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

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Abstract

This paper uses an exogenous industry shock to demonstrate that covenants in debt markets cause spillovers and trigger liquidations of unrelated loans in loan portfolios. Specifically, I show that following a negative shock to the oil and gas (O&G) industry, collateralized loan obligations (CLOs) with exposure to O&G loans are pushed closer to their covenant thresholds and sell non-O&G loans in the secondary market to alleviate these constraints. These sales exert price pressure on the securities of non-O&G firms, creating market dislocations. The erosion in the liquidity positions of exposed firms also spills over into real economic activity. Hence, liquidations originating from covenants may exacerbate credit crunches, by propagating shocks through capital markets.

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1 Introduction

Covenants help resolve incomplete contracting issues. They align incentives (e.g., Rajan and Winton (1995)), allocate control rights (Aghion and Bolton (1992)), and prevent ex post inefficient risk-shifting (Jensen and Meckling (1976)). By contrast, in this paper, I identify the negative consequences of covenants. I show that covenants in collateralized loan obligation (CLO) contracts trigger and exacerbate fire sales, imposing significant social costs. This paper relates to recent work by Elkamhi and Nozawa (2020), who show that idiosyncratic shocks to a firm can trigger a fire sale of its loans. By contrast, I identify the economic mechanism through which covenants transmit and amplify shocks to unrelated firms by propagating shocks through capital markets. When some loans in a CLO experience distress due to an exogenous shock, the CLO will be forced to liquidate other loans issued by firms that are not directly affected by the distress in order to loosen its covenants. This mechanism can cause financial and economic trouble for these "innocent bystanders."

To fix ideas, consider a CLO that is exposed to several industries. Suppose this CLO has a particularly high exposure to the oil and gas industry, as in the empirical setting. If the price of oil and gas plunges, the CLO's covenants tighten. As a result, the CLO is incentivized to liquidate loans issued by firms *not* directly affected by the oil and gas shock. Once this liquidation occurs, the other firms experience fire sale discounts in the secondary and primary markets. These discounts make it more expensive for the firms to access capital markets, which spills over into real economic activity. In this paper, I use a natural experiment to demonstrate this mechanism at play.

I employ a reduced-form instrumental variable strategy to identify this mechanism. Specifically, I use a Bartik-style difference-in-differences identification strategy. I compare the outcomes of (non-oil and gas) firms held in US CLOs with varying exposures to oil and gas (O&G) loans between 2013 and 2015, before and after the O&G price plunge in June 2014. The O&G price plunge is the largest shock to affect the developed CLO market to date. I argue that the O&G price plunge is exogenous and that the matching of firms with CLOs is as good as random, as supported by a battery of tests.[1]

I delineate the causal pathway connecting covenant tightening with fluctuations in asset prices and firm operations, using detailed microdata on the composition of CLO portfolios, along with firm financial and fundamental data. I begin by validating that a CLO's exposure to the O&G industry is related to the tightness of its covenants. When the O&G price plunge

[1]Generally, one is concerned that the incidence of firm distress in a portfolio may be attributed to the correlated omitted characteristics of the fund. Using the variation in oil price changes circumvents concerns of matching between CLOs and portfolio firms to a large extent.

occurs, CLOs with greater ex ante exposure to the O&G industry experience a greater tightening of their covenants relative to CLOs with lower ex-ante exposure. Specifically, a one percentage point increase in the average CLO's share of O&G loans is associated with a 0.22% to 0.52% decline in its distance to the most stringent capital covenant, after the O&G price shock. This is a nontrivial effect. While the median CLO operates within a 4% buffer of the most stringent covenant threshold since the Great Recession, many CLOs have much smaller buffers. In fact, the average CLO was in violation of the most stringent covenant threshold during the O&G price plunge.

The firms that are held by CLOs that become covenant-constrained experience loan sales and price distortions in the secondary loan market. I measure a firm's exposure to the O&G industry through CLOs by taking the average of the firm's exposures to CLOs, weighted by the CLOs' exposures to the O&G industry. I find that firms whose loans are held by CLOs with greater O&G exposure experience greater loan sales, after the O&G price shock. These loan sales exert price pressure. A one percentage point increase in a firm's exposure to the O&G industry through CLOs is associated with a decrease in its loan price by up to 181 bps in the secondary loan market. The dislocation in the secondary loan market passes through to the primary loan market, as I find that a one percentage point increase in a firm's exposure to the O&G industry through CLOs is associated with an increase in the primary loan spread by up to 22 bps. These patterns reveal that limits to arbitrage prevent other participants from frictionlessly absorbing sales by CLOs.[2] These financial market dislocations are persistent and endure long enough to have significant effects on firms' real economic activity. I further explore the role of market liquidity in generating these effects and show that an equal-sized trade in the leveraged loan market exerts a larger impact on secondary loan prices than in more liquid debt markets.

I trace the full chain of events from the oil and gas price plunge to fire sales, and document their effects on real economic activity. As the effective cost of capital for innocent bystanders increases, firms have limited ability to substitute to other sources of financing. Firms whose loans are held by CLOs with greater exposure to the O&G industry draw down lines of credit more aggressively compared to firms with lower exposure. However, the liquidity obtained from lines of credit is insufficient to preserve real activity. The exposed firms make financial and operational adjustments, following a pecking order. The largest reductions are in research and development (R&D) growth and debt growth, followed by acquisitions, cash flow, investment,

[2]See Shleifer and Vishny (1992), Shleifer and Vishny (1997), Gabaix, Krishnamurthy and Vigneron (2007), Mitchell, Pedersen and Pulvino (2007*a*), Chernenko and Sunderam (2012) for theory and evidence on segmented markets and arbitrage.

and employment growth. As a robustness check, I use the COVID-19 pandemic shock instead of the O&G price shock to assess the external validity of the main findings. While identification in this setting is less sharp, I find stronger effects of fire sales during contractionary periods.

Why do covenants create fire sales? CLO managers engage in "contractual arbitrage" to loosen their covenants. CLOs can loosen their covenants by liquidating loans with higher market values than book values. While loans typically have market values lower than their book values, there are instances where the market values exceed the book values, particularly for risky loans. This is because the accounting rules force CLOs to recognize risky loans at values other than their historical cost. For example, defaulted loans are marked to market value or recovery value. Discounted loans are marked at the purchase price until the loan trades above a specified threshold (typically 90¢/$) for more than 30 days, and, all loans in excess of a CCC/Caa1 limit are marked to their market prices, starting with the lowest priced loans.[3] As a result, the liquidation of risky loans enables managers to loosen their covenants by realizing the market values of loans recorded at lower values. Hence, the piecewise nature of covenant design creates contracting frictions and gives rise to contractual arbitrage.

I demonstrate that the fire sales disproportionately impact the most vulnerable firms. I show that CLOs liquidate riskier loans when they experience a tightening of their covenants.[4] These sales are associated with compositional changes. After the O&G price shock, CLOs hold the lower-yielding loans issued by firms with higher O&G exposure and are less likely to hold defaulted loans issued by these firms.[5] This selection helps rationalize the large effects I find in the baseline results. The aggregate declines in debt prices and real economic activity are primarily driven by distressed firms, which experience effects that are over five times as large as the effects experienced by non-distressed firms.

Overall, these findings suggest that CLOs are not a panacea for liquidity problems. I show that the covenants that are necessary to support the CLO funding structure lead to fire sales. These results raise questions regarding the optimal design of financial contracts. One may argue that the observed fire sale effects reflect issues in CLO contracts and addressing this "bug" may remove the perverse effects of covenants. However, an alternative perspective suggests that fire sales are not a bug but rather a feature. The current covenants may be necessary to support the long-term funding structure of CLOs and improve stability relative

[3]Several reports and prospectuses document these rules including Hu Daniel and Saykovskyi (2019); Creditflux (2020); Scaggs (2020); Cioffi (2020); GSO Capital Partners (2020); Fleckenstein (2022).

[4]An alternative hypothesis is that CLOs can generate improvements to par by selling loans that trade above par. I empirically rule out this hypothesis in Section 6.

[5]At the fund level, CLOs with a greater ex-ante exposure to the O&G industry hold a lower share of defaulted loans after the price shock.

to short-term funding, even though liquidity problems are not removed altogether.

1.1 Related Literature

The papers closely related to mine include Elkamhi and Nozawa (2020) and Kundu (2023*b*), who both document that CLOs sell distressed loans, generating price pressure for these loans. For instance, if an O&G firm experiences default, constrained CLOs may sell loans issued by the O&G firm, which in turn exerts price pressure for loans issued by the same O&G firm. By contrast, this paper highlights the spillovers of idiosyncratic shocks to other firms, i.e., if an O&G firm experiences default, constrained CLOs may sell a software company's loans, exerting price pressure for loans issued by the software company. Thus, I delve into a specific mechanism that amplifies idiosyncratic shocks and transmits them to other firms. I also highlight the specific role of covenants in generating fire sales and their consequences on the real economic activity for innocent bystanders.

This paper builds upon empirical papers examining the consequences of covenants in debt contracts. Several of these papers examine the effects of covenant violations on firms' investment and financial policy (e.g., Chava and Roberts (2008*a*); Roberts and Sufi (2009*a*); Roberts and Sufi (2009*b*); Nini, Smith and Sufi (2012); Murfin (2012); Acharya, Almeida and Campello (2013); Acharya et al. (2014); Acharya et al. (2020); Chodorow-Reich and Falato (2022)). These papers show that typically, covenants mitigate agency frictions and firm risk-shifting through restrictions on firm investment and financial policy. I contribute to this literature by providing some of the first evidence that fire sale externalities can originate from covenants.[6] Furthermore, I show that the structure of CLO covenants creates incentives for constrained CLOs to sell riskier loans through contractual arbitrage, in contrast to other intermediaries who typically sell their most liquid loans to minimize selling costs and fire sale discounts.[7]

Broadly, I discuss a novel channel through which fire sales can arise in closed-end funds.

[6] Previous papers on fire sale externalities do not examine how financial contracts contribute to these effects. Theoretically, fire sales may exacerbate the real effects of credit crunches (see Kashyap et al. (2008)). Shleifer and Vishny (2010) show that during fire sales, lower security prices can present investment opportunities to banks that are superior to direct lending, causing banks to forgo funding real activity, creating systemic risk and economic volatility. Diamond and Rajan (2011) show that banks that are active in securities trading may have incentives to keep illiquid securities and increase investments of fire-sold securities akin to underinvestment. Abbassi et al. (2016) empirically show that fire sales in securities markets can have externalities on credit supply through the trading behavior of financial intermediaries. Benmelech and Bergman (2011) show that bankrupt firms impose negative externalities on their non-bankrupt competitors through a collateral channel mechanism – a type of financial accelerator that increases the cost of external debt finance across the industry. Mitchell, Pedersen and Pulvino (2007*b*) and Mitchell and Pulvino (2012) examine the liabilities' side of arbitrageurs' balance sheets and provide evidence of how immediate withdrawals of capital used to finance arbitrage portfolios and the lack of offsetting new capital can lead to a cycle of losses.

[7] See Manconi, Massa and Yasuda (2012) and Irani and Meisenzahl (2017) which document that mutual funds and banks experiencing liquidity shortages are more likely to sell liquid, less informationally-sensitive assets.

Without any contractual provisions, agency problems arise in CLOs like in other closed-end funds.[8] CLOs use covenants within a closed-end structure to address this agency problem. However, this remediation can create fire sale risk like in open-end funds.[9] Hence, the differences in the fund organizational structure cannot eliminate fire sale risk.

Furthermore, I show that a source of market financing, in contrast to relationship financing like bank lending, can affect a firm's financial decisions and real economic activity, due to contracting frictions. Firms operating in informationally sensitive environments cannot readily substitute to other sources of financing. Previous papers on credit supply shocks focus on the role of bank lending relationships on firm outcomes (e.g., Bernanke and Blinder (1988); Bernanke and Gertler (1989); Holmstrom and Tirole (1997); Peek and Rosengren (2000); Khwaja and Mian (2008)).[10] Iyer et al. (2014) show that the credit supply reduction is strongest for smaller firms that cannot compensate the credit crunch with other sources of debt. I emphasize the role of financing frictions in a market-based setting with larger firms. I show that contracting frictions in the CLO market can propagate to firms that cannot substitute to other sources of financing, even at times when other markets are not dislocated. Hence, I show that shocks to CLOs, which are a market-based financing mechanism, can transmit to firms and have real effects.

The paper continues as follows. I explain the institutional setting and contractual arbitrage in Section 2. The data are described in Section 3. In Section 4, I discuss the methodology. I present the main results in Section 5. I explore the underlying mechanism in Section 6. I discuss the robustness tests in Section 7. Lastly, I conclude in Section 8.

2 Institutional Background and Contractual Arbitrage

While covenants support the long-term funding structure of CLOs, they create fire sale risk. In this section, I first describe the mechanics of CLOs and their covenants. I then show

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

[9]Open-end funds address the agency problem as they allow investors to withdraw their capital. This withdrawal is seen as "a form of partial takeover or liquidation which deprives management of control over assets" (Fama and Jensen (1983)). However, the redeemable nature of claims on demand also renders open-end funds vulnerable to fire sales, as evidenced in previous studies (e.g., Coval and Stafford (2007), Mitchell, Pedersen and Pulvino (2007*a*), Jotikasthira, Lundblad and Ramadorai (2012), Choi et al. (2020)).

[10]Bank intermediaries are known to be more efficient at resolving informational asymmetries than the market. See Kashyap, Lamont and Stein (1994); Gertler and Gilchrist (1994); Kashyap and Stein (2000); 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 (2023) for evidence on the propagation of credit supply shocks.

that CLOs can maximize improvements to their covenants by selling loans that exhibit higher market values than their book values. This practice of "contractual arbitrage" can generate fire sales in the leveraged loan market.

A CLO operates as a special purpose vehicle (SPV) that issues tranched asset-backed securities or notes, and uses the proceeds to finance the purchase of an underlying portfolio of leveraged loans. CLOs have covenants to align managerial incentives with their debt investors.[11] I focus on the "capital covenants" of CLOs as CLOs operate closest to these covenants among the coverage covenants. These capital covenants effectively ensure that a CLO is sufficiently collateralized to mitigate the risk of default. In other words, these covenants create cushions for principal losses for more senior tranches.[12]

If the credit quality of loans held in a CLO deteriorates, the capital covenants may bind. Triggering the capital covenants has a detrimental effect on a CLO, as it leads to the diversion of proceeds from the underlying loans away from junior tranches, junior management fees, and equity distributions. Instead, these funds are allocated towards the early repayment of liabilities in order of seniority or the acquisition of "higher-quality" collateral. Coverage covenant violations have significant financial and reputational implications for the CLO manager.[13] However, I show that when the value of loans deteriorates, managers have the ability to undertake certain actions to prevent the triggering of these covenants. Before delving into these actions, I explain how the capital covenants are calculated.

The calculation of the capital covenants relies on determining the value of loans according to a set of accounting rules. The capital covenants — the overcollateralization (OC) and interest diversion (ID) covenants — are measured in a similar manner to leverage. The ID covenant, the most stringent capital covenant, is triggered before all other capital covenants. In the calculation of the ID covenant, loans are typically valued at their par value and are not affected by market fluctuations unless they meet certain risk criteria, such as (1) default, (2) discount

[11] A CLO manager's incentives are most aligned with the equity class as their compensation consists of a fixed fee and series of subordinated fees that are proportional to the residual interest available to the equity class. For a more detailed discussion, see Kundu (2023*a*).

[12] Among the coverage covenants, CLO contracts also include "liquidity covenants" such as interest coverage (IC) covenants. These covenants ensure that there is a specific level of coverage for interest due on tranches relative to the triggers. Aside from the coverage covenants, another class of covenants are "quality covenants." These covenants are maintain-or-improve constraints. If a quality covenant is triggered, the manager must maintain the credit quality of the portfolio. Quality covenants include concentration limits, as well as covenants including weighted average rating factor (WARF), weighted average spread (WAS), and weighted average life (WA Life).

[13] First, fees and payments may be siphoned off from the manager and other junior stakeholders. These constraints may hinder the manager from making portfolio-enhancing trades. 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. Kundu (2023*b*) explores some of the costs of covenant violations.

obligation, or (3) a rating of CCC/Caa1 or below, exceeding the CLO limit. In such cases, the loans' market values often exceed their book values. Defaulted loans are marked at the lower of their market values and recovery values; discount obligations are marked to their purchase prices until they trade above a threshold (typically 90¢/$) for more than 30 days; and loans in excess of a CCC/Caa1 limit are marked at their market values, starting with the lowest priced loans (e.g., Hu Daniel and Saykovskyi (2019); Creditflux (2020); Scaggs (2020); Cioffi (2020); GSO Capital Partners (2020); Fleckenstein (2022)). Equation 1 illustrates the impact of various types of collateral on the calculation of the ID covenant:

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

This piecewise design of covenants significantly influences the incentives of CLO managers in their liquidation behavior. For example, CLOs are generally restricted to having a maximum of 7.5% of their portfolio allocated to CCC/Caa1 rated loans. CCC/Caa1 loans in excess of this limit are marked at their market values, starting with the lowest priced loans. The following example of contractual arbitrage illustrates how CLO managers can take specific actions to loosen their covenants .

