**	-401.7083**	-405.7873**	-409.4155*	-460.2031**
	(185.9240)	(186.8647)	(187.4312)	(228.5919)	(222.3893)
Post	11.5017*	13.7653*	14.3364*	13.6066	
	(5.8430)	(7.5244)	(7.6126)	(8.4188)	
Issuer FE	✓	✓	✓	✓	✓
Secured FE		✓	✓	✓	✓
Purpose FE				✓	✓
Distribution Method FE				✓	✓
Seniority FE			✓	✓	✓
Loan Type FE			✓	✓	✓
Country of Syndication FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	582	582	582	582	582
R^2	0.5993	0.6008	0.6374	0.6895	0.7240

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and primary loan maturity for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the Maturity (months) loan spread of loan i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.9: Primary Institutional Loan Amount and O&G Exposure

ln(Loan Amount)	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-6.5846	-6.3589	-7.6556	-4.6737	-5.8864
	(7.5029)	(7.4790)	(7.9242)	(6.5940)	(7.9274)
Post	0.0032	0.1184	0.1482	0.1400	
	(0.2570)	(0.3110)	(0.3321)	(0.2718)	
Maturity				0.0196***	0.0205***
				(0.0033)	(0.0032)
Issuer FE	✓	✓	✓	✓	✓
Secured FE		✓	✓	✓	✓
Purpose FE				✓	✓
Distribution Method FE				✓	✓
Seniority FE			✓	✓	✓
Loan Type FE			✓	✓	✓
Country of Syndication FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	582	582	582	582	582
R^2	0.6228	0.6243	0.6653	0.7341	0.7514

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and primary institutional loan amount for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity}_{i,t} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the (standardized) ln(loan amount) of loan i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO×issuer and trade date.

Table A.10: Bond Liquidity and O&G Exposure

Bond Liquidity	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	0.0208**	0.0208**	0.0226**	0.0241**	0.0241**
	(0.0101)	(0.0100)	(0.0105)	(0.0094)	(0.0094)
Post	-0.0006**	-0.0004	-0.0005	-0.0004	
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	
Time to Maturity				0.0002***	0.0002***
				(0.0000)	(0.0000)
Issuer FE	✓	✓	✓	✓	✓
Bond Type FE	✓	✓	✓	✓	✓
Security Level FE			✓	✓	✓
Rating FE				✓	✓
IG FE				✓	✓
Defaulted FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	9,955	9,955	9,955	9,955	9,955
R^2	0.2739	0.2767	0.2876	0.3823	0.3887

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and bond liquidity for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Time to Maturity}_{i,t} + \gamma_0 X_{i,t} + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the (standardized) bond liquidity (%) of bond i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of controls associated with bond i including bond type, security level, rating, investment-grade indicator, and defaulted status, and m, y denote the month and year respectively. Bond liquidity is defined as the average bid-ask spread. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.11: Transaction Amount in the Cross-Section and O&G Exposure

Transaction Amount	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Bond Access		**Size**		**Age**		**Loan Refinancing**	
	Access	No Access	Large	Small	Old	Young	After Shock	Before Shock
O&G Share × Post	-13.8277***	-22.6504***	-18.3108**	-22.7841***	4.4170	-28.0192***	0.4278	-26.7812***
	(2.8186)	(7.7187)	(7.1537)	(7.2238)	(10.3713)	(7.6840)	(11.5195)	(9.5857)
Issuer-Loan Type FE FE	✓	✓	✓	✓	✓	✓	✓	✓
Month-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
N	107,385	21,747	24,584	12,111	11,367	13,155	4,665	13,890
R^2	0.0821	0.0840	0.0709	0.1180	0.1031	0.0781	0.1424	0.0781

Standard errors are clustered by CLO-issuer and trade date in parentheses

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

Notes: The table presents the relation between firm O&G exposure and transaction amount for non-O&G firms by bond access, size, age, and loan refinancing. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{i,t}$ where $Y_{i,t}$ is the transaction amount of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, X is a vector of CLO controls including manager, m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. I present the results from this baseline regression for various sub-samples. In Columns 1 and 2, I segment firms based on access to the bond market; firms with access to the bond market are in Column 1 and firms without access are in Column 2. In Columns 3 and 4, I segment firms based on size; firms designated as small are in Column 3 and firms designated as large are in Column 4. In Columns 5 and 6, I segment firms based on age; firms designated as young are in Column 5 and firms designated as old are in Column 6. In Columns 7 and 8, I segment firms without access to the bond-market based on timing of loan refinancing; early refinancing firms (refi before median date) without access to the bond market are in Column 7 and late refinancing firms (refi after median date) without access to the bond market are in Column 8. Standard errors are clustered by CLO-issuer and trade date.

