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

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Abstract

I investigate how covenants, intrinsic to *Collateralized Loan Obligation* (CLO) indentures provide a mechanism through which idiosyncratic shocks may be amplified, imposing negative externalities on other unrelated firms in CLO portfolios. I exploit cross-sectional variation in firm exposure to the Oil & Gas (O&G) industry through CLOs, as well as the timing of the O&G bust in 2014 to study how non-O&G firms in CLO portfolios are affected. When CLOs are subject to idiosyncratic shocks that push them closer to their covenant constraints, they fire-sell unrelated loans in the secondary loan market to alleviate these constraints. The ex-post, secondary market spread becomes the effective cost of capital for these innocent bystanders, as the expected rate of return across debt instruments is equalized in market equilibrium. Hence, the real costs of fire sales may exacerbate credit crunches through the contraction of credit. In response, firms make financial and real adjustments. Contrary to traditional fire sale settings, I find that CLOs fire sell loans issued by riskier firms for *contractual arbitrage* purposes – exploiting loopholes in the design of covenants. The sample period for this study is 2013-2015, a relatively benign macroeconomic period. However, the results suggest that the effects may be larger during times of stress, including the outset of the COVID-19 pandemic.

JEL Classification: E44, G23, E32, E22, G33, G14, G18

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1 Introduction

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

CLOs are the largest purchasers of leveraged loans and constitute an increasingly prominent source of credit to risky firms. In quest to devolve risk in the post-financial crisis era of 2008, banks have shifted from an "originate-to-retain" model to "originate-to-distribute," diversifying credit and liquidity risks to a gamut of investors, chiefly, CLOs.[1] CLOs purchased nearly 75% of all syndicated institutional leveraged loans in 2019 and held 25% of all outstanding leveraged loans (pro rata and institutional) in 2020 (Leveraged Commentary and Data (2019); International Monetary Fund (2020)). However, greater diversification has also contributed to the opacity and complexity of interconnections between the traditional banking and rising shadow banking sectors. The Federal Reserve recently warned that the secondary market for leveraged loans is not liquid and during times of stress, price declines from CLO loan sales may be excessive (Board of Governors (2019)).[2] The Bank of England outlined the risk to financial institutions, emphasizing the high concentration of leveraged loans among bank and non-bank institutions with uncertain implications on firm financing (Financial Policy Committee (2019)).[3] The Financial Stability Board has raised questions about the risk to borrowers, stating that: *Shocks arising from outside of the leveraged loan and CLO markets that place intermediaries under financial strain, could impair the supply of capital to leveraged borrowers or cause other intermediaries in the market to become unable to offload exposures to leveraged borrowers* (Federal Stability Board (2019)). Understanding the externalities of covenants is critical from a policy

[1] I refer readers to Kundu (2021*a*) for a comprehensive overview of the leveraged loan and CLO markets.

[2] *Investors in CLOs ... face the risk that strains within the underlying loan pool will result in unexpected losses ... The secondary market is not very liquid even in normal times, and liquidity is likely to deteriorate in times of stress, which could amplify any price declines. It is hard to know with certainty how today's CLO structures and investors would fare in a prolonged period of stress* (Board of Governors (2019)).

[3] *Globally, banks account for more than half of the financial system's exposure to leveraged loans...Non-bank investors also have significant holdings of leveraged loans. Leveraged loan holdings by open-ended investment funds are significantly higher than pre-crisis, and large-scale redemptions during stress could amplify price falls. In a stress, the leveraged loan and high-yield corporate bond markets may not be sufficiently liquid to meet demand from borrowers, potentially restricting corporates from accessing funds* (Financial Policy Committee (2019)).

perspective for informing regulatory intervention and developing targeted and well grounded guidelines (Stein (2013)).

Underlying the CLO market is a set of legal indentures, mutually agreed upon by the core trinity of CLO participants: arranger, manager, and trustee. A CLO indenture governs the operations and activities a CLO manager may undertake. Broadly, CLO liabilities are of two forms: debt tranches and equity tranches. Without any contractual embellishments, the inherent structure of a CLO produces agency frictions. The manager's interests are most aligned with the equity class; their compensation consists of a fixed fee and subordinated fees that are proportional to the residual interest available to the equity class. The manager may maximize cash flow by shifting investment decisions in favor of the equity class at the expense of debtholders. Thus, covenants intrinsic to managerial contracts serve as disciplining devices to curtail against risk-shifting behavior and protect debtholders, mitigating conflicts of interest. Specifically, violation of coverage covenants – which ensure that there is a specific level of coverage and subordination relative to the covenant triggers for each tranche – may be punitive, as proceeds intended for junior tranches, management fees, and equity distributions may be diverted towards prematurely paying down liabilities in order of seniority or towards the purchase of higher-quality collateral, until the CLO is in compliance with its constraints. Therefore, covenants also provide a mechanism for allocating control rights between debt and equity investors. Unlike in other settings, covenants in CLO indentures are not renegotiable, reducing the potential for hold-up of investment decisions, ex-ante (Gârleanu and Zwiebel (2009)).