Figure 1: CLO Accounting of CCC/Caa1 Loans

(a) CLO with 7.5% CCC/Caa1 Allocation (b) CLO with Excess CCC/Caa1 Allocation

Notes: This figure illustrates an example of how two CLOs account for CCC/Caa1 loans. Both CLOs have a maximum allocation of 7.5% for CCC/Caa1 loans. In Figure 1a, the CLO has 7.5% of its portfolio in CCC/Caa1 loans, and all loans are marked at book value since they are within the limit. In Figure 1b, the CLO exceeds the 7.5% limit with 15% of its assets in CCC/Caa1 loans. Of this 15%, 7.5% have a market value of 20¢/$ and the other 7.5% have a market value of 95¢/$. The excess 7.5% of loans are valued at 20¢/$ in Figure 1b.

Figure 1a illustrates that a CLO holding up to 7.5% of its assets in CCC/Caa1 rated loans values those loans at book value, while Figure 1b illustrates that when a CLO exceeds the 7.5% allocation, for example, by another 7.5%, the excess 7.5% is marked at market value. Notably, these loans are marked at market value starting from those with the lowest market values.

The CLO in Figure 1b can improve its covenants by strategically selling loans with higher market values than book values. Suppose 7.5% of the CCC/Caa1 loans have a market value of 20¢/$ and 7.5% have a market value of at 95¢/$. As the CLO is restricted to having a maximum of 7.5% of its portfolio allocated to CCC/Caa1 rated loans, the excess 7.5% is valued at 20¢/$. By selling the 7.5% portion that trades at 95¢/$, the CLO can realize higher market values and effectively avoid breaching the 7.5% limit. Consequently, this action helps relax the capital covenants. This numerical example is detailed step-by-step in Appendix Section A.1. In Appendix Section A.2, I generalize this example to demonstrate how a CLO can strategically maximize improvements to the capital covenants by selling risky loans that exhibit higher market values than book values, starting from the loans that recover the highest dollar market value. Similar to the case of CCC/Caa1 loans, 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 liquidating the defaulted or discounted loan and realizing its market value. In Section 5, I show that CLOs liquidate positions when their covenants tighten. In Section 6, I come back to these specific incentives and assess whether CLOs liquidate optimally.

3 Data Sources

To establish a causal relationship between covenant tightening and its real consequences, I leverage detailed microdata on the composition of CLO portfolios and their evolution over time. A noteworthy contribution of this paper is the construction of several datasets, which serve to effectively delineate the causal pathway connecting covenant tightening with fluctuations in asset prices and firm operations. To this end, I draw upon a variety of data sources, encompassing financial and firm fundamental data. The primary period of focus for this study spans from 2013 to 2015.

The primary data source is the CreditFlux CLO-i Database, which provides information on 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 covers 52%-68% of the market for my sample period from 2013 to 2015.[14] On average, each issuer's loans are held in 125 CLOs and total to $230 million. I limit my analysis to firms that received a syndicated loan, as indicated in DealScan, to ensure comprehensive coverage across datasets. The processed data covers 1,631 distinct issuers.

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. In addition to primary issuance data, I use the WRDS Bond Database to retrieve information related to bond credit spreads and liquidity, and monthly equity returns from CRSP. The monthly Fama-French five factors are from Kenneth French's website.

For firm characteristics, I use two databases from S&P Capital IQ: Compustat North America (Compustat) and Capital Structure. I describe the construction of firm-level variables in Appendix Section D. 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. In addition, I use Capital Structure data to understand the dynamics of firm liquidity, specifically, data on lines of credit. Both datasets are collapsed to the quarterly frequency.

Lastly, I use time-series macroeconomic data from FRED. I obtain WTI crude oil data from FRED. I use this data to track the start of the oil price plunge from June 2014, as well as price movements.

One significant hurdle is matching firms across datasets. There is no identifying code in the 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. Thus, I manually encode the data and generate several crosswalks between the CLO-i database and other datasets. For completeness and correctness, I verify and supplement matches using 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*b*)).

I summarize the main outcome variables used in this paper in Table 1. The table reports the distribution of CLO and borrower characteristics.

4 Empirical Strategy

This section describes the identification strategy employed to examine how covenant tightening incentivizes CLOs to sell loans as well as the resulting implications of such actions.

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

To fix ideas, consider the following thought experiment of the ideal empirical design, depicted in Figure 2. There are two CLOs operating in two parallel universes: CLO A and CLO B. CLO A and CLO B hold identical portfolios of assets. Suppose that due to a random act of nature, a specific loan held in CLO A is hit by a shock that does not impact the corresponding loan in CLO B. As a result, CLO A's covenants tighten, while CLO B's covenants remain unchanged. Consequently, CLO A and CLO B will have different incentives in liquidating loans. Hence, the question of interest is: If CLO A and CLO B both hold a loan issued by an innocent bystander, WidgetCo, how does the distance to the covenant threshold impact WidgetCo's cost of financing and real economic activity in these parallel universes? Broadly, how do idiosyncratic shocks propagate to other portfolio firms through CLO intermediaries?[15]

4.1 Identification Strategy

I exploit variation from a natural experiment to identify the key mechanism in the experiment described above. Specifically, I use a Bartik-style difference-in-differences (DiD) design (Bartik (1991)). I compare the outcomes of (non-O&G) firms held in CLOs with varying amounts of O&G loans. I examine the changes in firm outcomes before and after the O&G price plunge in June 2014.[16] There are two assumptions underlying this specification: exogeneity of the O&G shock to the leveraged loan and CLO markets, and selection and matching of firms held in CLO portfolios. In other words, the O&G shock was unexpected and higher CLO exposure to the O&G industry is unrelated to the composition of the rest of the portfolio. I explain why these assumptions are plausible in the subsequent subsections.

Under these assumptions, I identify the effect of O&G exposure on CLO outcomes around

[15] A microcosm of the empirical setting is presented in Appendix Figure C.1, demonstrating how idiosyncratic risk may amplify to systemic risk. The diagram illustrates the bidirectional transmission of shocks between firms and CLOs. Firms are interlinked through CLOs, with links representing the mutual impact of firm performance on CLO cash flows and the potential transmission of CLO distress to firms (left figure). If a firm experiences severe distress, indicated by the red outer circle, it could trigger a tightening of the associated CLO covenants, marked in pink (center figure). Consequently, the CLO manager may preemptively address this by divesting loans issued by the distressed firm, causing the red firm to become detached from the CLO in the diagram. In this scenario, the CLO manager may also sell loans unrelated to the source of distress – loans issued by innocent bystanders with no direct exposure – to create slack in the covenants. These sales are depicted by the pink firms with dashed connections to the CLO (right figure). While these sales may alleviate CLO covenants, they may potentially contribute to future distress (bottom figure).

[16] The incidence of firm distress may be correlated with omitted characteristics of the associated CLO. Using the variation in oil price changes circumvents concerns of matching between CLOs and portfolio firms. This is discussed later in Section 4.3.

the O&G price plunge using the following:

$$
\begin{aligned}
Y_{c,t} &= \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t \\
&\quad + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \gamma_0' X_c + \epsilon_{c,t},
\end{aligned} \tag{2}
$$

where c denotes the CLO, t denotes the time, and X denotes the vector of controls, consisting of age, size, defaulted share, and CCC-share. CLO O&G Exposure_c is the O&G share of CLO c, reported before the O&G shock occurs, and Oil Shock_t is an indicator variable that takes a value of 1 after the O&G price plunge, and is 0 otherwise. $Y_{c,t}$ is CLO covenant tightness, which is the distance to the ID threshold, measured as the natural-log ratio of the covenant value to the covenant threshold.

I then turn to the firm level to understand how (non-O&G) firms' outcomes are affected based on their exposure to the O&G industry through CLOs. I first construct firms' exposures to the O&G industry by weighting each firm's exposure to CLOs by the CLOs' exposures to the O&G industry before the price shock in June 2014.

$$
\text{Firm O\&G Exposure}_f = \sum_{c \in C} \underbrace{\left(\frac{\sum_{k \in K} \mathcal{L}_{f,k,c}}{\sum_{c \in C} \sum_{k \in K} \mathcal{L}_{f,k,c}} \right)}_{\text{Firm exposure to CLO}} \times \underbrace{\left(\frac{\sum_{f \in F} \sum_{k \in K} L_{O\&G,f,k,c}}{\sum_{i \in I} \sum_{f \in F} \sum_{k \in K} L_{i,f,k,c}} \right)}_{\text{CLO exposure to O\&G}} \tag{3}
$$

where $L_{i,k,f,c}$ 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.

I then investigate the impact of non-O&G firms' outcomes based on their exposure to the O&G industry through CLOs, using the following:

$$
\begin{aligned}
Y_{f,t} &= \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t \\
&\quad + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_f + \alpha_{m,y} + \epsilon_{f,t},
\end{aligned} \tag{4}
$$

where Firm O&G Exposure_f is measured before the price shock occurs. Oil Shock_t is an indicator variable that takes a value of 1 after the O&G price plunge, and is 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" to refer to to a non-O&G firm's exposure to the O&G industry through CLOs.

The sample period of study is 2013-2015, which is a window around the O&G price plunge.[17] In the remainder of this section, I discuss the assumptions underlying the methodology and address related concerns.

4.2 Exogeneity of O&G Shock

A concern with the identification strategy is the exogeneity of the O&G price shock to the CLO and leveraged loan markets. If the O&G shock is not exogenous, it may be correlated with the errors, causing the estimator to be inconsistent. In this section, I argue that the O&G price plunge is exogenous.

Figure 3 exhibits the average crude oil price ($ per barrel) from 1960 through 2020.[18] The oil price precipitously dropped in June 2014. The plunge lasted until 2016, making this 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)).[19]

Several major factors contributed to the price plunge. First, booming shale production in the United States and improvements in fracking technology reduced the break-even prices of shale production.[20] Specifically, post-crisis financing conditions facilitated developments in hydraulic fracking and horizontal drilling, improving oil extraction.[21] Given the shorter life cycle of these projects and lower capital cost relative to conventional extracting methods, shale production presented itself as a viable substitute to conventional crude production in the wake of the price plunge as it is more elastic to oil price changes than crude oil (Baffes et al. (2015); Krane and Agerton (2015); McCracken (2015)). Second, OPEC announced a shift in policy, renouncing price targeting in November 2014, partly, in response to the increasing shale share of the global oil supply. The oil price experienced a 51% decrease in the following 83 days after the announcement (Baffes et al. (2016)). Third, receding geopolitical tensions allowed oil production to function without disruption or conflict, hence, supply remained steady. Fourth, the appreciation of the US dollar beginning in June 2014 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)). Although some demand shocks also occurred contemporaneously, for example, the stock market turbulence in China reduced demand for oil, consensus has formed

[17] The analysis is robust to a wider sample period. The oil and gas price plunge began in June 2014 and ended in December 2015. I focus on this window to create equal pre and post periods.

[18] See Appendix Figure C.2 for the monthly crude oil price trend.

[19] A plot of monthly crude oil prices from 2012-2018 is available in Appendix Figure C.2.

[20] For example, shale production in the United States totalled 2,116 billion cubic feet in 2008. It increased to 13,447 billion cubic feet in 2014. See data from the US Energy Information Administration.

[21] Other developments that increased oil extraction include increased biofuel production and extraction from Canadian oil sands.

around supply-driven factors as dominant contributors to the oil price plunge (e.g., Arezki and Blanchard (2014); Hamilton (2014)). While I cannot identify the exact root cause of the O&G shock among these mechanisms, all of these explanations share a common characteristic: they are unrelated to the leveraged loan and CLO markets, which is what is needed for the identification strategy to be valid.

4.3 Selection and Matching of CLO Portfolios

Another potential concern with the identification strategy may be 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 well as differences in the concentration of investment across industries and geographies. I show that concerns of selection are minute.

First, I assess the presence of selection by examining pre-existing trends. I examine whether the relationship between O&G exposure and firm outcomes is driven by pre-trends that occurred before the O&G price decline. I study the relation between: (1) the price of a secondary loan issued by a non-O&G firm and the non-O&G firm's O&G exposure through CLOs, and, (2) the distance to the ID threshold and CLO O&G exposure. The findings in Figure 4 are consistent with the parallel trends assumption. Prior to the shock, the relationships between a firm's O&G exposure and the secondary price of its loans, and, a CLO's O&G exposure and its distance to the ID threshold, are statistically indistinguishable from the last pre-treatment period. The 95% confidence intervals include the null in the period before the shock.

Furthermore, I conduct a thorough investigation to assess the prevalence of selection concerns. I find the following: (1) portfolios largely overlap across CLOs, (2) the ID threshold does not vary with O&G exposure before the shock, (3) there are negligible differences in the distribution of investments across non-O&G industries before the shock, (4) there are negligible differences in the geographic distribution of investments across states before the shock, (5), there are no material differences in firm characteristics across CLOs of differing O&G exposure, and (6), a firm's sensitivity to the oil price cannot predict selection into a CLO with higher of lower O&G exposure. See Appendix Section B for details of the tests.

5 Results

This section reports the main findings of the paper. I present direct evidence that CLOs exposed to O&G experience covenant tightening after the O&G shock. I show that CLOs with greater exposure to O&G sell a greater volume of loans. These fire sales have extensive implications for asset prices across security markets as well as real economic activity.

5.1 O&G and CLO Covenant Tightness

The O&G price plunge in June 2014 resulted in a significant tightening of the covenants faced by CLO managers, reaching levels last observed during the aftermath of the Great Recession. Figure 5 shows the distance to the ID threshold from 2009 through 2020. I identify the ID covenant as the covenant with the lowest threshold. The average CLO breached the covenant threshold after the O&G price plunge. This finding is consistent with anecdotal reports.[22] Appendix Figure C.5 provides supporting evidence that distress in the O&G industry led to downgrades in credit ratings which, in turn, tightens CLO covenants.[23]

I further examine the relation between a CLO's exposure to the O&G industry and its distance to the ID threshold, according to the specification of Equation 2 in Table 2. I account for differences in CLO specialization, risk aversion, taste, reputation, sophistication, and style through manager and CLO fixed effects. Quantitatively, I find that a 1 pp increase in a CLO's ex ante O&G share is associated with a 0.52% decline in the distance to the ID threshold, after the shock, using a within manager estimator.[24] I augment this specification in columns (2)-(6) using control variables and higher dimension fixed effects. CLO controls are added to the specification for columns (2)-(4), including CLO age (columns (2)-(4)), CLO size (columns (3)-(4)), and the share of CCC loans and defaulted loans (column (4)). I further account for aggregate shocks using year fixed effects (column (2)) and month-year fixed effects (columns (3)-(4)). The results in columns (2)-(4) are consistent with the baseline estimate of column (1), indicating that a 1 pp increase in a CLO's ex ante O&G share is associated with 0.42% to 0.51% decline in the distance to the ID threshold. I next employ a within-CLO estimator and show

[22]In October 2015, the O&G sector accounted for the largest share of distressed collateral in US CLOs, and the percentage of loans trading below 90¢/$ (a typical threshold for discount obligations) reached its highest level up to that point (Haunss (2015)). In this period, the average mark of the O&G loans in CLO portfolios was around 80¢/$ and the lowest priced loans were marked below 40¢/$; approximately 22% of the US loan exposure to O&G was marked below 70¢/$, 11% below 60¢/$ and 8% below 50¢/$ (Sallerson (2015)).The average O&G loan prices for Vantage Drilling Company, Samson Resources Corporation, Sabine Oil & Gas, Ascent Resources, LLC. were 39.4¢/$, 15.9 ¢/$, and 20.7 ¢/$, 26.5 ¢/$ (Sallerson (2015)).

[23]I find that approximately, 40% (30%) of O&G loans reported a double-B rating, 55% (60%) reported a single-B rating, and 5% (10%) reported a rating of Caa1 or below. The percentage of defaulted O&G loans increased by 33 times during this period.

[24]The distance to the ID covenant threshold is the ratio of the covenant result to the covenant threshold.

in columns (5) and (6) that the point estimate remains statistically significant, although the magnitude diminishes.[25] Next, I explain that the magnitude of the decline in the distance to the ID threshold is significant considering the narrow buffer within which CLOs operate.

Notably, between 2009 and 2020, I find that the median CLO operated with a buffer of only 4% of the covenant threshold, which means that the O&G shock affected up to 13% of the average buffer. While the median CLO operates within 4% of the ID covenant threshold (see Table 1), many CLOs operate with much smaller buffers. For instance, assuming uniform shocks to asset values of between +4% and -4%, a 4% buffer can eliminate the risk of default. However, a buffer of 3.6% implies a 5% probability of default, which is high enough that managers may take preemptive actions to prevent liquidation. Of course, this argument depends on the distribution of shocks. Therefore, I quantify this relation and show that the O&G shock meaningfully increases the probability that a CLO violates a covenant. Appendix Table C.4 shows that a 1 pp increase in a CLO's ex ante O&G is associated with a 3.10 pp to 4.51 pp increase in the likelihood that a CLO violates the ID covenant for the first time in at least six months.

Furthermore, these estimates serve as a lower bound of the effect. I show that the magnitude of the effect grows over time in Figure 4b. This figure shows the relation between a CLO's O&G exposure and its distance to the ID threshold, in six-month increments around the shock. The figure shows that in the pre-shock period, CLOs with greater exposure to O&G operate farther away from the Interest Diversion threshold, relative to CLOs with lower exposure to O&G.[26] In the post-shock period, I find that the relation between a CLO's O&G exposure and its distance to the ID threshold exhibits a negative relation. An increase in a CLO's ex ante exposure to O&G is associated with a sharp tightening of the covenant after the shock. This magnitude grows for several months.