Table A.12: Transaction Price in the Cross-Section and O&G Exposure

Transaction Price (per $100 par)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Bond Access		**Size**		**Age**		**Loan Refinancing**	
	Access	No Access	Large	Small	Old	Young	After Shock	Before Shock
O&G Share × Post	-6.4453	-355.3860***	-177.4253***	-123.7883**	-218.6469***	-379.5570***	-131.1193	-427.0697***
	(25.3652)	(57.9202)	(43.1133)	(62.3494)	(62.6011)	(79.9495)	(93.2234)	(81.1176)
Issuer-Loan Type FE FE	✓	✓	✓	✓	✓	✓	✓	✓
Month-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
N	107,400	21,750	24,590	12,111	11,372	13,155	4,666	13,892
R^2	0.5376	0.3797	0.2279	0.4701	0.3787	0.3424	0.3710	0.2472

Standard errors are clustered by CLO-issuer and trade date in parentheses

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

Notes: The table presents the relation between firm O&G exposure and transaction price for non-O&G firms by bond access, size, age, and loan refinancing. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{i,t}$ where $Y_{i,t}$ is the transaction price of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, X is a vector of CLO controls including manager, m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. I present the results from this baseline regression for various sub-samples. In Columns 1 and 2, I segment firms based on access to the bond market; firms with access to the bond market are in Column 1 and firms without access are in Column 2. In Columns 3 and 4, I segment firms based on size; firms designated as small are in Column 3 and firms designated as large are in Column 4. In Columns 5 and 6, I segment firms based on age; firms designated as young are in Column 5 and firms designated as old are in Column 6. In Columns 7 and 8, I segment firms without access to the bond-market based on timing of loan refinancing; early refinancing firms (refi before median date) without access to the bond market are in Column 7 and late refinancing firms (refi after median date) without access to the bond market are in Column 8. Standard errors are clustered by CLO-issuer and trade date.

Table A.13: Investment in the Cross-Section and O&G Exposure

Investment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Bond Access		**Size**		**Age**		**Loan Refinancing**	
	Access	No Access	Large	Small	Old	Young	After Shock	Before Shock
O&G Share $\times$ Post	0.6071	-10.1692***	-1.0910	-8.3904**	-3.4139	-6.6943*	-8.2438	-11.4849**
	(1.8012)	(3.8311)	(2.1711)	(3.8354)	(2.7481)	(3.9496)	(5.7068)	(5.0063)
Issuer FE	✓	✓	✓	✓	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
N	1,661	1,320	1,710	1,271	1,037	957	441	708
R^2	0.1637	0.1961	0.2040	0.1547	0.1553	0.1690	0.1854	0.2561

Standard errors are clustered by issuer in parentheses

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

Notes: The table presents the relation between firm O&G exposure and investment for non-O&G firms by bond access, size, age, and loan refinancing. The baseline regression specification takes the form $I_{ft} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{q,y} + \alpha_f + \alpha_d + \epsilon_{f,t}$ where I_{ft} denotes (standardized) investment of firm f at time t ($f \in$ CLO c), d denotes the industry, and q, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. I present the results from this baseline regression for various sub-samples. In Columns 1 and 2, I segment firms based on access to the bond market; firms with access to the bond market are in Column 1 and firms without access are in Column 2. In Columns 3 and 4, I segment firms based on size; firms designated as small are in Column 3 and firms designated as large are in Column 4. In Columns 5 and 6, I segment firms based on age; firms designated as young are in Column 5 and firms designated as old are in Column 6. In Columns 7 and 8, I segment firms without access to the bond-market based on timing of loan refinancing; early refinancing firms (refi before median date) without access to the bond market are in Column 7 and late refinancing firms (refi after median date) without access to the bond market are in Column 8. Standard errors are clustered by issuer.