The objective of this paper is twofold: *(1)* to understand whether contracts have externalities on asset prices, and if so, *(2)* to explore the mechanism through which firm distress can propagate to other firms. I postulate that shocks can propagate through capital markets via CLO fire sales. While covenants are largely effective tools in addressing agency frictions, in some states of the world, they can generate forced sales. The markets for loans and corporate debt are relatively illiquid, hence, CLO forced sales can have material effects on the prices of debt securities, even if the creditworthiness of the debt's issuer is unchanged.

For illustration of the mechanism through which idiosyncratic risk may amplify to systemic risk, consider the following microcosm of the empirical setting, as presented in Figure 1. Firms and CLO intermediaries can be conceived as a web. In the network, CLOs purchase loans issued by firms which are represented by the outer circles, and firms are connected to other firms through the CLO. The spokes are bidirectional because firm performance affects cash flows to CLOs and intermediary distress may also transmit to firms (left figure).

If a firm experiences extreme distress, as represented by the red outer circle, a CLO may be pushed against its constraints as represented by the pink color (center figure). In this event, the CLO manager will sell loans issued by the distressed firm preemptively to eliminate the risk of becoming further constrained, thereby disconnecting the red firm in the diagram (Kundu (2021*b*)). Furthermore, the CLO manager may sell other unrelated risky loans – loans issued by innocent bystanders with no direct exposure to the source of distress – to generate more slack in the constraints – represented by the pink firms with dashed connections to the CLO (right figure). Thus, financial constraints may potentially create a cycle. If a firm becomes distressed and a CLO is pushed against its constraints, the manager may sell the distressed loan as well as sell loans issued by innocent bystanders. This may alleviate CLO constraints. However, it may also ultimately sow the seeds of future distress (bottom figure). In this paper, I focus on how innocent bystanders are affected by actions the CLO manager takes.

I begin by first describing the institutional background and the covenants intrinsic to CLO managerial contracts. I demonstrate how the accounting of covenant constraints give rise to opportunities for *contractual arbitrage*. Specifically, the piecewise nature of accounting of covenant constraints incentivize constrained CLO managers to sell loans issued by the riskier segment of firms. The loans in this segment may be accounted below market value, unlike the remaining portfolio which is marked at book value. CLO managers may maximize improvements to the capital constraints by selling the best of the riskier loans which recover the highest market values but are accounted for at lower valuations. This framework proffers conjectures regarding the distributional effects of fire sales.

To study the externalities of fire sales, I use a Bartik-style difference-in-differences identification strategy, exploiting the timing of the oil price plunge in 2014, as well as cross-sectional variation in the oil and gas (O&G) exposure before the shock. After the oil price plunge, CLOs with higher O&G exposure experienced a tightening in their capital constraints, relative to CLOs with lower O&G exposure. The level of constraint directly affects selling pressure experienced by CLOs, which in turn, affects the prices of debt securities issued by innocent bystanders. In the ideal thought experiment, the objective is to compare the differences in outcomes between two virtually identical innocent bystanders, held in different CLO portfolios with varying O&G exposures, after the O&G price plunge. This empirical design largely circumvents concerns about non-random matching between CLOs and portfolio firms. I find that O&G share is related to the distance to the capital constraints. A 1 pp increase in the O&G share before the shock is associated with a 0.05-0.08 standard deviations decline in the distance to the most stringent capital constraint covenant, after the shock. I argue that the O&G price plunge was exogenous, and conduct a battery of tests to study selection.