Lastly, CLO liquidation incentives depend on the proximity to the covenant threshold. As the potential impact of the O&G shock is unknown ex ante, CLO managers often preemptively make portfolio adjustments.[27] Overall, these findings suggest that the O&G shock provides a substantial source of variation that affects CLO covenants and their liquidation incentives.

[25] The control variables are measured prior to the price plunge and, therefore, absorbed by CLO fixed effects in the specifications of columns (5) and (6).

[26] This is consistent with the findings in Appendix Figure C.6 and Appendix Figure C.7, which show that O&G loans exhibit higher ratings than non-O&G loans and yield higher returns relative to their rating category, in the pre-shock period. Appendix Figure C.6 indicates that O&G loans exhibited higher ratings than non-O&G loans in the pre-shock period; 40% of O&G loans reported a double-B rating compared to 21% of non-O&G loans. Appendix Figure C.7 shows that the O&G loans yielded higher returns than non-O&G loans for each rating category that O&G loans were active in, in the pre-shock period. These findings reflect the boom and bust nature of the O&G industry.

[27] Indeed, CLOs preemptively sell distressed loans several months before default is even realized (Kundu (2023*b*)).

5.2 Fire Sales of Non-O&G Loans

Once CLO covenants tighten, they begin liquidating loans. I show that the amount of selling increases in the degree of constraint, as reflected by O&G exposure, after the shock. Firms with higher O&G exposure through CLOs experience greater CLO sales in the secondary loan market. In this section, I examine trades at the transaction, CLO-issuer, and issuer levels to identify systematic sales.

I begin by studying the relation between firm O&G exposure and its transaction volume around the O&G price plunge to identify CLO sales in Table 3, according to the empirical specification of Equation 4. The outcome variable is in dollar units. The transaction amount is negative (positive) if the transaction is a sale (purchase). In the specification for column (1), I do not include any fixed effects. In the specifications for columns (2)-(6), I add additional fixed effects including manager, rating-industry, issuer-loan type, year, and month-year fixed effects to account for potential confounders. I find that the point estimate remains negative, statistically significant, and economically meaningful even after saturating the model with high dimensional fixed effects. Specifically, across all estimates, I find that a 1 pp increase in a firm's exposure to O&G is associated with a \$148K to \$251K decline in the transaction amount, after the shock. This is a substantial decline, as it represents 0.11 to 0.19 standard deviations of the transaction amount.

To study whether these patterns hold at a coarser level, 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 and present the results from this estimation in Appendix Table C.5. Consistent with the previous findings at the transaction level, I find that firms with greater O&G exposure experience larger declines in the net transaction amount after the shock. These results remain statistically significant at the issuer-level as well, as reported in Appendix Table C.6.

However, it is important to note that a decrease in the transaction amount at the transaction, CLO-issuer and issuer levels does not necessarily imply greater sales. In fact, reduced purchases can also lead to similar outcomes. 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 in Appendix Table C.7. The results in columns (4)-(6) corroborate the hypothesis that CLO selling pressure increases with the O&G exposure after the shock. Moreover, the positive relation between purchases and O&G exposure counter the conjecture that the effect is driven by a decrease in purchases. Hence, this robust finding shows that firms with greater exposure to constrained CLOs experience greater liquidations in the secondary loan market. In other words, CLOs with tighter covenants sell more issued by innocent bystanders.

5.3 Implications for Asset Prices

CLO liquidations in the secondary loan market generate price dislocations across capital markets. In this section, I investigate the price impact resulting from the liquidation by CLOs following covenant tightening. I show that 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 pass through to other securities such as primary loans. I find evidence of limited substitution to corporate bonds.

The identifying assumption 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.). I include time fixed effects to control for common shocks. Later, in Section 7.5, I confirm that the findings are not driven by changes in firm fundamentals or bank regulatory constraints that may be correlated with CLO covenants through two falsification exercises.

5.3.1 Secondary Loan Prices

As marginal investors in the secondary loan market, CLO liquidations are expected to influence prices. Consistent with this conjecture, I find that secondary loans issued by firms with greater exposures to O&G, trade at lower prices, relative to firms with lesser exposures to O&G in the secondary loan market.

I examine examines 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, according to Equation 4. In the specification for column (1), I do not include any fixed effects. The results show 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.[28] In the specifications for columns (2)-(6),

[28]In the pre-shock period, 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 cycles of O&G, consistent with the trading patterns before and after the shock in Table 3. This is further illustrated in Figure 4 and Appendix Figures C.6 and C.7, which show that in the pre-shock period, O&G loans outperformed their non-O&G counterparts. Loan purchases are higher when O&G prices are higher, as shown in Appendix Tables C.5, C.6 and C.7. Hence, debt securities issued by innocent bystanders exhibit higher price volatility when CLOs have larger exposure to more volatile sectors, such as O&G. Appendix Figure C.10 presents the findings using the log-transformed oil price instead of an indicator for the price plunge. The figure shows that as the O&G

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 to better identify the effect of CLO covenant tightness on asset prices. In columns (2)-(6), I find that a 1 pp increase in a firm's exposure to O&G is associated with a \$0.61 to \$1.80 decline in the secondary loan price. Further, the point estimates are statistically significant across all specifications. Given concerns of the potential skewness of trading prices, I show that the results are robust to the natural log transformation of the transaction price in Appendix Table C.8; a 1 pp increase in a firm's exposure to O&G is associated with a 0.81% to 2.54% decline in the secondary loan price. Hence, after the shock, secondary loans issued by firms with greater exposures to O&G, trade at lower prices than firms with lesser exposures to O&G.

Moreover, these effects are persistent. Figure 4a shows that the decline in the secondary loan prices reaches a trough 18 months after the price plunge. Thereafter, the point estimate attenuates in magnitude and the confidence intervals widen over time. Hence, the transaction amount declines in firms' exposure to O&G, after the shock. I come back to this finding in Section 5.3.4 where I demonstrate that asset prices exhibit greater sensitivity to a given volume of trades in the leveraged loan market compared to more liquid debt markets.

5.3.2 Primary Loan Prices

In this section, I examine whether the dislocation in the secondary loan spread passes through to the primary loan market. Table 5 shows how the spread associated with refinancing primary institutional loans varies with O&G exposure, according to Equation 4.[29] The outcome variable is the all-in-drawn spread, defined as the total annual spread above LIBOR for each dollar drawn from a loan.[30] In the specifications for 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 CLO covenant tightness. These include issuer, secured status, purpose, distribution method, seniority, loan type, country of syndication, year, and month-year fixed effects. In columns (1)-(5), I find that a 1 pp increase in a firm's exposure to O&G is associated with a 18 to 22 bps increase in the primary loan spread after the shock. This represents a change of 4.18% to 5.10% of the average loan spread. Despite the relatively small sample, I find strong significance across all specifications. This finding shows that firms that

price is higher, firms with greater O&G exposure experience greater net purchases, higher secondary loan prices, and lower all-in-drawn spread.

[29] A term loan is deemed to be an institutional loan if it is not a term loan A facility.

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

refinance after the shock face higher term loan spreads if they had greater exposure to the O&G industry through CLOs prior to the shock.

I further study how the non-price terms of loan contracts vary with O&G exposure after the shock to determine whether there are adjustments in other dimensions. Appendix Table C.9 shows that a 1 pp increase in a firm's exposure to O&G is associated with a decrease in the loan maturity of four to five months, after the shock. This point estimate is negative, statistically significant, economically meaningful, and stable across all specifications. Appendix Table C.10 shows that a 1 pp increase in a firm's exposure to O&G is associated with a 4.67% to 7.66% decrease in the loan amount 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.

5.3.3 Corporate Bond Spreads

Faced with difficulties in the loan market, the innocent bystanders should naturally turn to the bond market. I show that their ability to do so is limited. The limited investor base for syndicated loans creates segmented markets, inhibiting arbitrage (e.g., Shleifer and Vishny (1992); Shleifer and Vishny (1997); Gabaix, Krishnamurthy and Vigneron (2007); Mitchell, Pedersen and Pulvino (2007*a*)); Chernenko and Sunderam (2012)). In addition, a limited share of leveraged loan issuers have access to the bond market, hindering substitution to other sources of external financing.

I empirically test this proposition and examine the sensitivity of bond credit spreads to firm O&G exposure around the O&G price plunge, according to Equation 4. In the specifications for Appendix Table C.11, I include issuer and bond-type fixed effects to exploit the temporal variation within issuer. In the specifications for columns (2)-(6), I account for various dimensions of bond heterogeneity including the time-to-maturity, security-level credit rating, investment-grade status, and default 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 a 28 to 36 bps increase in the bond credit spread after the shock. This represents a 8.35% to 10.74% change in the average bond credit spread. In addition, bond liquidity deteriorates with firms' exposure to O&G, after the shock (see Appendix Table C.12). Thus, due to imperfect substitution between markets, the bond market does not offer better financing terms than the primary and secondary loan markets.

5.3.4 Persistence and Liquidity

Thus far, I have traced the chain of events linking CLO loan sales to price effects. Nevertheless, two questions still remain: (1) Do these effects persist long enough to have significant repercussions to firms, and (2) if so, why? In this section, I address these questions.

I assess the persistence of the price shock across capital markets to establish the plausibility of the link between financial market dislocations and real effects to borrowers (Section 5.4.2). To this end, I conduct several Jordà style linear projections, as shown in Figure 6. I estimate the coefficients in the figures using the following regression:

$$
\begin{aligned}
Y_{f,t+h} - Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure}_f \times \text{Post}_t) + \beta_2\text{Firm O\&G Exposure}_f \\
+ \beta_3\text{Post}_t + \alpha_f + \alpha_y + \epsilon_{f,t}. \qquad (5)
\end{aligned}
$$

The outcome variables ($Y_{f,t}$) 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.

Figures 6a and 6b show the response of secondary loan prices and bond credit spreads to the shock. The findings show that asset prices fall and spreads rise for four quarters after the initial shock. Then, an inflection occurs, at which point asset prices begin to rise and credit spreads begin to fall, reverting towards zero after seven quarters. This pattern is consistent with the trend analysis shown in Figure 4. In addition, the depression in prices persists long enough to have a material impact on firms, as discussed further in Section 5.4.2. I find that asset prices start declining from the onset of the shock, while firm characteristics respond after a delay.

The persistence of the effects may be attributed to financial frictions that can amplify the depth and duration of deviation of asset prices and credit spreads.[31] For example, limits to arbitrage may prevent other participants from frictionlessly absorbing sales by CLOs.[32] I explore the role of market liquidity in affecting the relation between loan sales and price impact. I measure the illiquidity of the leveraged loan market, using an Amihud-type price impact measure (Amihud (2002)). The Amihud measure relates the price impact to the volume

[31] 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)).

[32] The most natural buyers of leveraged loans — other CLOs — are unable to absorb excess supply, due to similar binding constraints as a result of portfolio overlap; 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)).

of a trade. I hypothesize that firms with greater exposure to O&G experience a larger liquidity premium after the shock as reflected by the Amihud measure. A higher Amihud measure is indicative of higher illiquidity, and implies that the price moves to a greater extent for a given volume of trades. In Appendix Table C.13, I examine the relation between a firm's exposure to O&G and an Amihud price impact measure. I construct the Amihud price impact measure using the ratio of the absolute value of the loan discount (bps) to the net sale amount in millions (negative for purchases). I find that a 1 pp increase in a firm's O&G exposure is associated with a 180 bps/$mln to 404 bps/$mln increase in the Amihud price impact measure, after the shock. In other words, under a 1 pp increase in a firm's O&G exposure, selling $1 million of a loan shifts the price by 180 to 404 bps, after the shock. This is substantially higher than the Amihud measure for even the most illiquid corporate bonds during the Great Recession. Benmelech and Bergman (2018) report that the median Amihud measure is 57.7 bps with 25$^{\text{th}}$ and 75$^{\text{th}}$ percentile values of 18 bps and 159 bps during the Great Recession, respectively. Friewald, Jankowitsch and Subrahmanyam (2012) report a similar range between October 2004 and December 2008 — the median Amihud measure is 38 bps with 25$^{\text{th}}$ and 75$^{\text{th}}$ percentile values of 10 bps and 130 bps, respectively; the 95$^{\text{th}}$ measure is 260.7 bps. Hence, an equal-sized trade in the leveraged loan market exerts a larger impact on prices than in more liquid debt markets.

5.4 Implications for Firms

Thus far, I have documented that fire sales originating from CLO covenants exert price pressure across security markets. In this section, I examine whether persistent market dislocations have significant effects on firms. I show that as the liquidated firms struggle to find financing, they cut down their real activity. Specifically, I show that credit market dislocations erode the liquidity positions of exposed firms and affect firm real activity.

5.4.1 Impact on Firm Liquidity

As their effective cost of capital increases, firms substitute away from external sources of funding and are more aggressive in drawing down their existing lines of credit. I show that firms' O&G exposures affect an important component of corporate liquidity management around the O&G price plunge — the amount of credit available through lines of credit.

Table 6 reports the results, according to Equation 4. The outcome variable in the specifications for columns (1)-(3) is the change in the unused line of credit. The outcome variable in the specifications for columns (4)-(6) is the change in the drawn line of credit. I employ a within issuer estimator in the regressions for all columns. I also control for aggregate shocks and sectoral differences through year fixed effects in the specifications for columns (2) and (4), and industry and quarter-year fixed effects in columns (3) and (6). I find robust results across all specifications. I find that firms with a greater exposure to the O&G industry draw down their lines of credit at a faster rate, after the shock. As a result, they experience larger declines in the quarterly change in the unused line of credit and larger increases in the quarterly change in the drawn line of credit. Thus, as firms' effective cost of capital increases, firms are more aggressive in drawing down liquidity from their existing lines of credit.

5.4.2 Impact on Firm Real Activity

However, the liquidity obtained from lines of credit is insufficient to fully substitute for other forms of credit and preserve real economic activity. As a result, firms with greater exposure to the O&G industry adjust their operations accordingly.

Table 7 provides the results of an examination of how firms' exposure to O&G through CLOs affects various financial and real outcomes of firms, according to Equation 4. In columns (1)-(6), I examine the effect of firms' exposure to O&G on long-term debt growth, cash flow, acquisitions, investment, R&D growth, and employment growth, respectively.[33] I include issuer, industry, and quarter-year fixed effects for all the specifications. I find that a 1 pp increase in a firm's exposure to O&G is associated with a 1.11 pp (0.04 standard deviations) decline in long-term debt growth, a 0.50 pp (0.03 standard deviations) decline in cash flow, a 0.65 pp (0.05 standard deviations) decline in acquisitions, a 0.40 pp (0.04 standard deviations) decline in investment, a 2.75 pp (0.09 standard deviations) decline in R&D growth, and a 0.35 pp (0.04 standard deviations) decline in employment growth, after the shock. These point estimates are statistically significant and suggest that firms' long-term debt growth and various measures of investment are most external financing dependent, followed by cash flow and employment growth. Although the magnitudes are small, it is surprising that contracting frictions in a market-based setting have any impact on firms at all.

Moreover, to establish a plausible link between financial market dislocations and real effects to borrowers, I conduct Jordà style linear projections. The linear projections in Figures 6c and 6d show that firm characteristics exhibit a delayed response to the O&G shock, unlike asset prices which react instantaneously, as explained in Section 5.3.4. Leverage, for instance, takes approximately four quarters to react, followed by a subsequent reversal that becomes apparent after seven quarters. Similarly, investment experiences a decline beginning two months after the initial shock and continues to decrease until the seventh quarter, after which

[33]The construction of these variables is described in Appendix Section D.

it gradually converges towards zero. Thus, the market dislocations persist long enough for the real effects to materialize. These findings suggest that a temporary episode of distress can damage firms for a longer-term — an externality of "short-termist" damage control.

The persistent real effects raise concerns of the extent to which firms are vulnerable through exposure to CLOs compared to other organizational structures. Specifically, are firms more susceptible to cross-firm spillovers through CLO structures compared to bond mutual funds or banks? In the bond mutual fund setting, 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 in the bond credit spread.[34] In the bank lending setting, Chodorow-Reich (2014) finds that employment at the precrisis clients of lenders at the 10th percentile of bank health fell by 4 pp to 5 pp more than clients at the 90th percentile. By contrast, I find that the employment of issuers at the 10th percentile of CLO O&G exposure fell by 1.66 pp more than issuers at the 90th percentile. Hence, the effect through CLOs is two to three times smaller than that of banks. Together, these results suggest that firms are more exposed to cross-firm spillovers through CLO structures than through other arm's-length intermediaries, but less so than through banks.

Overall, I find that disruptions in the leveraged loan market have non-trivial effects on financial markets and firm activity. There are two main reasons that the baseline estimates may be understated. First, in the baseline analysis, I consider all non-O&G firms. However, not all non-O&G firms are equally likely to be innocent bystanders. Later, in Section 6, I explore the underlying mechanism and provide evidence that firms that are more likely to be innocent bystanders experience significantly larger effects. Second, I conduct my analysis for a relatively benign macroeconomic episode when financial markets were tranquil and relatively liquid. I conduct the analysis using the COVID-19 shock for external validity in Section 7.7 and show that the potential impact of the shock is larger when markets are illiquid.

6 Mechanism: Contractual Arbitrage and CLO Portfolio Effects

Loan sales help improve CLO covenants. CLOs have the choice to sell a variety of loans. The optimal strategy for a CLO to improve its covenants is to divest risky loans first. I provide evidence in support of this conjecture, strengthening the contractual arbitrage mechanism. The

[34] 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 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.

finding that risky, illiquid loans are sold first helps explain the large magnitude of the baseline effects and their persistent nature, as explained in Section 5.