Table A.14: Triple-Difference: Constrained Firms and Investment

Investment	(1)	(2)
No Access × O&G Share × Post	-10.8285**	
	(4.2109)	
Small × O&G Share × Post		-7.2847*
		(4.3765)
No Access × Post	0.2040	
	(0.1236)	
Small × Post		0.1940
		(0.1341)
O&G Share × Post	0.6152	-1.0657
	(1.7951)	(2.1537)
Issuer FE	✓	✓
Quarter-Year	✓	✓
N	2,981	2,981
R^2	0.1756	0.1740

Standard errors are clustered by issuer in parentheses

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

Notes: The table presents the relation between firm O&G exposure and investment growth for non-O&G firms by bond access and size. The baseline regression specification takes the form $I_{ft} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4(\text{Constrained}_f \times \text{Oil Shock}_t) + \beta_5(\text{Constrained}_f \times \text{Oil Shock}_t \times \text{Firm O\&G Exposure}_f) + \beta_6\text{Constrained}_f + \beta_7(\text{Constrained}_f \times \text{Firm O\&G Exposure}_f) + \alpha_{q,y} + \alpha_f + \alpha_d + \epsilon_{f,t}$ where I_{ft} denotes (standardized) investment of firm f at time t ($f \in$ CLO c), d denotes the industry, and q, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. In Column 1, a firm is *constrained* if it does not have access to the corporate bond market. In Column 2, a firm is *constrained* if it is small. Standard errors are clustered by issuer.

Table A.15: Triple-Difference: Risky Firms and Firm Outcomes

	(1) Secondary Loan Price	(2) All-In-Drawn Spread	(3) Investment
Risky × O&G Share × Post	-270.7383***	1494.2151	-10.0547*
	(86.1335)	(2159.2770)	(5.2123)
Risky × Post	6.6826***	-31.0497	0.2241
	(2.3895)	(61.7280)	(0.1526)
O&G Share × Post	36.3184	1631.8741*	-2.1114
	(32.6817)	(923.1815)	(2.0887)
Issuer-Loan Type FE	✓		
Issuer FE		✓	✓
Primary Loan Controls		✓	
Firm Controls			✓
Month-Year FE	✓	✓	
Quarter-Year FE			✓
N	57,593	567	2,575
R^2	0.6042	0.9330	0.1924

Standard errors are clustered in parentheses

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

Notes: The table presents the relation between firm riskiness, firm O&G exposure, and firm outcomes for non-O&G firms. The baseline regression specification takes the form $Y_{i,f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4(\text{Defaulted}_f \times \text{Oil Shock}_t) + \beta_5(\text{Defaulted}_f \times \text{Oil Shock}_t \times \text{Firm O\&G Exposure}_f) + \beta_6\text{Defaulted}_f + \beta_7(\text{Defaulted}_f \times \text{Firm O\&G Exposure}_f) + \beta_7(\text{Maturity}_{i,t}) + \gamma_0 X_{i/f} + \alpha_{m/q,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,f,t})$ denotes the secondary loan price in Column 1, all-in-spread drawn in Column 2, and (standardized) investment in Column 3 for firm f at time t (loan $i \in f \in$ CLO c), I denotes the industry, and q, y denote the month and year respectively. X is the vector of non-time varying controls associated with loan i in column 2, including secured status, purpose, distribution method, seniority, loan type, and country of syndication. X is the vector of non-time varying controls associated with firm f in column 3, including industry and rating. $Maturity_{i,t}$ denotes the maturity of loan i at time t. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. A firm is *distressed* if it defaulted on a loan at some point in the sample. Standard errors are two-way clustered by CLO × issuer and month-year (Col. 1), issuer and month-year (Col. 2), and issuer (Col. 3) in parentheses.