I proceed in several steps. First, I find evidence of increased selling after the shock. A one percentage point increase in a firm's exposure to O&G through CLOs, before the shock, is associated with 0.106-0.182 standard deviations decline in the transaction amount. Second, I study the effects on asset prices. I find that a one percentage point increase in a firm's exposure to O&G through CLOs, before the shock, is associated with $0.67-$1.82 decline in the secondary loan price, increase of 18-23 bps in the primary loan spread, increase of 28-35 bps in the bond credit spread, 0.03 standard deviations decline in the quarterly change in the unused line of credit, and a 0.03 standard deviations increase in the quarterly change in the drawn line of credit. The increase in the spreads across different forms of debt instruments is explained through a variation of a no-arbitrage argument which connects fire sales to credit crunch effects. In market equilibrium, the expected rate of return for any form of debt issued by a firm is equalized, therefore, for affected innocent bystanders, their effective cost of capital may increase.

Next, I study the real effects to firms. I examine how non-O&G portfolio firms respond. I find that a one percentage point increase in a firm's exposure to O&G through CLOs, before the shock, is associated with 0.04 standard deviations decline in long-term debt growth, 0.03 standard deviations decline in cash flow, 0.04 standard deviations decline in investment, 0.09 standard deviations decline in R&D growth, and 0.04 standard deviations decline in employment growth, after the shock. Correspondingly, a one percentage point increase in a firm's exposure to O&G through CLOs, before the shock, is associated with a 0.3 pp decline in monthly equity returns, after the shock. Further, I study how investment responds across different characteristics of firms. I find that firms which do not have access to the bond market, smaller firms, younger firms, firms in the tradable sector, and firms which had last refinanced before the shock drive the aggregate decline in investment. This corroborates the hypothesis that firms which are more bank-dependent are most vulnerable to intermediary constraints. The link between financial market dislocations and real effects is plausible. The dislocation in asset prices endures up to seven quarters – long enough for real effects to materialize. This finding suggests that a temporary episode of distress can damage firms for a longer-term – an externality of "short-termist" damage control.

An opposing hypothesis to contractual arbitrage is that CLOs sell loans which trade above par while purchasing those below par. I find direct evidence that the likelihood of selling a loan above (below) par decreases (increases) in the degree of constraint, after the shock. Further, the interest rates and incidence of default associated with portfolio loans also decline in the degree of constraint, after the shock. I show that CLOs which had higher O&G exposure before the shock decrease their share of risky loans afterwards by more than CLOs which had lower O&G exposure before the shock. Lastly, as confirmatory evidence, consistent with contractual arbitrage, I find that a one percentage point increase in a firm's exposure to O&G through CLOs, before the shock, is associated with a decline of $2.32 in the secondary loan price (per $100 par), 56 bps increase in the All-In-Drawn spread, and 0.12 standard deviations decline in investment, among risky firms – firms which defaulted ona loan at some point in the sample – after the shock. These point estimates are economically meaningful, statistically significant, and stable, standing in contrast to the estimates produced for non-risky firms.

For external validity, I study whether the proposed mechanism is consistent with the findings from a more recent crisis: the COVID-19 pandemic. As I conduct my analysis for a relatively benign macroeconomic period – from 2013-2015, it raises concerns for what may occur when markets become more 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, simultaneous default may have disastrous implications (Federal Stability Board (2019)). I replicate the baseline result using the COVID-19 shock for external validity and to study how the magnitude changes under a larger, adverse shocks. The identifying assumption of this analysis is that COVID-19 is not an aggregate shock, but rather a series of industry-wide shocks across several vulnerable industries. The time period for the analysis is from Jan 1, 2020-May 6, 2020. I restrict the time horizon to prevent "contamination" from federal interventions. I use various measures of exposure to different vulnerable industries and show that the estimate across all specifications is larger in magnitude than that of the baseline analysis. Hence, the effect is expected to be larger during crisis periods with limited intervention.

There are two novel contributions of this work. First, I show that intermediaries which operate in a market setting may serve as a linchpin between financial markets and real economic activity – distinct from the standard credit supply shock channel of banks. Second, I show that when intermediaries become constrained, they sell the riskier segment of loans rather than the safest loans. This fire sale is an unintended consequence of the design of optimal contracts.

This paper contributes to the existing literature by providing evidence of how a source of market financing can affect firm financial decisions through covenants, standing in contrast to a rich literature base on credit supply shocks that has focused on bank lending relationships. Bank intermediaries are known to be more efficient at resolving informational asymmetries than the market by developing unique relationships with firms, allowing for close monitoring.