In this section, I examine the distribution of prices for distressed loans to better understand whether the conditions for a sale via contractual arbitrage are likely to be met. Figure 7 presents the cumulative distribution function (CDF) and probability density function (PDF) of CCC/Caa1 loan prices during the smaple period. The figures indicate that most CCC/Caa1 loans report a market price above 90¢/$. The average price of a CCC/Caa1 loans is 85¢/$; the 25th and 75th percentile values are 80¢/$ and 99¢/$. However, the cheapest CCC/Caa1 loan held in each CLO is priced at 58¢/$ on average; the 25th and 75th percentile values are 34¢/$ and 85¢/$. 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 in Appendix Figure C.8, providing further evidence that the market prices of distressed loans frequently exceed the projected recovery rate on bank loans.[35] These findings suggest that the conditions for a loan sale via contractual arbitrage are likely to be met, allowing CLO managers to loosen their covenants.

Next, I examine how the likelihood of selling risky loans varies with firm exposure to the O&G industry around the O&G price plunge. In Panel A of Table 8, I examine how the likelihood of selling a loan that trades above par varies with firm O&G exposure around the price plunge. The outcome variable takes a value of 1 if the loan that is sold trades above $100 per $100 of par, and 0, otherwise. In Panel B of Table 8, I examine how the likelihood of selling a loan that trades below par varies with firm O&G exposure around the price plunge. The outcome variable takes a value of 1 if the loan that is sold trades below $90 per $100 of par (typical threshold for discount obligations), and 0, otherwise. I include combinations of rating-industry, issuer-loan type, year, and month-year fixed effects 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 with the tightness of their covenants. In other words, an increase in a firm's exposure to O&G is associated with a decrease in the probability of selling loans above par and an increase in the probability of selling discount obligations, after the shock. Hence, these results rule out an alternative hypothesis that CLOs generate improvements to par by systematically selling loans that trade above par.[36]

[35] Chen, Wang and Zhang (2019) report that the overall recovery rate associated with leveraged loans is 59.5%. According to Appendix Figure C.8, almost 30% of defaulted loans report a market price above 60 ¢/$ in the sample period.

[36] Moreover, because loans are floating rate and frequently refinanced, it is uncommon for loans to trade above par for an extended period of time. Further, replicating the par gains generated by contractual arbitrage by

To further substantiate the selling of riskier loans by CLOs, I investigate the compositional changes in CLO portfolios. The extensive sales of riskier loans lead to significant compositional changes in CLO portfolios, aligning with the derisking motives of the covenants. I start by examining whether the interest rate associated with individual loans held in CLO portfolios changes with firm exposure to the O&G industry around the shock. As this analysis is conducted at a more granular portfolio level, I augment the baseline specification in Equation 4 with high-dimension fixed effects. I use 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 regression specification takes the following form,

$$\begin{aligned} Y_{i,c,t} &= \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t \\ &\quad + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 Z_i + \gamma_0 X_c + \alpha_{l,f,c} + \alpha_{m,y} + \epsilon_{i,c,t} \end{aligned} \tag{6}$$

where $Y_{i,c,t}$ 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 is 0 otherwise.

Indeed, consistent with motives of derisking, in Table 9, I find that CLOs experience compositional changes after the shock. The results suggest that CLOs hold the lower-yielding loans issued by firms with higher O&G exposure after the O&G shock. As the interest rate partly reflects loan default risk, this finding suggests that CLOs hold fewer risky loans issued by the firms with higher O&G exposure, after the shock. As a more direct measure of portfolio risk, I examine whether the incidence and amount of risky loans changes with exposure to the shock. 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 10. The outcome variable takes a value of 1 if the loan defaulted, and is 0, otherwise.[37] The results indicate that CLOs are less likely to hold defaulted loans issued by firms with higher O&G exposures after the shock. I further

selling non-distressed loans at a price above par can involve a greater volume of transactions. Other alternative mechanisms include injecting equity in the CLO by deleveraging the debt stack or increasing reinvestment activities to increase the par value of portfolio. These alternative strategies are *consequences* of violating the ID and OC covenants and are costly to managers. See Kundu (2023*b*) for evidence that the effective costs of covenant breaches can be larger than the costs of fire sales.

[37] 82% 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.

show that these findings are consistent at the fund level in Table 11, in which I use the share of defaulted loans, a continuous measure as the outcome variable. Overall, these results suggest that CLOs appropriately derisk as they approach their covenant thresholds.[38]

The liquidation of distressed loans leads to more pronounced financial and real effects for the segment of distressed firms. I define a firm as distressed if it has defaulted on a loan in the sample period and is otherwise non-distressed. I compare the effects on the secondary loan price, all-in-spread drawn, and investment for distressed and non-distressed firms in Table 12. The estimates indicate that distressed firms drive the declines in the secondary loan price, the all-in-spread drawn, and investment. A 1 pp increase in a distressed firm's exposure to O&G is associated with a decline of 2.32 pp in the secondary loan price (per $100 par), a 56 bps increase in the all-in-spread drawn, and a 1.28 pp decline in investment, after the shock. In contrast to the estimates produced for non-distressed firms, the point estimates for distressed firms are economically meaningful; they are more than five times as large as the effects experienced by non-distressed firms and are statistically significant.[39]

Together, these findings shed light on the underlying dynamics of financial contracts. The design of CLO covenants incentivizes contractual arbitrage, thereby inducing CLOs to prudently manage risks as they approach their covenant thresholds. However, an unintended consequence of this design is fire sale risk — a significant externality.

7 Robustness

I conduct a series of tests to ensure the robustness of the findings. First, I employ a cross-sectional approach, demonstrating that the level effects corroborate the difference effects used in the baseline empirical analysis. Second, I apply an IV strategy to show that CLO covenants are the source of cross-firm spillovers. Third, I conduct two falsification tests to dispel the concern that the findings may reflect changes in firm fundamentals or bank constraints. Fourth, I report the results of a placebo test that addresses whether the results may be driven by omitted variable bias. Fifth, 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.

[38] An alternative hypothesis 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 Appendix Figure C.9. The percent 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.

[39] The statistical significance of the differences between these two sets of estimates is assessed in Appendix Table C.16.

7.1 Cross-Sectional Strategy

I employ a Bartik-style difference-in-differences (DiD) design to estimate the causal effect of covenant tightness. The advantage of this technique is that it exploits both time-series and cross-sectional variation to measure the differences between treatment and control groups over time. This design mitigates the effects of selection bias and omitted variable bias that afflict cross-sectional studies, allowing for a tighter identification of the effects. To supplement the baseline analysis, I use a cross-sectional approach to estimate the effect in levels, based on the findings of Section 4 — the change in oil prices was unexpected and matching between firms and CLOs is unrelated to exposure to oil prices. I restrict the cross-sectional approach to the post-shock period. As before, the main variable of interest is firm exposure to the O&G industry. The estimates in Appendix Table C.17 indicate that there is a negative relation between O&G exposure and the distance to the ID covenant, loan transaction amount, loan transaction price, and the all-in-spread drawn.[40] Thus, the level effects reflected in the cross-sectional estimates corroborate the difference effects reflected in the baseline specification.

7.2 Instrumental Variable Strategy

I employ a reduced-form IV strategy to show that CLO covenants induce cross-firm spillovers. The key advantage of this empirical strategy over a two-stage least squares (2SLS) instrumental variable strategy is that identification follows from the differential exogenous exposure to the O&G shock following Goldsmith-Pinkham, Sorkin and Swift (2020). By contrast, the IV and 2SLS estimations rely on stronger assumptions.[41]

Nonetheless, to corroborate that covenants are the source of cross-firm spillovers, I present the IV and 2SLS estimates in Appendix Table C.18. 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. Column (1) presents the results from an OLS regression of the transaction amount on a measure of exposure to the CLO ID covenant. Column (2) presents the reduced-form IV result for comparison. Columns (3) and (4) present the results from a 2SLS strategy. All specifications include issuer-loan type and month-year fixed effects. I find that the relation between the firms' exposure to the CLO covenant and the transaction amount are statistically significant at the 1% level. Hence, the IV and 2SLS results support the reduced-form IV strategy.

[40] A limitation of this analysis is that I cannot include CLO fixed effects in column 1 or issuer fixed effects in columns 2 through 4.

[41] Firms' exposure to the CLO covenant may be correlated with omitted characteristics of the fund. Moreover, O&G exposure may affect non-O&G firms through channels other than the covenant channel after the price plunge.

7.3 Mismeasurement of O&G Exposure

I next investigate whether the main effects are sensitive to the measurement of O&G exposure. In Appendix Table C.19, I verify the results are robust to alternative measures of firm exposure to O&G. In the specifications for columns (1)-(3), a firm's exposure is measured as the equal-weighted average O&G share across all CLOs. In columns (4)-(6), a firm's exposure is measured as the loan-frequency equal-weighted average O&G share across all CLOs.[42] In columns (7)-(9), a firm's exposure is measured as the loan-frequency value-weighted average O&G share across all CLOs. Lastly, in columns (9)-(12), a firm's exposure is measured as the loan-amount value-weighted average O&G share across all CLOs. The results are robust to these alternative measures of firm exposure.

Lastly, I consider how the results differ under an alternative empirical specification in which I directly use a continuous measure of the oil price instead of an indicator for the price plunge. To do this, I directly use the log transformed oil price. In Appendix Figure C.10, 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. The figure shows that as the O&G price is higher, firms with greater O&G exposure experience higher net purchases, higher secondary loan prices and a lower all-in-spread drawn. Conversely, when the O&G price is lower, firms with greater O&G exposure experience lower net purchases, lower secondary loan prices, and higher all-in-spread drawn.

7.4 Heterogeneous Effects by Firm Dependence on CLOs

In this robustness analysis, I investigate how firms' dependence on the CLO market for funding impacts the baseline findings. To estimate the CLO share of firms' total debt, I employ holdings data.

First, I study the relationship between firms' exposure to the O&G industry and the growth in firms' CLO debt around the O&G price plunge. I collapse holdings across CLO portfolios and aggregate them to the firm level to estimate the relation between a firm's O&G exposure and the growth of its CLO debt around the O&G price plunge. Appendix Table C.20 reports the results. The relation between a firm's O&G exposure and the growth of its CLO debt is negative and stable across all columns.

I next leverage the cross-sectional variation in the holdings data to explore the distributional effects across firms with varying vulnerability levels. I use two measures to construct firm

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

vulnerability: (1) firm exposure to O&G, and (2) dependence on CLOs. Taken together, these measures reflect the relative importance of CLO covenants to firms. Column (4) in Appendix Table C.21 shows that consistent with contractual arbitrage, the relation between firms' exposure to the O&G industry and the growth in firms' CLO debt is negative, economically large, and statistically significant among firms with high O&G exposure and high dependence on CLOs. This estimate is almost twice as large as the baseline estimate of Appendix Table C.20. In addition, firms that exhibit low O&G exposure or low dependence on CLOs are virtually unaffected, 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.

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

One may be concerned that the baseline findings reflect changes in firm fundamentals or changes in bank constraints. However, any systemic effect of the O&G price plunge is reflected in the *Post* variable. To further rule out these concerns, I conduct two falsification tests.

In the first falsification test, I examine 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 should also increase for these facilities in response to changes in demand. If the findings are driven by CLO covenant tightness, the all-in-spread drawn should not change with firm O&G exposure, after the shock. The results in Appendix Table C.22 do not show any robust evidence of an increase in the all-in-spread drawn for revolving lines of credit and/or term loans A.

In the second falsification test, I examine whether firms' exposure to the CLO covenant may be confounded by their exposure to bank constraints. Specifically, I examine how a firm's all-in-spread undrawn for revolving lines of credit varies with its O&G exposure. If firms' exposure to bank constraints is correlated with their exposure to the CLO covenant via O&G, the all-in-spread undrawn should change with firms' O&G exposure, after the shock. The results in Appendix Table C.23 do not show any robust evidence of a change in the all-in-spread undrawn for revolving lines of credit.

7.6 Placebo Tests and Omitted Variable Bias

I next examine 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 main regression specifications. Appendix Figure C.11 presents the main findings. The outcome variable is the transaction amount in Appendix Figure C.11a, secondary loan price in Appendix Figure C.11b, and the all-in-spread drawn in Appendix Figure C.11c. The "true" point estimates from the baseline regressions lie outside of the figures. I assess the statistical significance of the test of the null hypothesis that the mean is equal to zero in each of the placebo analyses. The *t*-statistics for the tests of the null hypothesis are -0.1022, -0.7503 and 0.7690 in Appendix Figures C.11a, C.11b, and C.11c, respectively. Hence, the null cannot be rejected in any case. This confirms that OVB does not drive the results; firm exposure to O&G and the price plunge are important for the findings.

7.7 External Validity

In this section, I examine whether the proposed mechanism can be externally validated. I focus on a relatively benign macroeconomic period: 2013-2015. During this period, financial markets were calm and relatively liquid. Although the effects from a financially tranquil period are temperate, it raises concerns of the potential effects when markets are illiquid, during times of stress. As 90% of CLOs are exposed to the top 50 US borrowers, and 80% are exposed to the top five borrowers, the effects may be especially damaging if borrowers simultaneously default and impose negative externalities on other unrelated firms held in CLO portfolios (Financial Stability Board (2019)). Therefore, I replicate the baseline analysis using the COVID-19 pandemic as a 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.

I limit the analysis to January 1, 2020 to May 6, 2020 as Foley-Fisher, Gorton and Verani (2020) highlight 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 Appendix Table C.24.[43] In Appendix Table C.25, I validate that CLO exposure to these most vulnerable industries affects the distance to the ID threshold.

As in the baseline analysis, I examine how the secondary loan price varies for firms that are not in the affected industry, as designated by the column header. The results in Appendix

[43]For a complete description of the industries, see Moody's 35 Industry Categories.

Table C.24 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 estimates across all columns are larger in magnitude than that of the baseline table. Hence, price pressure is expected to be larger under more adverse shocks.

8 Conclusion

In this paper, I show that contracting frictions in the CLO market can amplify idiosyncratic shocks. CLO covenants tighten in response to adverse shocks. The piecewise nature of the accounting associated with CLO covenants can induce CLO managers to sell unrelated, riskier loans in their portfolios to alleviate their covenants. I find that following the O&G price plunge in June 2014, CLOs with exposure to O&G loans are pushed closer to their covenant thresholds and fire-sell unrelated loans in the secondary loan market to alleviate these constraints. These fire sales exert price pressure on the securities of unrelated firms, creating market distortions. The erosion in the liquidity positions of exposed firms spills over into real economic activity. The consequences of contractual arbitrage raise concerns of systemic risk. Given the illiquidity of corporate debt markets, including the secondary loan market, large sales have substantial financial and real effects. Hence, fire sales originating from the CLO market may exacerbate credit crunches, by propagating shocks through capital markets.

These results challenge the prevailing notion that CLOs are inherently resilient to fire sales as a result of their stable funding. I demonstrate that covenants – the remediation designed to address the agency problem within the closed-end structure – can generate price pressure, and potentially amplify fire sale risk and increase the social costs associated with fire sales. This finding questions the extent to which CLOs can effectively withstand and mitigate the risks associated with fire sales. 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

(a) Unconstrained (b) Constrained

Figure 2: Thought Experiment

Notes: The figure illustrates the thought experiment underlying the empirical strategy. There are two CLOs operating in two parallel universes: CLO A and CLO B. CLO A and CLO B hold portfolios of assets that are nearly identical. The only distinguishing factor is that CLO B has a large exposure to assets from a one specific issuer, whereas CLO A has no exposure to that issuer. In the event that the issuer defaults and its assets lose value CLO B's covenants will tighten; the red shading signifies default and the pink shading signifies constraint. However, CLO A will remain unconstrained. The objective is to study how the outcomes to an innocent bystander, represented in yellow, is affected by the degree of covenant tightening in these two parallel universes.