Table A.16: Instrumental Variable Regression

Transaction Amount (Net Purchase)	(1)	(2)	(3)	(4)
			2SLS	
	OLS	IV	Second Stage	First Stage
CLO Constraint	-0.0058		1.6336***	
	(0.0325)		(0.3910)	
O&G Share × Post		-14.3665***		-8.7970***
		(3.0472)		(1.1360)
Issuer-Loan Type FE	✓	✓	✓	✓
Month-Year FE	✓	✓	✓	✓
N	126,146	126,146	126,146	126,164
R^2	0.0741	0.0748	-0.0965	0.6117
KP LM Statistic			58.1476***	
KP Wald F Statistic			59.9309	

Standard errors are two-way clustered by CLO-issuer and trade date in parentheses

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

Notes: The table reports the results of regressing the transaction price (per \$100 par) on the natural log of the distance to the ID threshold. The 2SLS specification is of the form:

$$
\begin{aligned}
Y_{i,t} =& \beta_0 + \beta_1(\text{CLO Constraint})_{f,t} + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{i,t} \\
\text{CLO Constraint}_{f,t} =& \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t \\
&+ \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{f,t}
\end{aligned}
$$

where $Y_{i,t}$ is the transaction amount (net purchase) of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, and m, y denote the month and year respectively. CLO Constraint$_{f,t}$ is a measure of firm exposure to CLO constraint. It is the weighted average of the distance to the ID threshold ($ln(\frac{\text{Current Performance}}{\text{Current Threshold}})$ across all CLOs c a firm f is held in at time t. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO × issuer and trade date.

Table A.17: Falsification Test: Primary Non-Institutional Loan Spread and O&G Exposure

All-In-Spread-Drawn	(1)	(2)	(3)	(4)	(5)
O&G Share $\times$ Post	137.8844	132.0103	246.4978	197.1342	-142.2520
	(266.5643)	(273.1646)	(263.7165)	(194.2592)	(223.3746)
Post	-27.0198**	-15.0067	-18.1787	-14.3602	
	(11.5126)	(19.1854)	(17.3523)	(17.5971)	
Maturity				-1.9344**	-1.5368**
				(0.7311)	(0.6951)
Issuer FE	✓	✓	✓	✓	✓
Secured FE		✓	✓	✓	✓
Purpose FE				✓	✓
Distribution Method FE				✓	✓
Seniority FE			✓	✓	✓
Loan Type FE			✓	✓	✓
Country of Syndication FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	432	432	432	432	432
R^2	0.8486	0.8503	0.8763	0.8912	0.9141

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and primary non-institutional loan spread for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity}_{i,t} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the all-in-spread drawn of loan i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.18: Falsification Test: Primary Revolving Credit Undrawn Spread and O&G Exposure

All-In-Spread-Undrawn	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	9.1183	13.5492	20.5996	1.7606	137.2510
	(33.7049)	(50.8815)	(48.1542)	(45.7783)	(89.8507)
Post	-3.2853**	-0.2432	-0.3888	0.4567	
	(1.3369)	(2.4524)	(2.4282)	(2.5537)	
Maturity				-0.1177	-0.1319
				(0.0748)	(0.1356)
Issuer FE	✓	✓	✓	✓	✓
Secured FE		✓	✓	✓	✓
Purpose FE				✓	✓
Distribution Method FE				✓	✓
Seniority FE			✓	✓	✓
Loan Type FE			✓	✓	✓
Country of Syndication FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	289	199	199	193	188
R^2	0.9339	0.9346	0.9359	0.9390	0.9617

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and primary undrawn spread associated with revolving credit facilities for non-O&G firms. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity}_{i,t} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the all-in-spread undrawn of facility i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with facility i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.19: Alternative Measures of Issuer Exposure to CLOs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Equal Weights			**Equal Weighting (Loan Frequency)**			**Value Weighting (Loan Frequency)**			**Value Weighting (Loan Amount)**		
	Transaction Amount	Secondary Price	AISD	Transaction Amount	Secondary Price	AISD	Transaction Amount	Secondary Price	AISD	Transaction Amount	Secondary Price	AISD
O&G Share × Post	-15.1462***	-66.2332*	2051.6695***	-14.8092***	-82.5273**	2102.7887***	-14.6684***	-80.1203**	2024.8176***	-14.8181***	-82.6503**	2102.7887***
	(2.7720)	(34.1845)	(733.2065)	(2.8569)	(35.1134)	(737.3682)	(2.7987)	(34.4993)	(721.4302)	(2.8569)	(35.1149)	(737.3682)
Post	0.2751***	1.6175	-51.7958	0.2666***	2.0636**	-53.4040	0.2641***	2.0054*	-51.4677	0.2668***	2.0668**	-53.4040
	(0.0845)	(1.0083)	(32.3647)	(0.0865)	(1.0346)	(32.3613)	(0.0854)	(1.0237)	(31.5815)	(0.0865)	(1.0346)	(32.3613)
Issuer-Loan Type FE	✓	✓		✓	✓		✓	✓		✓	✓	
Issuer FE			✓			✓			✓			✓
Primary Loan Controls			✓			✓			✓			✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
N	129,132	57,593	567	129,132	57,593	567	129,132	57,593	567	129,132	57,593	567
R^2	0.0758	0.5962	0.9215	0.0758	0.5963	0.9217	0.0758	0.5963	0.9215	0.0758	0.5963	0.9217