If a bank collapses, naturally, dependent borrowers may also be in distress. Theoretical work has emphasized how shocks to bank capital can affect real economic outcomes through the credit channel (e.g., Bernanke and Blinder (1988); Bernanke and Gertler (1989); Holmstrom and Tirole (1997)). Empirical work, exploiting variation through the use of instruments and natural experiments has investigated how changes in bank credit supply affect real economic outcomes with varying deductions (e.g., Kashyap, Lamont and Stein (1994); Gerlter and Gilchrist (1994); Kashyap and Stein (2000); Peek and Rosengren (2000); Khwaja and Mian (2008); Paravisini (2008); Ivashina and Scharfstein (2010); Chava and Purnanandam (2011); Benmelech, Bergman and Seru (2011); Schnabl (2012); Chodorow-Reich (2014); Huber (2018); Amiti and Weinstein (2018); Kundu and Vats (2021)). CLOs, in contrast, are at arms-length. They are institutions that hold bank loans. CLOs are not directly involved with firms, nor do they possess any firm-specific private information about fundamentals (Kundu (2021*b*)). Thus, the finding that frictions in capital markets can transmit to firms is a novel contribution.

This paper is also related the literature on fire sales. I show that fire sale risk can transpire in closed-end funds due to contractual frictions – not triggered by withdrawals or demandable deposits, building off of results in Kundu (2021*b*). When CLOs experience constraint, they sell the riskier segment of loans to alleviate the capital constraints associated with the covenants. This result contrasts from prior work which posits that intermediaries sell their most liquid loans to minimize selling costs and fire sale discounts. The main distinction is the underlying mechanism of fire sales. The literature, thus far, has examined various mechanisms through which fire sale risk can materialize (e.g., Shleifer and Vishny (1992); Shleifer and Vishny (1997); Pulvino (1998); Coval and Stafford (2007); Mitchell, Pedersen and Pulvino (2007); Caballero and Simsek (2013); Jotikasthira, Lundblad and Ramadorai (2012); Campbell, Giglio and Pathak (2011)). I contribute to this literature by showing that covenants intrinsic to optimal contracts may foment financial instability. Specifically, I demonstrate that the accounting of covenant constraints may influence the incentives of CLO managers and their trading decisions, by extension. The piecewise treatment of covenant constraints may explain why CLO managers sell riskier loans. Further, I show that forced sales in the relatively illiquid secondary loan market may spillover to other financial markets with real effects at the firm level.

The roadmap for the paper is as follows. I explain the institutional setting and contractual arbitrage in Section 2. The data sources used in this study are described in Section 3. The empirical strategy used in this analysis is discussed in Section 4. I present the main results in Section 5. I explore the underlying mechanism in Section 6. The checks for external validity are described in Section 7. Lastly, I conclude in Section 8.

2 Institutional Background

In this section, I provide a pithy summary of how CLOs function. For a more detailed discussion, I refer the readers to Kundu (2021*a*).

A CLO operates as a *special purpose vehicle* that issues tranched asset-backed securities or notes, and uses the proceeds to finance the purchase of the underlying portfolio of leveraged loans. From a balance sheet perspective, the loans of a CLO consist of leveraged loans, and, the liabilities consist of notes that are issued to investors. Higher-rated tranches have lower risk and pay out lower returns relative to lower-rated tranches which have higher risk and higher returns. There are two categories of tranches: debt tranches and equity tranches. Debt tranches are paid a fixed spread above LIBOR based on seniority. The equity tranche receives the remaining spread after proceeds from the underlying loans have been distributed towards senior liabilities. The objective of the CLO is to maximize the excess spread.

As the financial interests of a CLO manager are most aligned with the equity class – a manager's compensation consists of a fixed fee and subordinated fees that are proportional to the residual interest available to the equity class – managers have incentives to risk-shift in favor of the equity class to maximize revenue.[4] Debt investors do not benefit from excess risk or returns because they are paid a fixed spread above LIBOR based on seniority. As monitoring a manager's investment decisions and verifying cash flows may be costly from the perspective of debt investors, covenants are in place to address the risk-shifting motives of CLO managers.

Covenants serve as disciplining devices for managers to adequately screen and monitor their investments. Covenants allow investors to exert control when incentives conflicts. There are two classes of covenants: quality covenants and coverage covenants. Quality covenants are maintain-or-improve constraints. These constraints do not directly prescribe any action to the managers in the event of a breach. In event that a quality covenant is triggered, the manager must maintain the credit quality of the portfolio and may not make trades that may worsen the credit quality. In contrast to quality covenants, if coverage covenants are triggered, proceeds from the underlying loans may be diverted from junior tranches, junior management fees and equity distributions towards paying down liabilities in order of seniority, prematurely or towards the purchase of "higher-quality" collateral. Coverage covenants may be financially costly to the manager in several ways. First, fees and payments may be siphoned off from the manager and other junior stakeholders. These constraints may impair the manager in optimizing the portfolio. Second, investors may also lose confidence in the manager's ability to

[4]If managers are residual claimants, i.e., have skin-in-the-game, managers may have even greater incentives to risk-shift.

administer the CLO portfolio. If CLO failures persist, i.e., the manager serially breaches contractual provisions, the manager may be dismissed. Further, if the underlying loans default, equity holders may elect to not exercise the call until the defaulted loans rebound in price. These ramifications may result in a CLO operating well-beyond its expected call date until legal maturity.