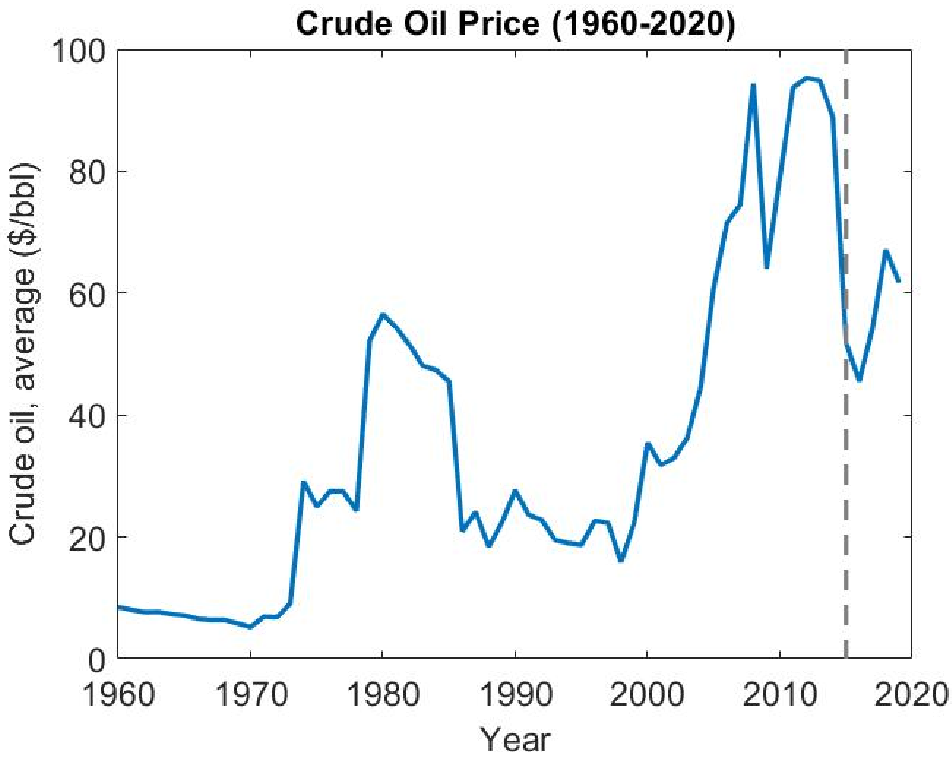
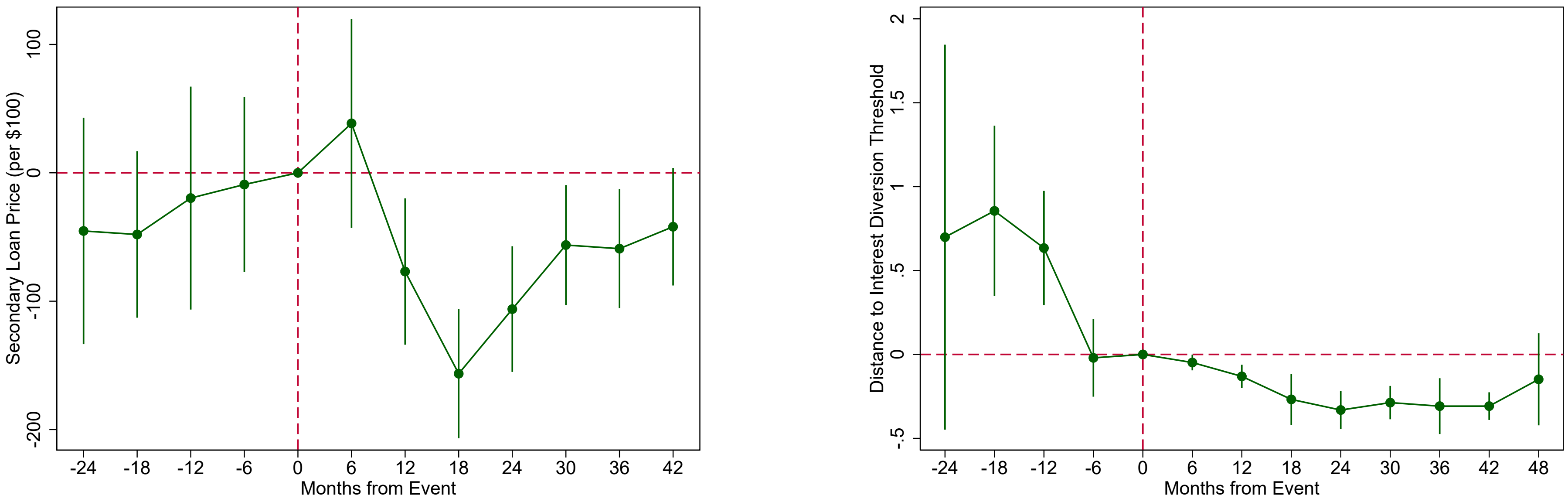


Figure 3: Crude Oil Price (1960-2020)

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 Appendix Figure C.2. Source: FRED.



(a) Secondary Loan Price

(b) Distance to Interest Diversion Threshold

Figure 4: Assessment of Pre-Trends: Secondary Loan Price and Distance to Interest Diversion Threshold

Notes: The figures present pre-trends. The baseline specifications of Figures 4a and Figure 4b 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 4a) and distance to the Interest Diversion threshold (Figure 4b). Standard errors are two-way clustered by CLO × issuer and month-year in Figure 4a. Standard errors are two-way clustered by CLO and month-year in Figure 4b.

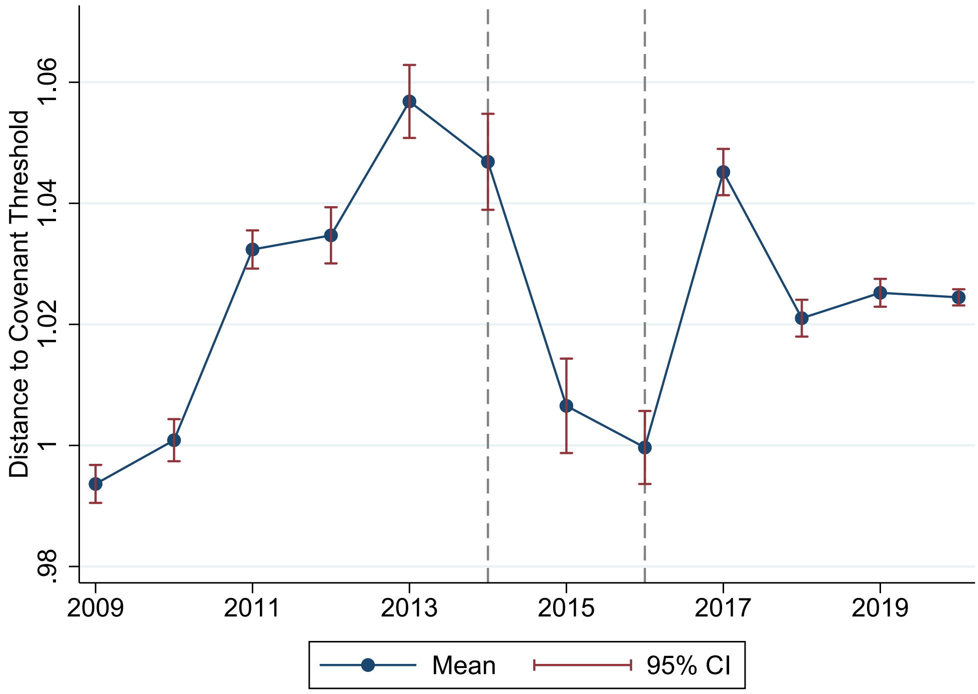
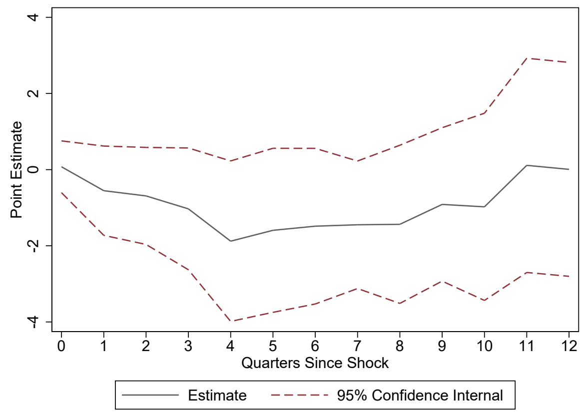
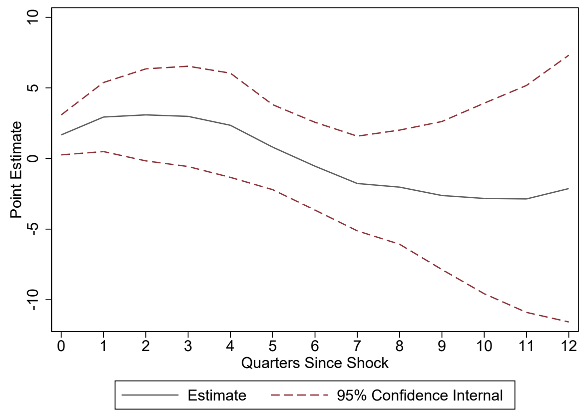


Figure 5: Time Series of Distance to Capital Covenant (2009-2020)

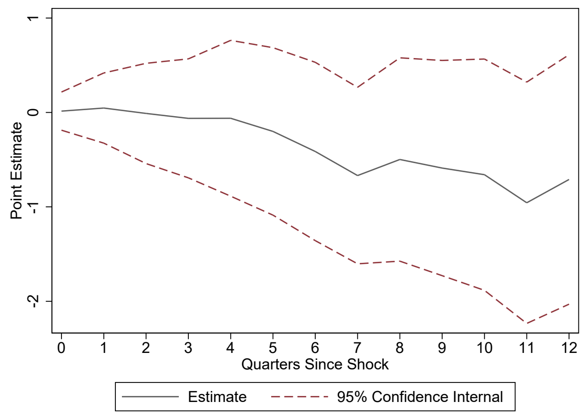
Notes: The figure shows the distance to the most stringent capital covenant from 2009 through 2020. The most stringent capital covenant is identified as the capital covenant with the lowest threshold. The distance to the most stringent capital covenant threshold is measured as the as the ratio of the 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.



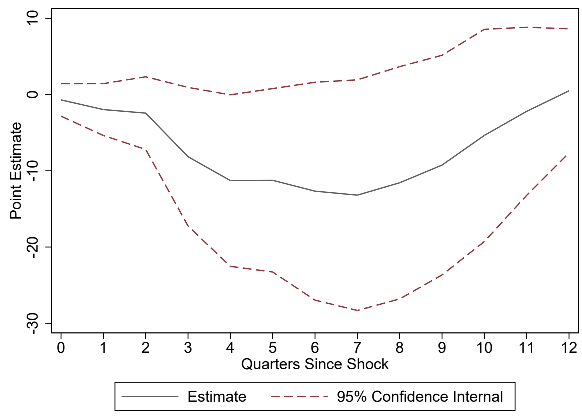
(a) Secondary Loan Price



(b) Bond Yield



(c) Leverage

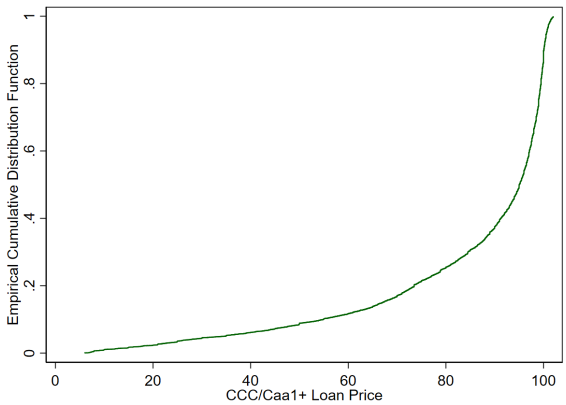


(d) Investment

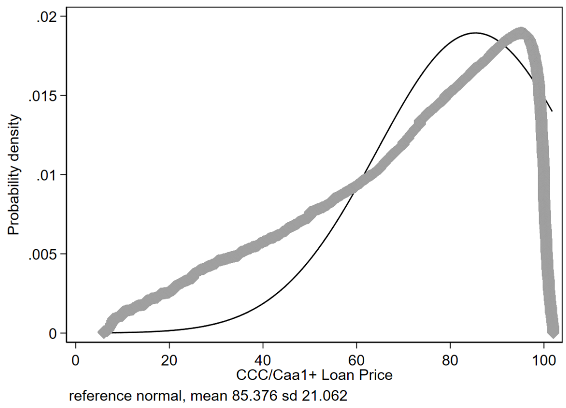
Figure 6: Heterogeneous Dynamics in Response to O&G Shock: Jordà Linear Projections

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 6a. Standard errors are clustered by issuer in Figures 6b, 6c. and 6d.

Figure 7: 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 7a presents the CDF of CCC/Caa1 loan prices. Figure 7b 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.

9.2 Tables

Table 1: Summary Statistics

	N	Q1	Median	Q3	Mean	Std. Dev.
Dist. to ID Covenant ($\frac{\text{Covenant Result}}{\text{Covenant Threshold}}$)	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	99.0000	99.7500	100.0000	97.6138	9.4910
All-in-Drawn Spread (Term Loans)	1,515	325.0000	400.0000	500.0000	431.2657	185.8061
Facility Maturity (Term Loans)	1,529	59.0000	72.0000	84.0000	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
ΔUnused Line	2,097	-0.0056	0.0000	0.0041	0.0002	0.0325
Δ Drawn Line	2,092	0.0000	0.0000	0.0000	0.0007	0.0254
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
R&D Growth	519	-0.0540	0.0179	0.0975	0.0209	0.3168
Acquisitions	2,895	0.0000	0.0000	0.0042	0.0273	0.0987
Investment/Capital	2,985	-0.0090	0.0030	0.0236	0.0185	0.0932
ln(Employment)	2,958	0.8771	1.6605	2.8332	1.8660	1.2155
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} percentile value, median, 75^{th} percentile 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	-0.5176***	-0.4221***	-0.4793***	-0.5138***	-0.2271***	-0.2161**
	(0.1418)	(0.1409)	(0.1133)	(0.1145)	(0.0824)	(0.0829)
O&G Share	-0.1790	-0.0404	0.1079	0.4484*		
	(0.4010)	(0.2760)	(0.1875)	(0.2571)		
Post	0.0211***	0.0110			0.0093***	
	(0.0070)	(0.0066)			(0.0033)	
CLO Controls		✓	✓	✓		
CLO FE					✓	✓
Manager FE	✓	✓	✓	✓		
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	1,856	1,856	1,856	1,856	1,856	1,856
R^2	0.3569	0.3951	0.4301	0.4640	0.8424	0.8491

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 threshold ($ln(\frac{\text{Current Value)}}{\text{Current Threshold}})$ 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 ($ mn)					
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-14.8359***	-14.8884***	-14.8744***	-25.0884***	-19.7271***	-20.7458***
	(3.9476)	(3.9785)	(3.7936)	(3.5876)	(3.7639)	(3.6870)
O&G Share	12.1741***	12.2735***	12.1685***	25.1241***		
	(3.2751)	(3.3001)	(3.2086)	(2.9362)		
Post	0.2135*	0.2986**			0.3551***	
	(0.1104)	(0.1209)			(0.1149)	
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-Spread Drawn				
	(1)	(2)	(3)	(4)	(5)
O&G Share × 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-drawn spread (bps) of loan i at time t, issued by firm f ($i \in f \in \text{CLO } c$), 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: Firm Liquidity and O&G Exposure

	Credit Line					
	ΔUnused			ΔUsed		
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-0.1123*	-0.1122*	-0.1126*	0.1011**	0.1008**	0.1004**
	(0.0571)	(0.0571)	(0.0577)	(0.0495)	(0.0496)	(0.0500)
Post	0.0031*	0.0024		-0.0023	-0.0039*	
	(0.0018)	(0.0024)		(0.0018)	(0.0022)	
Issuer FE	✓	✓	✓	✓	✓	✓
Industry 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 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 7: Firm Adjustments and O&G Exposure

	Debt Growth	Cash Flow	Acquisitions	Investment	R&D Growth	Emp. Growth
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share $\times$ Post	-1.1162*	-0.4994*	-0.4589*	-0.3997*	-2.7501***	-0.3543**
	(0.6523)	(0.2577)	(0.2493)	(0.2224)	(0.9311)	(0.1726)
Issuer FE	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓	✓	✓
N	2,867	2,860	2,883	2,981	518	2,899
R^2	0.1117	0.8981	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 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), acquisitions (Column 3), investment (Column 4), R&D growth (Column 5), and employment growth (Column 6). Standard errors are clustered by issuer.

Table 8: 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 $\mathbb{1}_{(price \lesseqgtr p)_{i,t}} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{f,l} + \gamma_0 Z_f + \alpha_{m,y} + \epsilon_{i,t}$ where $\mathbb{1}_{(price \lesseqgtr p)_i,t}$ 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 9: 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 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 Interest Rate$_{i,c,t}$ 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 10: 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 $\mathbb{1}_{(\text{defaulted loan})i,c,t}$ 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 11: 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 12: Comparison of Effects by Risk and O&G Exposure

	Secondary Loan Price		All-In-Spread Drawn		Investment	
	Non-Distressed	Distressed	Non-Distressed	Distressed	Non-Distressed	Distressed
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	33.7732	-232.3941***	1088.0890	5648.7368*	-0.2244	-1.2826**
	(29.5111)	(72.8425)	(732.2927)	(2883.8527)	(0.2214)	(0.5328)
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-drawn spread 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 Contractual Arbitrage

A.1 Numerical Example

This section demonstrates that the piecewise design of covenants significantly influences the incentives of CLO managers in their liquidation behavior. I show that CLOs can maximize improvements to the capital covenants by strategically selling loans with higher market values than book values. Consider the following illustration of how CLO managers can participate in *contractual arbitrage*. In the numerical example that follows, 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.

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. Before distress settles in:

$$ID = 1. \tag{A.1}$$

Now consider that distress settles in such that:

- Share of good risky assets, g, is 7.5%
- Share of of bad risky assets, b, is 7.5%
- Market price of good, risky assets, γ is 95 ¢/$
- Market price of bad, risky assets, β, is 20 ¢/$

Now, the total share of (good and bad) risky assets sums to 15%, exceeding the 7.5% threshold. Consequently, the capital covenant will tighten. Specifically, the ID ratio will be:

$$ID = \frac{(1-(0.15-0.075))100 + (0.15-0.075)0.20 \times 100}{100} \tag{A.2}$$

$$ID = \boxed{0.9400} \tag{A.3}$$

Now, if the CLO sells all of the good, risky assets, total share of risky assets no longer exceeds the 7.5% threshold. Hence, the ID ratio will be:

$$ID = \frac{(1-(0.075))100 + (0.075)0.95}{100} \tag{A.4}$$

$$ID = \boxed{0.99625} \tag{A.5}$$

I generalize this numerical example in Appendix Section A.2 to demonstrate 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 liquidating the defaulted or discounted loan and realizing its market value. The implications of contractual arbitrage are discussed in Section 6.