Standard errors are clustered by CLO×Issuer and trade date in Columns 1, 2, 4, 5, 7, 8, 10, 11 and by issuer and month-year in Columns 3, 6, 9, 12

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

Notes: The table presents the relation between firm O&G exposure and transaction amount (Columns 1, 4, 7, 10) secondary loan price (Columns 2, 5, 8, 11) and all-in-spread drawn (Columns 3, 6, 9, 12) for non-O&G firms. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{f,l} + \alpha_y + \epsilon_{i,t}$ where $Y_{i,t}$ is the transaction amount (Columns 1, 4, 7, 10) and secondary loan price (Columns 2, 5, 8, 11) of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, and y denotes the year in Columns 1, 3, 5, and 7. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity}_{i,t} + \gamma_0 X_i + \alpha_y + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the all-in-spread drawn of loan i at time t, issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and y denotes the year respectively in Columns 3, 6, 9, and 12. In Columns 1-3, Firm O&G Exposure$_f$ measure the equal-weighted average of O&G share by issuer amount of firm f across all CLOs before the shock occurs. In Columns 4-6, Firm O&G Exposure$_f$ measure the equal-weighted average of O&G share by loan frequency of firm f across all CLOs before the shock occurs. In Columns 7-9, Firm O&G Exposure$_f$ measure the value-weighted average of O&G share by loan frequency of firm f across all CLOs before the shock occurs. In Columns 10-12, Firm O&G Exposure$_f$ measure the value-weighted average of O&G share by loan amount of firm f across all CLOs before the shock occurs. Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are clustered by CLO×Issuer and trade date in Columns 1, 2, 4, 5, 7, 8, 10, 11 and by issuer and month-year in Columns 3, 6, 9, 12.

Table A.20: Secondary Loan Price and COVID-19 Exposure

Transaction Price (per \$100 par)	(1) O&G	(2) Auto	(3) Retail	(4) Consumer Goods	(5) Transportation	(6) Cargo	(7) O&G and Auto	(8) Retail and Goods	(9) All (Col 1-6)
COVID-19 Share × Post	-91.0212***	-75.2506***	-142.4787***	-203.7944***	-84.1403***	-314.7237***	-167.9910***	-74.5372***	-69.2296***
	(20.0355)	(25.8422)	(10.3454)	(18.2773)	(18.2879)	(30.8661)	(10.3390)	(13.4084)	(6.8968)
Issuer-Loan Type FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Month-Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	134,845	134,712	134,289	138,503	138,429	136,564	134,193	130,989	121,379
R^2	0.7832	0.7896	0.7904	0.7933	0.7928	0.7926	0.7905	0.7791	0.7740

Standard errors are clustered by CLO in parentheses

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

Notes: The table presents the relation between firm COVID-19 exposure and secondary loan price for non-COVID-19 exposed firms. COVID-19 exposure or share is represented by a firm's exposure to an industry, as specified by the column header. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm COVID-19 Exposure})_f + \beta_2(\text{COVID-19 Shock})_t + \beta_3(\text{Firm COVID-19 Exposure}_f \times \text{COVID-19 Shock}_t) + \alpha_{f,l} + \alpha_{m,y} + \epsilon_{i,t}$ where $Y_{i,t}$ is the secondary loan price of loan i at time t issued by firm f ($i \in f \in$ CLO c), l denotes the loan-type, and m, y denote the month and year respectively. Firm COVID-19 Exposure$_f$ measures the weighted average of the vulnerable share of f across all CLOs before the shock occurs, while COVID-19 Shock$_t$ is an indicator variable that takes a value of 1 after the onset of the pandemic, and 0 otherwise. The vulnerable share is the share of O&G in Column 1, Automobiles in Column 2, Retail in Column 3, Durable Consumer Goods in Column 4, Transportation: Consumers in Column 5, Transportation: Cargo in Column 6, summation of O&G and Automobiles in Column 7, summation of Retail and Consumer Goods in Column 8, and summation of all vulnerable industries: O&G, Automobiles, Retail, Consumer Goods, Transportation: Consumers, and Transportation: Cargo in Column 9. Standard errors are clustered by CLO.

Table A.21: Aggregate Trading Effects

Δln(Holdings)	(1)	(2)	(3)
O&G Share × Post	-2.7432*	-2.7835*	-2.9752*
	(1.5504)	(1.5483)	(1.5261)
Post	0.0429	0.0809	
	(0.0399)	(0.0603)	
Firm FE	✓	✓	✓
Year FE		✓	
Month-Year FE			✓
N	26,388	26,388	26,388
R^2	0.0380	0.0390	0.1081

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and total selling amount for non-O&G firms. The baseline regression specification takes the form $\Delta log(H_{f,t}) = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_f + \alpha_{m,y} + \epsilon_{f,t}$ where $\Delta log(H_{f,t})$ is the total change in CLO holdings of firm f at time t, m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.22: Aggregate Trading Effects by Firm Vulnerability

Δln(Holdings)	(1)	(2)	(3)	(4)
	Low O&G Share		**High O&G Share**	
	Low Dependence	High Dependence	Low Dependence	High Dependence
O&G Share × Post	-0.2466	-0.0066	-0.8452	-5.5798***
	(0.9456)	(1.2320)	(2.0623)	(0.9398)
Issuer FE	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓
N	5,864	6,934	2,643	1,949
R^2	0.1059	0.1426	0.1698	0.2075

Standard errors are two-way clustered by issuer and month-year in parentheses

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

Notes: The table presents the relation between firm O&G exposure and total selling amount for non-O&G firms for four bins of firms: firms with low exposure to O&G and low dependence on CLOs (Column 1), firms with low exposure to O&G and high dependence on CLOs (Column 2), firms with high exposure to O&G and low dependence on CLOs (Column 3), and firms with high exposure to O&G and high dependence on CLOs (Column 4). A firm has low (high) exposure to O&G if its exposure is below (above) the 75^{th} percentile. A firm has low (high) dependence on CLOs if its share of total debt held by CLOs is below (above) the median. Total debt is measured before 2013, and is computed by cumulating DealScan loan data. The baseline regression specification takes the form $Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_f + \alpha_{m,y} + \epsilon_{f,t}$ where $Y_{c,f,t}$ is the total selling amount of firm f across all CLOs c at time t ($f \in$ CLO c), m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.23: Distance to Interest Diversion Covenant and COVID-19 Exposure

Distance to ID Threshold	(1)	(2)	(3)	(4)	(5)	(6)
COVID-19 Share × Post	-0.0762***	-0.0797***	-0.0797***	-0.0457*	-0.0966***	-0.0959***
	(0.0238)	(0.0235)	(0.0235)	(0.0230)	(0.0209)	(0.0214)
COVID-19 Share	-0.1969***	-0.0999*	-0.1000*	-0.0442		
	(0.0505)	(0.0499)	(0.0482)	(0.0421)		
Post	-0.0075**	-0.0072**			-0.0051*	
	(0.0027)	(0.0027)			(0.0024)	
CLO Controls		✓	✓	✓		
CLO FE					✓	✓
Manager FE	✓	✓	✓	✓		
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	4,969	4,969	4,969	4,969	4,969	4,969
R^2	0.6047	0.6561	0.7293	0.7911	0.8197	0.8929