A.2 General Case

Let τ denote the stipulated portfolio share of CCC/Caa1 loans, A denote total CLO assets, and L denote total CLO liabilities. Assume that A consists of N discrete assets with the same initial book value of \$1.

The initial OC/ID ratio is the following.

$$OC/ID = \frac{N}{L} \tag{A.6}$$

Suppose that n of these assets become risky such that the CLO breaches its CCC/Caa1 limit. That is,

$$\frac{n}{N} > \tau \tag{A.7}$$

Let $\{\beta_1, \beta_2, \ldots, \beta_n\}$ be the set of risky assets, ordered by their market values such that $\beta_i \leq \beta_{i+1}$ and $t = N - n$. The OC/ID ratio is then the following.

$$OC/ID = \frac{(N-t) + \sum_{i=1}^{t} \beta_i}{L} \tag{A.8}$$

The manager can sell t assets to satisfy the CCC/Caa1 limit. I compare the covenant outcomes when the manager sells t assets, starting from the first element to the last element and from the last element to the first element.

If the manager starts from the first element, the OC/ID covenant is equivalent to holding onto the loans:

$$OC/ID_{ascending} = \frac{(N-t) + \sum_{i=1}^{t} \beta_i}{L} \tag{A.9}$$

If the manager starts from the last element, the OC/ID covenant is the following.

$$OC/ID_{descending} = \frac{(N-t) + \sum_{i=n-t+1}^{n} \beta_i}{L} \tag{A.10}$$

Because the set is ordered, the following expression is true.

$$OC/ID_{ascending} \geq OC/ID_{descending} \tag{A.11}$$

Hence, the manager is incentivized to sell risky loans with the highest market values.

Appendix B Selection and Matching of CLO Portfolios

This section assesses the magnitude of selection concerns, underlying the empirical strategy.

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 of 2008 (Kundu (2023*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 Appendix Table C.1, I study whether the ID threshold and sectoral exposure are related. Specifically, I examine the relationship between O&G exposure and the ID threshold 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.[44] I do not find stable or statistically significant point estimates. These findings suggest that there is no relation between O&G exposure and the covenant threshold. Further, as the CLO covenant threshold cannot be renegotiated, it is unlikely to be endogenous to a CLO's subsequent investment decisions and trading behavior.

Third, there are negligible differences in the distribution of investments across non-O&G industries before the shock, as demonstrated in Appendix Figure C.3. I compare CLOs with high O&G exposure – CLOs with O&G exposure above the 75$^{\text{th}}$ percentile – to CLOs with low O&G exposure – CLOs with O&G exposure below the 25$^{\text{th}}$ 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 of the difference in O&G. 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 exposure.[45]

Fourth, I compare the geographic concentration of investment for CLOs with high O&G

[44] I report robust standard errors – there is no time series variation and there is one observation per CLO.

[45] The industry Herfindahl-Hirschman 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. The Euclidean distance between the two vectors of the

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 in Appendix Figure C.4. 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.[46]

Fifth, I draw comparisons of observable firm characteristics between CLOs with high O&G exposure and CLOs with low O&G exposure. 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 in Appendix Table C.2. 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. There are not material differences in firm characteristics across CLOs of differing O&G exposure.

Sixth, I directly test whether firm sensitivity to oil price affects CLO selection. There may be a concern that CLOs with high O&G exposure hold other loans which covary negatively with the price of oil. In Appendix Table C.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. Further, the R^2 associated with the simple OLS regression in column 1 is virtually nil. Hence, I rule out concerns of portfolio hedging with respect to O&G exposure.

In summary, these results suggest the following. CLOs hold largely overlapping portfolios. Firm, sectoral and geographic characteristics of CLO portfolios with different O&G exposures are largely similar. 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. In other words, a

industry share of firms held in CLOs with high and low CLO O&G exposure is 0.0473. The Kolmogorov-Smirnov test for equality of distribution functions fails to reject the null hypothesis, with a p-value of 1.00.

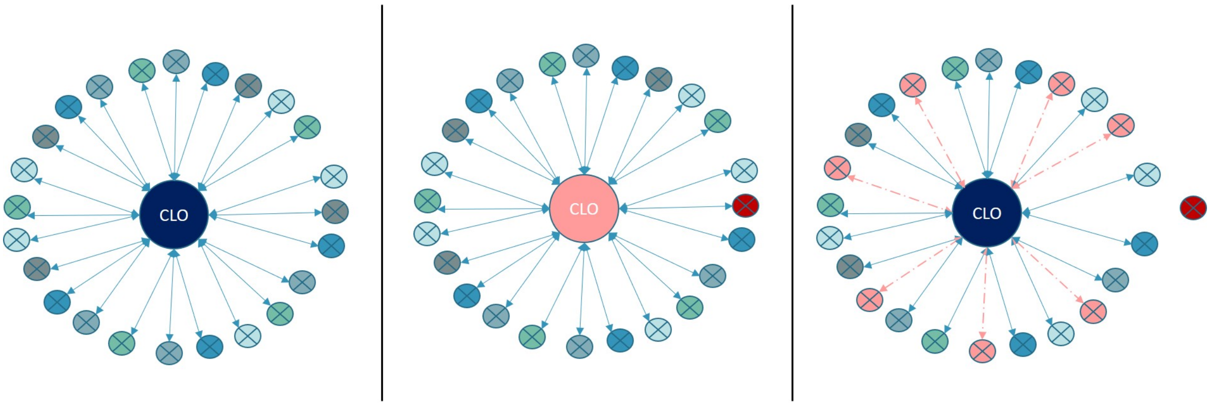
[46]The state Herfindahl-Hirschman Index (HHI) is 0.00501 for CLOs with high O&G exposure and 0.0493 for CLOs with low O&G exposure for non-O&G industries. The Euclidean distance between the two vectors of the state share of firms held in CLOs with high and low CLO O&G exposure is 0.0494. The Kolmogorov-Smirnov test for equality of distribution functions fails to reject the null hypothesis, with a p-value of 0.57.

CLO portfolio may be considered a combination of two distinct portfolios: a portfolio of O&G loans, and, the "market" portfolio – a portfolio of non-O&G loans. Variation in O&G exposure depends on how managers weigh the trade-off between enhancing arbitrage and default risk (Ashton (2020)). This is consistent with the findings of Appendix Figure C.6 and Appendix Figure C.7, which indicate that O&G loans exhibited higher ratings than non-O&G loans yet yielded higher returns than non-O&G loans in each rating category.

Appendix C Figures and Tables

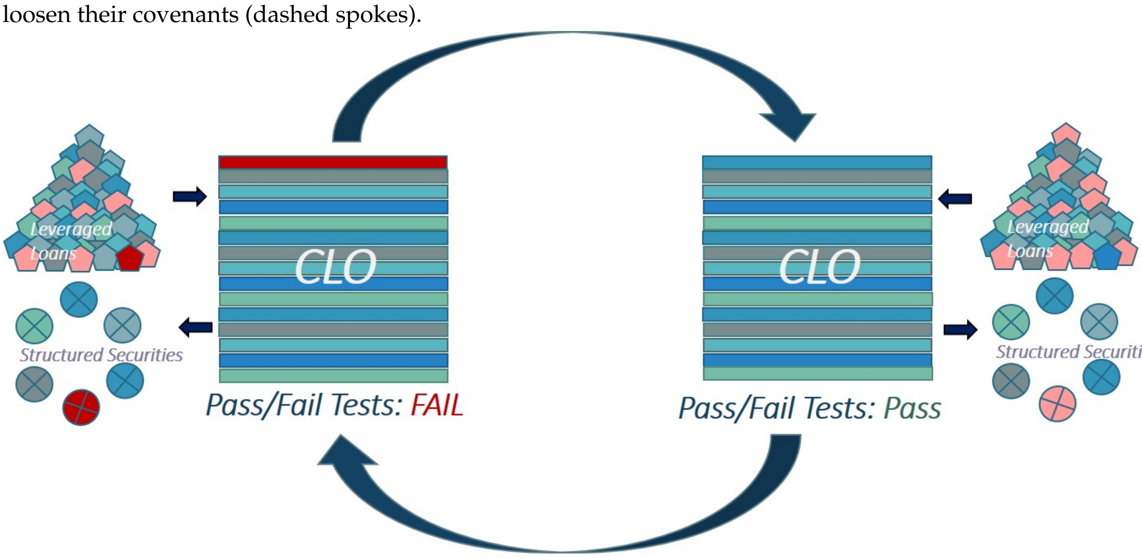
C.1 Figures

Figure C.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 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), the CLO may become constrained (pink). 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 will also sell other risky loans (pink) to loosen their covenants (dashed spokes).



(b) Cycle of Distress

Notes: The figure demonstrates the link between CLO covenants and the quality of leveraged loans. The CLO is in violation of its covenant because of defaulting loans, signified in red (left figure). The CLO may loosen its covenant by divesting itself of the loan in distress and selling other, unrelated loans (pink color). This may allow the CLO to satisfy the covenants (right figure). However, CLOs fire sales may increase the cost of financing to innocent bystanders which may lead these pink firms further into distress, like in the left figure.

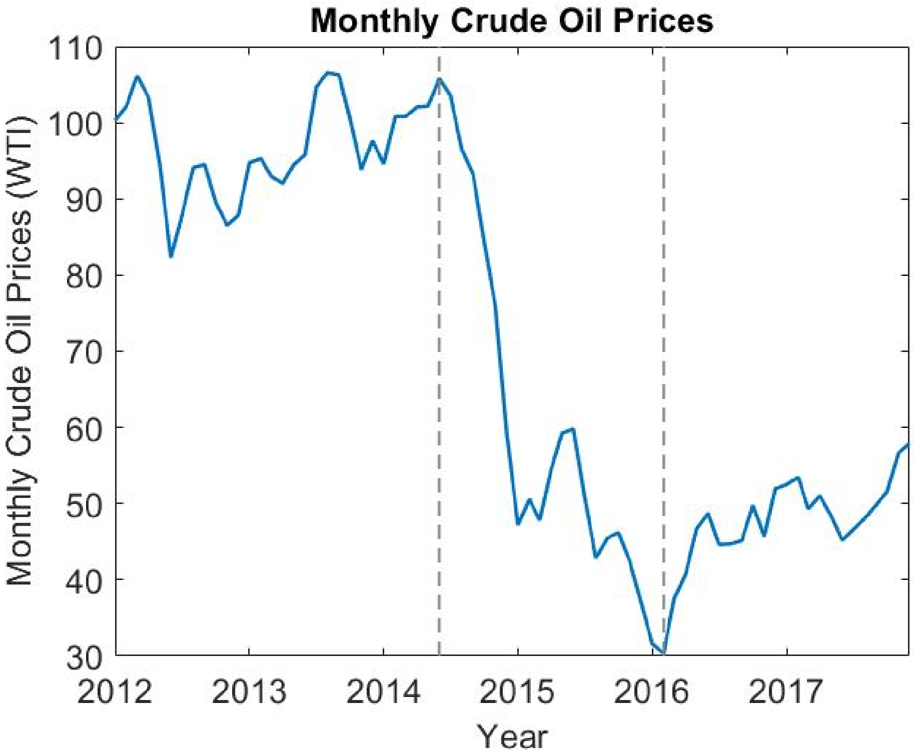


Figure C.2: Monthly Crude Oil Prices (2012-2018)

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. Source: FRED.

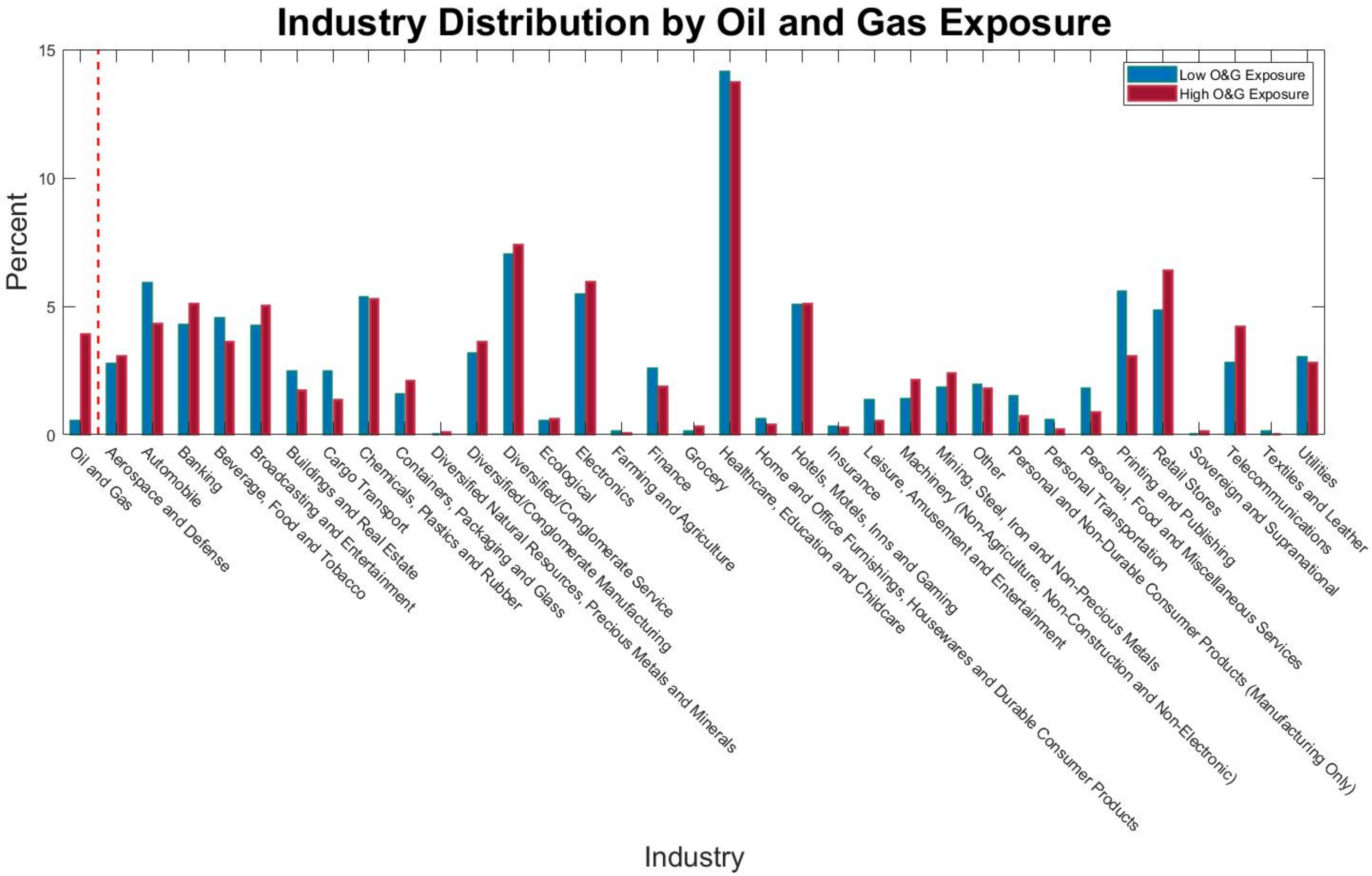
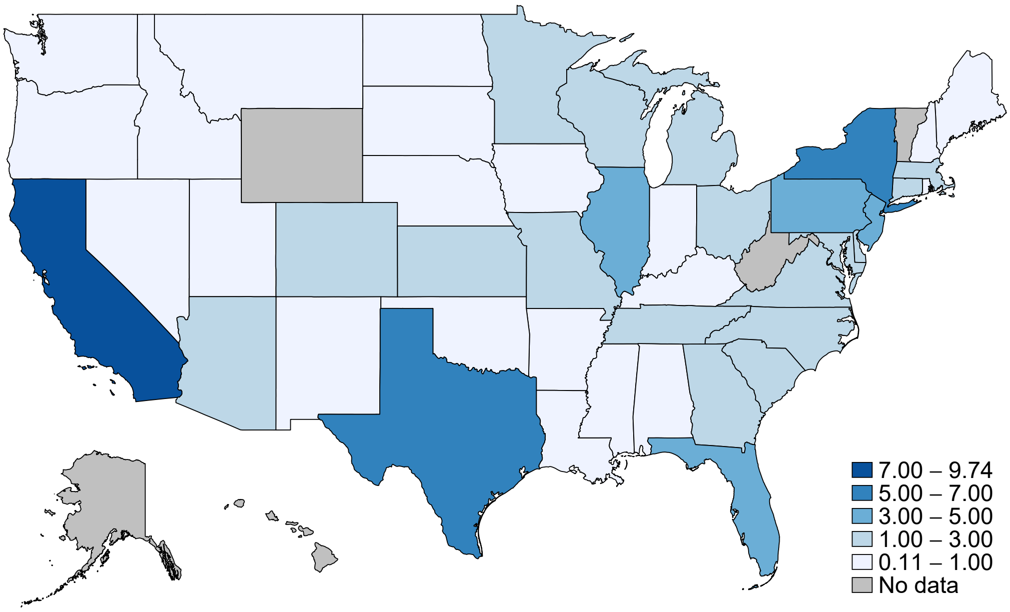
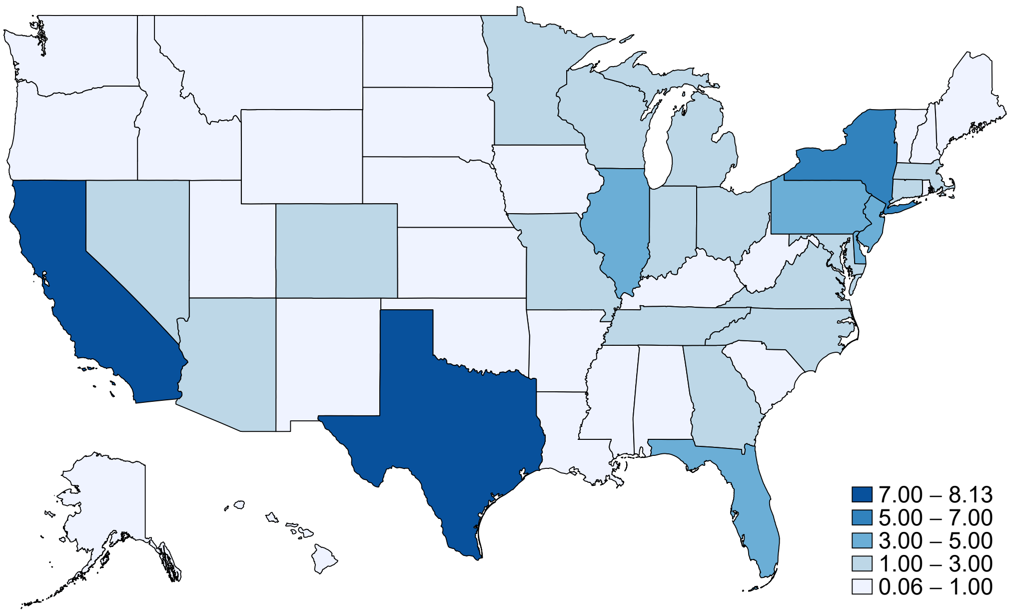


Figure C.3: Industry Composition by CLO O&G Exposure

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-Hirschman 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). The Euclidean distance between the two vectors of the industry share of firms held in CLOs with high and low CLO O&G exposure is 0.0473. The Kolmogorov-Smirnov test for equality of distribution functions fails to reject the null hypothesis, with a p-value of 1.00. 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 C.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 (HHI) is 0.0501, while it is 0.0493 for CLOs with high O&G exposure. The Euclidean distance between the two vectors of state share of firms held in CLOs with high and low CLO O&G exposure is 0.0494. The Kolmogorov-Smirnov test for equality of distribution functions fails to reject the null hypothesis, with a p-value of 0.57.