Standard errors are two-way clustered by CLO and month-year in parentheses

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

Notes: The table presents the relation between CLO COVID-19 exposure and distance to the Interest Diversion covenant. The baseline regression specification takes the form $Y_{c,t} = \beta_0 + \beta_1(\text{CLO COVID-19 Exposure})_c + \beta_2(\text{COVID-19 Shock})_t + \beta_3(\text{CLO COVID-19 Exposure}_c \times \text{COVID-19 Shock}_t) + \gamma_0' X_c + \epsilon_{c,t}$ where $Y_{c,t}$ is the distance to the Interest Diversion constraint ($ln(\frac{\text{Current Performance}}{\text{Current Threshold}})$) of CLO c at time t, and X denotes the vector of controls, consisting of current CLO age (Columns 2-4) and CLO size (Columns 3-4), and CCC-share and defaulted-share (Column 4). CLO COVID-19$_c$ is the share of CLO c in industries most vulnerable to COVID-19 – Oil & Gas; Automobiles; Retail; Durable Consumer Goods; Transportation: Cargo; Transportation: Consumer. COVID-19 Shock$_t$ is an indicator variable that takes a value of 1 after the onset of the pandemic, and 0 otherwise. Standard errors are two-way clustered by CLO and month-year.

Appendix B Data Construction of Firm-Level Variables

In this section, I describe the definition of variables.

1. *Debt Growth (long-term)* is defined as the log difference in long-term debt ($\beta ln(\texttt{dlttq})$).
2. *Real Sales Growth* is defined as the log difference in long-term debt ($\beta ln(\frac{\texttt{saleq}}{GDPDEF_{2009}})$), adjusted by a GDP deflator. The GDP deflator is `GDPDEF` series from FRED. All sales values are converted to 2009 dollar terms.
3. *Investment (Capital Stock Growth)* is defined as the log difference of capital stock. For each firm, the initial value of capital stock is equal to the level of gross plant, property and equipment (`ppegt`). This is k_{it+1} for firm i. The evolution of k_{it+1} is computed using changes in net plant, property and equipment (`ppent`). Missing observations of net plant, property, and equipment are estimated, using linear interpolation of values right before and after the observation, only if there are not two or more consecutive missing observations. This definition is used in Ottonello and Winberry (2020).
4. *R&D Growth* is defined as the log difference in R&D expenditures ($\beta ln(\texttt{xrdq})$)
5. *Acquisitions* is the ratio of acquisitions expenditures (`acq`) to total assets (`atq`).
6. *Cash Flow* is the ratio of the operating income before depreciation (`ebitda`) to cash adjusted, total assets (`atq-cheq`).
7. *Employment Growth* is defined as the log difference in employment ($\beta ln(\texttt{emp})$)
8. *Tobin's Q* is the ratio of market value of assets to book value of assets. First, I compute the market value of equity – the product of price close at quarter and common shares outstanding (`prccq` $\times$ `cshoq`). Then, I compute the market value of assets as the sum of the market value of equity, total assets (`atq`), and deferred taxes and investment tax credit (`txditcq`), minus the book value of common stock (`ceqq`). Lastly, I take the ratio of the market value of assets to the book value of assets (`atq`).
9. *Investment Growth* is the difference in the log of capital expenditures (β ln(`capxy`)).
10. *Market-to-Equity* is the ratio of the cash-adjusted market value of equity (`prccq` $\times$ `cshoq` - `cheq`) to cash-adjusted stockholders equity (`teqq` - `cheq`)
11. *Tangibility* is the ratio of capital stock (k_{it}) to the cash-adjusted total assets (`atq-cheq`). The capital stock is defined as described in *Investment*.
12. *Leverage* is the ratio of total debt (`dlcq+dltttq`) to total assets (`atq`).
13. *Profitability* is the return on assets, defined as the ratio of net income (`niq`) to total assets (`atq`).

Appendix C Alternative Strategies to Contractual Arbitrage

This section compares how the gains from contractual arbitrage compare to selling bad, risky assets (Appendix Section C.1) and to non-distressed, high performing assets (Appendix Section C.2).

C.1 Selling Bad, Risky Assets

Let τ denote the stipulated portfolio share of CCC/Caa1 loans, A denote total CLO assets, and L denote total CLO liabilities. Moreover, for simplicity, assume the portfolio has two types of assets – bad, risky assets, and good, risky assets – the sum of which counts toward the CCC/Caa1 limit, τ. The share of bad, risky assets is denoted by b, whereas the share of good, risky assets is denoted by g. This distinction is important; regardless of whether the risky assets are good or bad, they are marked to the lowest market value of the CCC/Caa1 share of loans – the market value associated with the bad assets, β. The market value of the good assets is γ.

Suppose the CLO breaches its limit on CCC/Caa1 loans, i.e., $b+g > \tau$ and $g > \tau$. Selling the bad, risky assets, b from the portfolio at market price β may loosen the capital covenants, under the binding CCC/Caa1 limit. It can improve the capital covenants by $\frac{(g-\tau)(\gamma-\beta)A}{L}$. The new OC/ID ratio is:

$$OC/ID = \frac{(1-(b+g-\tau))A + b\beta A + (g-\tau)\gamma A}{L}. \tag{C.1}$$

Note that the improvement from selling bad, risky assets is less than the improvement from selling good, risky assets. That is:

$$\frac{(g-\tau)(\gamma-\beta)A}{L} < \frac{g(\gamma-\beta)A}{L} \tag{C.2}$$

Hence, sales of good, risky assets improve the covenant more than sales of bad risky assets.

C.2 Selling Good Assets above Book Value

This section considers how the contractual arbitrage hypothesis compares with an alternative strategy in which CLOs sell non-distressed loans at a higher market price than book price. Selling non-distressed loans will not have any effect on the covenant if non-distressed loans are sold at a market price that is equivalent to the accounted value. Selling non-distressed loans can alleviate the covenant if the market price is above the book value.

In the following, I consider the two strategies of selling CCC/Caa1 loans and non-distressed loans. The main takeaway is that selling loan which were bought cheaply can involve a great volume of transactions relative to buying defaulted loans.

Let τ denote the stipulated portfolio share of CCC/Caa1 loans, A denote total CLO assets, and L denote total CLO liabilities. Moreover, for simplicity, assume the portfolio has two types of assets – bad, risky assets, and good, risky assets – the sum of which counts toward the CCC/Caa1 limit, τ. The share of bad, risky assets is denoted by b, whereas the share of good, risky assets is denoted by g. This distinction is important; regardless of whether the risky assets are good or bad, they are marked to the lowest market value of the CCC/Caa1 share of loans – the market value associated with the bad assets, β. The market value of the good assets is γ.

Suppose the CLO breaches its limit on CCC/Caa1 loans, i.e., $b + g > \tau$. Consequently, the capital covenants will tighten and the OC/ID ratio is computed as follows.

$$OC/ID = \frac{(1-(b+g-\tau))A + (b+g-\tau)\beta A}{L}. \tag{C.3}$$

Selling the good, risky assets, g from the portfolio at market price γ may loosen the capital covenants. The new OC/ID ratio is:

$$OC/ID_{CCC} = \frac{(1-(b+g-\tau))A + (b-\tau)\beta A + g\gamma A}{L}. \tag{C.4}$$

Sales of good, risky assets can improve the capital covenants by

$$\frac{g(\gamma-\beta)A}{L} \tag{C.5}$$

In contrast, if the CLO sells a share μ of non-distressed loans at price $\hat{a}$ where $\hat{a}$ is greater than the book value of 1, the OC/ID ratio will be:

$$OC/ID_{Non-Distressed} = \frac{(1-\mu-(b+g-\tau))A + (b+g-\tau)\beta + \hat{a}A}{L} \tag{C.6}$$

Sales of non-distressed assets can improve the capital covenants by

$$\frac{\mu(\hat{a}-1)A}{L} \tag{C.7}$$

The manager will compare Equation C.5 to C.7.

Or:

$$g(\gamma - \beta) \text{ vs. } \mu(\hat{a} - 1)$$

If the CLO manager chooses between selling an equal volume of good CCC/Caa1 loans and non-distressed loans, they will compare:

$$(\gamma - \beta) \text{ vs. } (\hat{a} - 1)$$

Based on the evidence of Figure 6 and Appendix Figure A.10 to the summary statistics on the transaction price of all leveraged loans in CLOs reported in Table 1, it is likely that $\gamma - \beta > \hat{a} - 1$. That is, the difference between the accounted value and market value is likely larger for defaulted loans than non-defaulted loans. For there to be an equivalent impact from selling non-defaulted loans, managers may have to sell a larger share of non-defaulted loans relative to defaulted loans.