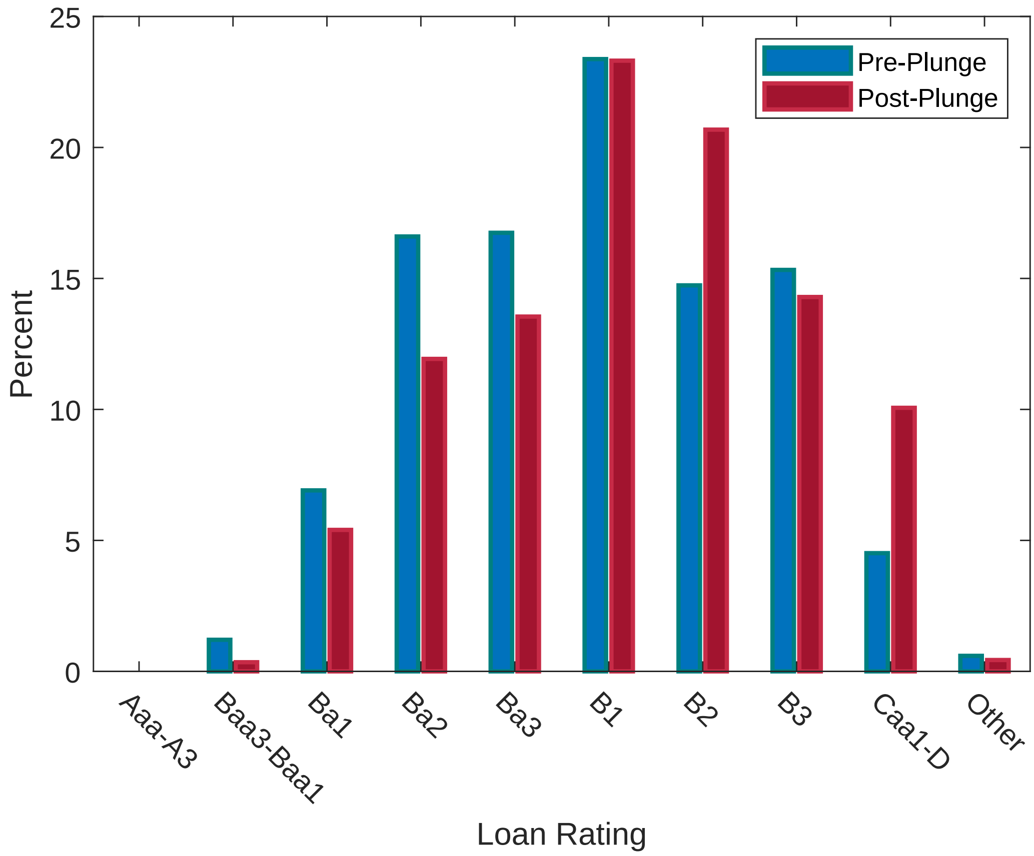
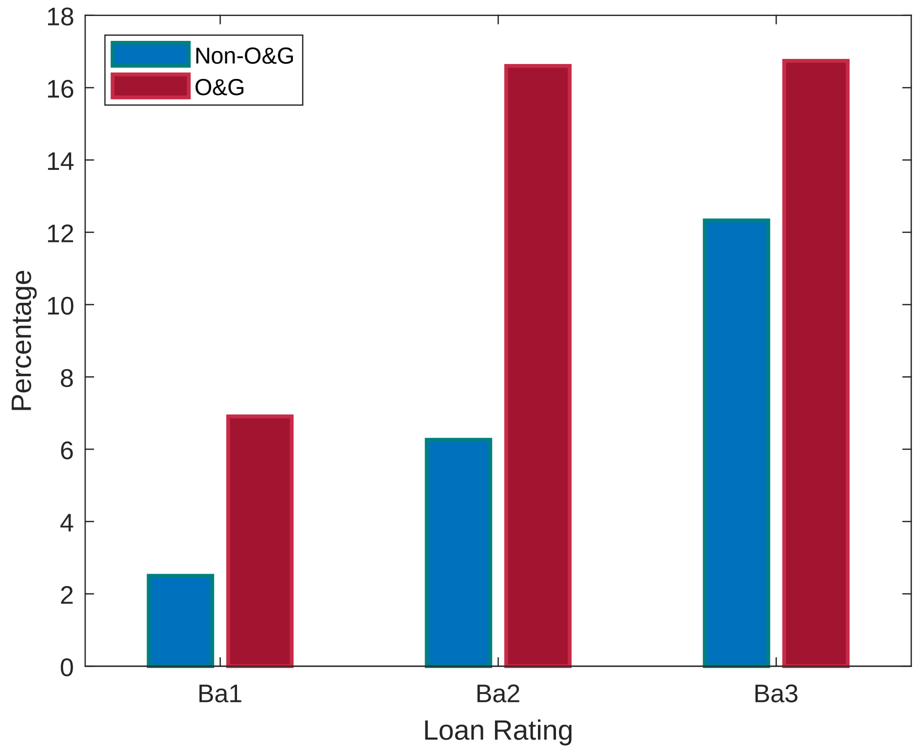
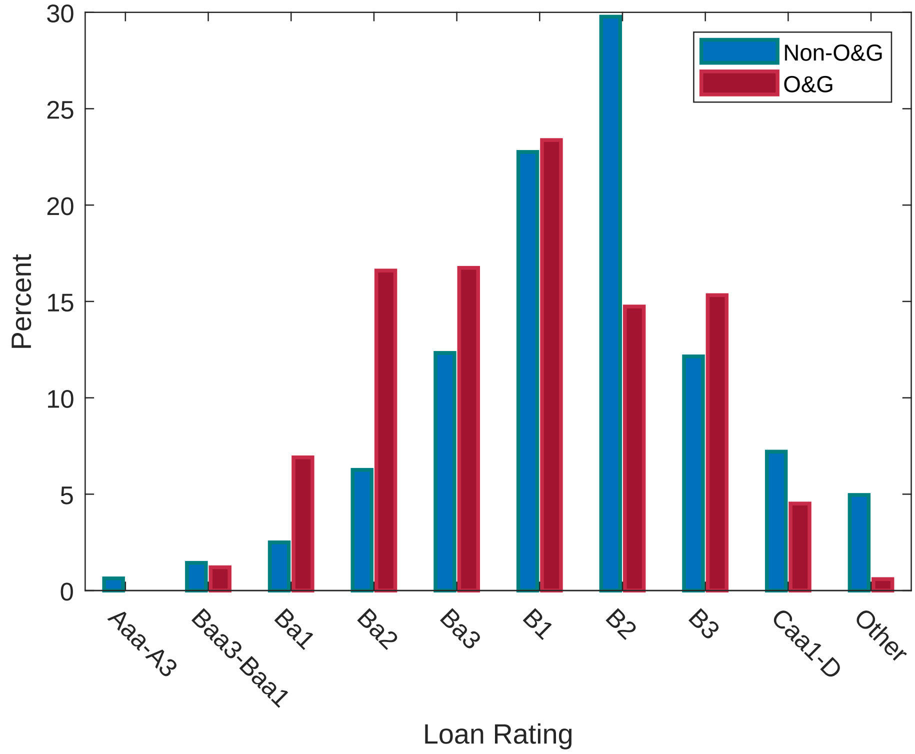


Figure C.5: O&G Ratings Pre- and Post- Plunge

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 C.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 C.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 C.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.

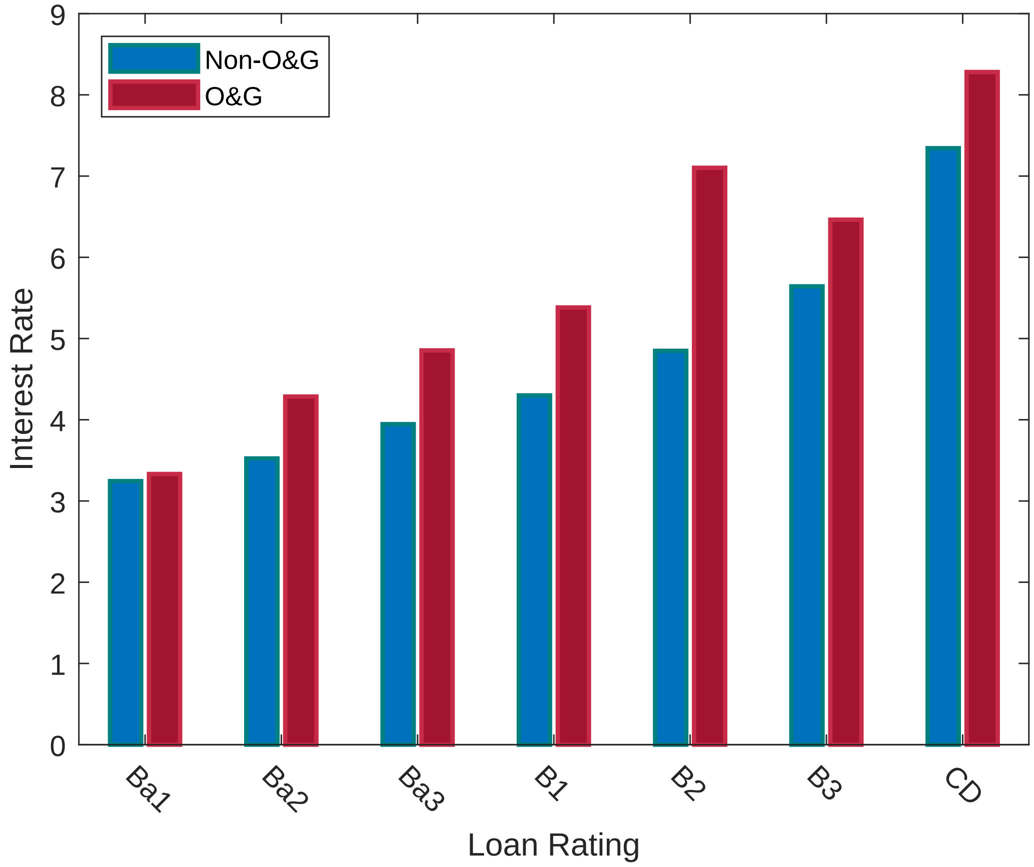
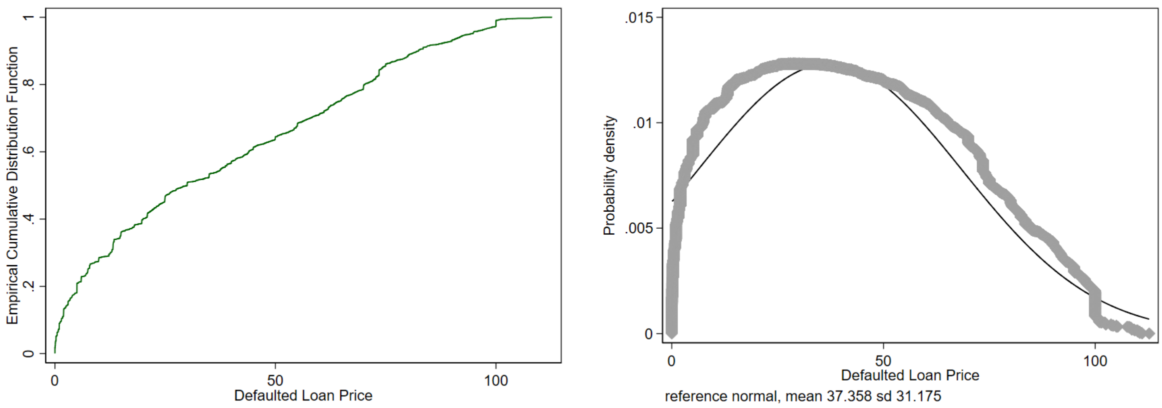


Figure C.7: O&G and Non-O&G Loan Yield

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) CDF of Defaulted Loan Prices

(b) PDF of Defaulted Loan Prices

Figure C.8: Distributions of Defaulted Loan Prices

Notes: The figure presents the cumulative distribution function (CDF) and probability density function (PDF) of defaulted loan prices. Appendix Figure C.8a presents the CDF of defaulted loan prices. Appendix Figure C.8b presents the PDF of defaulted loan prices.

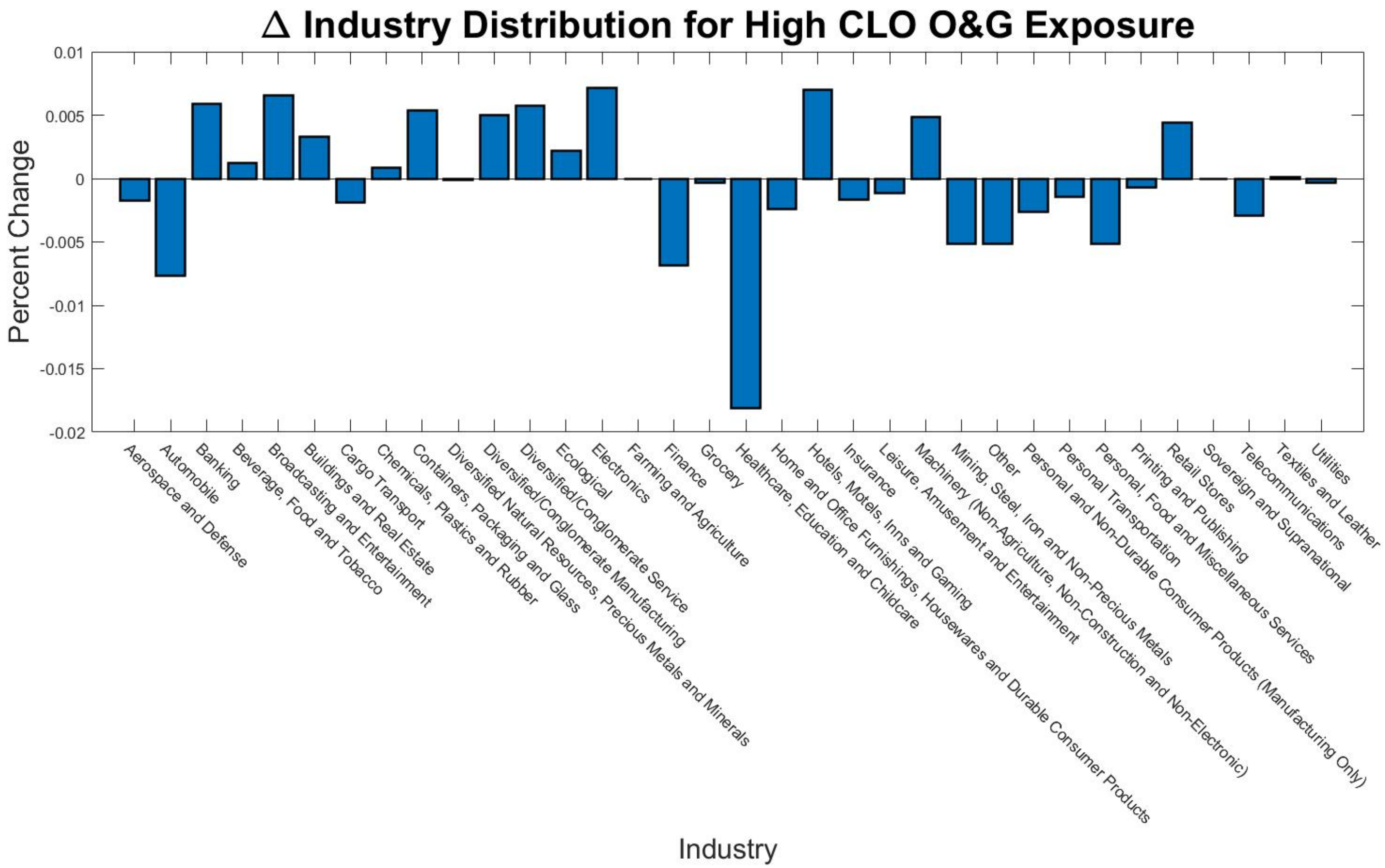
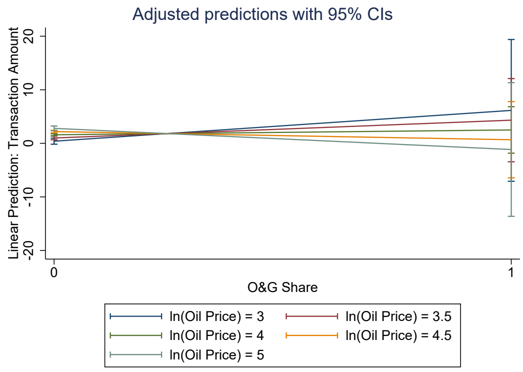
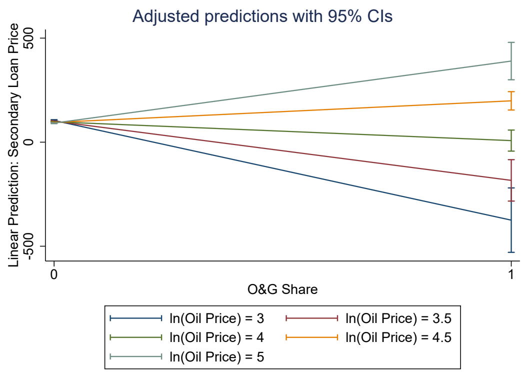


Figure C.9: Change in Industry Composition for Constrained CLOs

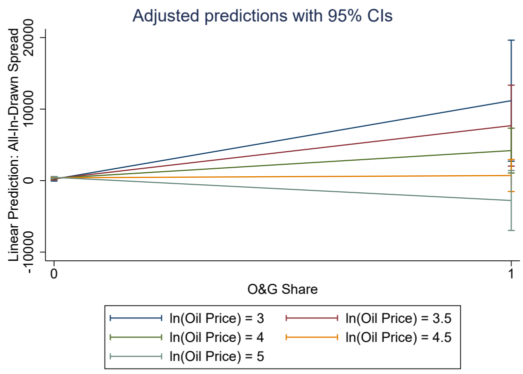
Notes: The figure presents the change in the industry share of loans before and after the shock for constrained CLOs – CLOs with high O&G exposure. CLOs with O&G exposure above the 75^{th} percentile of all O&G exposures have *high* O&G exposure. I list industries on the x-axis and percent change on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



(a) Transaction Amount



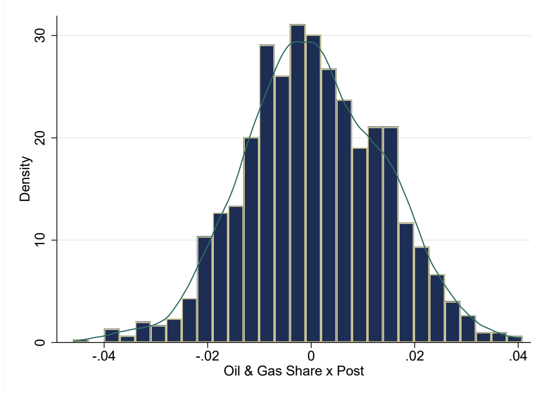
(b) Secondary Loan Price



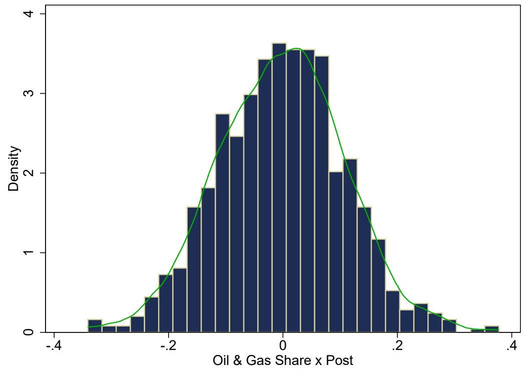
(c) All-in-Drawn Spread

Figure C.10: Alternative Empirical Specification

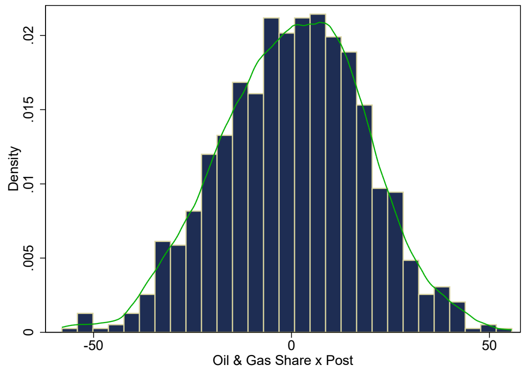
Notes: This figure plots the marginal effects – the slope of the secondary loan price (top) and all-in-drawn spread (bottom) on the price, while holding the value of the O&G share constant between 0 and 1. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2 ln(\text{Oil Price}_t)) + \beta_3(\text{Firm O\&G Exposure}_f \times ln(\text{Oil Price}_t)) + \alpha_y + \epsilon_{i,t}$ where $Y_{i,t}$ is the secondary loan amount (Appendix Figure C.10a) and secondary loan price (Appendix Figure C.10b) of loan i at time t issued by firm f ($i \in f \in \text{CLO } c$), 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-drawn spread of loan i at time t, issued by firm f ($i \in f \in \text{CLO } c$), 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.



(a) Transaction Amount



(b) Secondary Loan Price



(c) All-in-Drawn Spread

Figure C.11: 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 (Appendix Figure C.11a), secondary loan price (Appendix Figure C.11b), 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-drawn spread (Appendix Figure C.11c) 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 Appendix Figures C.11a, C.11b and C.11c 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.

C.2 Tables

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

	ln(ID Threshold)			
	(1)	(2)	(3)	(4)
O&G Share	-0.1872	-0.0981	-0.2722	-0.3812
	(0.3406)	(0.4040)	(0.4389)	(0.4469)
CLO Controls		✓	✓	✓
Manager FE	✓	✓	✓	✓
Arranger FE				✓
Trustee FE				✓
Year FE		✓		
Month-Year FE			✓	✓
N	60	60	60	60
R^2	0.5727	0.6166	0.8118	0.9747

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 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). 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 C.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 C.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 C.4: Interest Diversion Violation and O&G Exposure

	$\mathbb{1}_{Fail}$					
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	3.1017**	4.1211***	4.7000***	4.5095***	3.8504**	3.9075**
	(1.4811)	(1.4586)	(1.5690)	(1.5765)	(1.6956)	(1.7069)
O&G Share	-4.7686***	-4.5576**	-6.0045***	-5.0029***		
	(1.4938)	(1.6908)	(1.5809)	(1.7037)		
Post	0.1817**	0.0282			0.0185	
	(0.0694)	(0.0629)			(0.0696)	
CLO Controls		✓	✓	✓		
CLO FE					✓	✓
Manager FE	✓	✓	✓	✓		
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	1,955	1,955	1,955	1,953	1,955	1,955
R^2	0.2334	0.2682	0.3137	0.3194	0.4355	0.4591

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 the likelihood that a CLO violates the ID covenant for the first time in at least six months ($\mathbb{1}_{Fail}$) before the shock occurs. 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 C.5: CLO-Level Trading Effects

	Transaction Amount ($ mn)					
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-23.0196***	-22.7798***	-23.8230***	-28.1996***	-27.1063***	-43.5340***
	(5.1064)	(5.0771)	(4.9531)	(5.5716)	(6.1837)	(11.1474)
O&G Share	13.8889***	13.8734***	15.6038***	25.1883***	0.0000	0.0000
	(4.4329)	(4.3905)	(4.4970)	(5.6394)		
Post	0.1636	0.3658**			0.4181**	
	(0.1650)	(0.1668)			(0.1987)	
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 C.6: Issuer-Level Trading Effects

	Transaction Amount ($ mn)				
	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-58.1887*	-57.8606*	-102.0939**	-81.5002*	-89.1884*
	(32.4655)	(32.3796)	(37.5455)	(45.6667)	(46.1777)
O&G Share	30.5873	30.4665	82.2324**		
	(24.7595)	(24.6332)	(32.9503)		
Post	1.1431	0.7313		1.2290	
	(1.0167)	(1.0651)		(1.4482)	
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 C.7: Issuer-Level Effects by Transaction Type

	Transaction Amount ($ mn)					
	Purchases			Sales		
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	9.9950	50.1559	23.7551	139.0308***	186.7392***	164.0521***
	(73.5180)	(86.3225)	(82.7701)	(45.1156)	(54.3656)	(49.9189)
O&G Share	-152.0746**			-239.4250***		
	(69.8333)			(53.1694)		
Post		-3.4810			-6.3194***	
		(2.9189)			(2.0273)	
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 C.8: 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 C.9: 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 C.10: 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 $ln(\text{loan amount})$ 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 C.11: 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 C.12: 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 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 C.13: Amihud Price-Impact Measure and O&G Exposure

	Amihud Price Impact					
	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	40159.0***	40370.0***	39737.0***	23649.7***	18029.5**	18744.8**
	(9463.0588)	(9548.5090)	(9263.3140)	(8804.5855)	(8663.7959)	(8942.4308)
O&G Share	-36115.7***	-36395.7***	-36423.7***	-15012.9**		
	(8107.2503)	(8204.1772)	(7898.3872)	(6008.8737)		
Post	-1129.0***	-1269.8***			-529.4*	
	(277.2425)	(304.2915)			(279.4891)	
Manager FE			✓			
Rating-Industry FE				✓		
Issuer-Loan Type FE					✓	✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	128,723	128,723	128,720	117,242	128,723	128,723
R^2	0.0025	0.0027	0.0215	0.1385	0.2532	0.2564

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 the Amihud Price Impact measure 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 Amihud Price Impact measure 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. The Amihud Price Impact measure is the ratio of the absolute value of the loan discount (bps) to the net sale amount in millions (negative for purchases). Standard errors are two-way clustered by CLO × issuer and trade date. Standard errors are two-way clustered by CLO × issuer and month-year.

Table C.14: Investment in the Cross-Section and O&G Exposure

	Investment							
	Bond Access		**Size**		**Age**		**Loan Refinancing**	
	Access	No Access	Large	Small	Old	Young	Early Refi	Late Refi
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
O&G Share × Post	0.0642	-1.0760***	-0.1154	-0.8878**	-0.3612	-0.7083*	-0.8722	-1.2152**
	(0.1926)	(0.4107)	(0.2320)	(0.4109)	(0.2950)	(0.4240)	(0.6195)	(0.5392)
Issuer FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
N	1,661	1,320	1,710	1,271	1,037	957	452	697
R^2	0.1645	0.1961	0.2050	0.1547	0.1553	0.1694	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 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 C.15: Triple-Difference: Constrained Firms and Investment

	Investment	
	(1)	(2)
No Access × O&G Share × Post	-1.1457**	
	(0.4486)	
Small × O&G Share × Post		-0.7708*
		(0.4662)
No Access × Post	0.0216	
	(0.0132)	
Small × Post		0.0205
		(0.0143)
O&G Share × Post	0.0651	-0.1128
	(0.1912)	(0.2294)
Issuer FE	✓	✓
Industry FE	✓	✓
Quarter-Year	✓	✓
N	2,981	2,981
R^2	0.1760	0.1744

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 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 C.16: Triple-Difference: Risky Firms and Firm Outcomes

	Secondary Loan Price	All-In-Spread Drawn	Investment
	(1)	(2)	(3)
Risky × O&G Share × Post	-270.7383***	1494.2151	-1.0638*
	(77.1026)	(2159.2770)	(0.5515)
Risky × Post	6.6826***	-31.0497	0.0237
	(2.1269)	(61.7280)	(0.0161)
O&G Share × Post	36.3184	1631.8741*	-0.2234
	(29.6142)	(923.1815)	(0.2210)
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-drawn spread in Column 2, and 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 C.17: Empirical Design in Levels after O&G Shock

	ID Covenant	Transaction Amount	Transaction Price	All-in-Spread Drawn
	(1)	(2)	(3)	(4)
O&G Share	-1.7481*	-13.9002***	-72.9413***	1719.9542**
	(0.9704)	(1.6991)	(26.0487)	(787.1099)
Manager, Arranger, Trustee FE	✓			
CLO-Rating-Industry FE		✓	✓	
Primary Loan Controls				✓
Month-Year FE	✓	✓	✓	✓
N	1,089	67,242	29,603	354
R^2	0.6335	0.5249	0.7421	0.4960

Standard errors are clustered by CLO in column 1, CLO-issuer and trade date in columns 2 and 3, and issuer in column 4.

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

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 $Y_{c,m} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_f + Z_f + \alpha_{m,y} + \epsilon_{f,t}$ in column 1 and $Y_{f,m} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_f + Z_{lf} + \alpha_{m,y} + \epsilon_{f,t}$ in columns 2 through 4. CLO O&G Exposure$_c$ is the O&G share of CLO c measured when the CLO is first reported in the sample. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs. Z_c is a vector of time-invariant controls associated with the CLO and Z_f is a vector of time-invariant controls associated with the loan l. In column 4, primary loan controls include maturity, loan purpose, distribution method, seniority, secured, loan type, and country of syndication. Standard errors are clustered by CLO in column 1, CLO-issuer and trade date in columns 2 and 3, and issuer in column 4. Standard errors are two-way clustered by issuer and month-year.

Table C.18: Instrumental Variable Regression

	Transaction Amount (Net Purchase)			
	OLS	IV	2SLS	
			Second Stage	First Stage
	(1)	(2)	(3)	(4)
CLO Constraint	-0.5142		143.7380***	
	(2.8580)		(34.4075)	
O&G Share × Post		-19.2033***		-0.1336***
		(4.0731)		(0.0173)
Issuer-Loan Type FE	✓	✓	✓	✓
Month-Year FE	✓	✓	✓	✓
N	126,146	126,146	126,146	126,164
R^2	0.0741	0.0748		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 amount ($ mn) 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 in $ mn) 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 C.19: Alternative Measures of Issuer Exposure to CLOs

	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
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
O&G Share × Post	-20.3697***	-66.2332*	2051.6695***	-19.9165***	-82.5273**	2102.7887***	-14.6684***	-80.1203**	2024.8176***	-19.9284***	-82.6503**	2102.7887***
	(3.7280)	(34.1845)	(733.2065)	(3.8421)	(35.1134)	(737.3682)	(2.7987)	(34.4993)	(721.4302)	(3.8422)	(35.1149)	(737.3682)
Post	0.3700***	1.6175	-51.7958	0.3585***	2.0636**	-53.4040	0.2641***	2.0054*	-51.4677	0.3588***	2.0668**	-53.4040
	(0.1136)	(1.0083)	(32.3647)	(0.1163)	(1.0346)	(32.3613)	(0.0854)	(1.0237)	(31.5815)	(0.1163)	(1.0346)	(32.3613)
Issuer-Loan Type FE	✓	✓		✓	✓		✓	✓		✓	✓	
Issuer FE			✓			✓			✓			✓
Primary Loan Controls			✓			✓			✓			✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
N	129,132	57,593	567	129,132	57593	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-drawn spread (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 ($ mns) (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-drawn 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 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 C.20: 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 C.21: Aggregate Trading Effects by Firm Vulnerability

	Δln(Holdings)			
	Low O&G Share		**High O&G Share**	
	Low Dependence	High Dependence	Low Dependence	High Dependence
	(1)	(2)	(3)	(4)
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 C.22: 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-drawn 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 C.23: 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 C.24: 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 C.25: Distance to Interest Diversion Covenant and COVID-19 Exposure

	Distance to ID Threshold					
	(1)	(2)	(3)	(4)	(5)	(6)
COVID-19 Share × Post	-0.0761***	-0.0788***	-0.0789***	-0.0803***	-0.0959***	-0.0953***
	(0.0239)	(0.0236)	(0.0235)	(0.0222)	(0.0209)	(0.0214)
COVID-19 Share	-0.1970***	-0.1004*	-0.1003*	-0.0113		
	(0.0511)	(0.0505)	(0.0487)	(0.0500)		
Post	-0.0075**	-0.0073**			-0.0052*	
	(0.0027)	(0.0027)			(0.0024)	
CLO Controls		✓	✓	✓		
CLO FE					✓	✓
Manager FE	✓	✓	✓	✓		
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	4,945	4,945	4,945	4,945	4,945	4,945
R^2	0.6051	0.6561	0.7294	0.7724	0.8197	0.8932

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 D 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 ($\Delta ln(\texttt{dlttq})$).
2. *Cash Flow* is the ratio of the operating income before depreciation (`ebitda`) to lagged cash adjusted, total assets (`atq-cheq`).
3. *Acquisitions* is the ratio of acquisitions expenditures (`acq`) to lagged total assets (`atq`).
4. *R&D Growth* is defined as the log difference in R&D expenditures ($\Delta ln(\texttt{xrdq})$)
5. *Investment-Capital Ratio* is defined as the ratio of the change in capital stock to the lagged 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).
6. *Employment Growth* is defined as the log difference in employment ($\Delta ln(\texttt{emp})$)