Given the "course-correcting" nature of coverage covenants, I center my focus on these covenants. There are three types of coverage covenants that CLOs are typically subject to: Overcollateralization (OC) covenants, Interest Diversion (ID) covenants, and Interest Coverage (IC) covenants. The OC and ID covenants are *capital constraints*, which ensure that there is sufficient coverage and subordination of tranches relative to the tranche-specific triggers. They are akin to measures of leverage. The OC and ID covenants are measured similarly, with two caveats. First, the ID covenant has a lower threshold, hence, it is triggered before any of the OC covenants. Second, if the ID covenant is breached, proceeds are diverted towards the purchase of high-quality, value-increasing loans to eliminate the opportunity for asset substitution. This contrasts with the consequences of violating OC covenants, which force deleveraging. The IC covenants ensure that there is a specific level of coverage for interest due on tranches relative to the triggers. These are *liquidity constraints*. The IC covenants are similar to the OC covenants, insofar as they may also cause CLO managers to pay down liabilities early. Broadly, covenants create first-loss tranches, cushions for principal losses for more senior tranches.

$$
\begin{aligned}
OC/ID &= \frac{\text{Par value of collateral+Defaulted collateral value}}{\text{Principal balance of tranche and all senior tranches}} + \\
&\quad \frac{\text{Purchase price of discounted collateral-'CCC/Caa1' excess adjustment}}{\text{Principal balance of tranche and all senior tranches}} && (1) \\
IC &= \frac{\text{Interest from collateral}}{\text{Interest due on tranche and senior tranches}} && (2)
\end{aligned}
$$

CLOs operate closest to the ID constraint. From 2009-2018, CLOs operated within a 3% margin of the ID threshold, 5% margin of the Junior OC threshold, and 109% margin of the Junior IC threshold (Kundu (2021*b*)). Given the variation in the degree of constraint across covenants, I narrow my attention to the capital constraints.

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

2.1 Contractual Arbitrage

The piecewise nature of the accounting of covenant constraints can influence the incentives of CLO managers in their selling behavior. Consider the following illustration of how CLO managers can engage in *contractual arbitrage*. As an example, I focus on the accounting of CCC/Caa1 loans. The general framework may be extrapolated to the other cases of defaulted loans and discount obligations, as discussed in Section 6.3.

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

Let τ denote the stipulated portfolio share of CCC/Caa1 loans, A denote total CLO assets, and L denote total CLO liabilities. Moreover, for simplicity, assume that there are two types of assets in the portfolio – bad, risky assets, and good, risky assets – the sum of which count towards the CCC/Caa1 limit, τ. The share of bad, risky assets is denoted by ρ while the share of good, risky assets is denoted by μ. This distinction is important; regardless of whether the risky assets are good or bad, they are marked to the lowest market value of the CCC/Caa1 share of loans – the market value associated with the bad assets.

Suppose the CLO breaches its limit on CCC/Caa1 loans, i.e., $\rho + \mu > \tau$. Consequently, the capital constraints will tighten and the OC/ID ratio will be:

$$OC/ID = \frac{(1 - (\rho + \mu - \tau))A + (\rho + \mu - \tau)\delta A}{L}. \tag{3}$$

Selling the good, risky assets, μ from the portfolio at market price γ may loosen the capital constraints. It can improve the capital constraints by $\frac{\mu(\gamma - \delta)A}{L}$. The new OC/ID ratio is:

$$OC/ID = \frac{(1 - (\rho + \mu - \tau))A + (\rho - \tau)\delta A + \mu\gamma A}{L}. \tag{4}$$

However, the CLO suffers a financial loss – the total book value of the assets declines by $\mu(1 - \gamma)A$. Hence, there is a tradeoff between loosening the constraint and CLO profits. This illustrative example demonstrates how a CLO can maximize improvements to its capital constraints by selling CCC/Caa1 or risky loans from their highest dollar market value to their lowest dollar market value. Similarly, if the agency projected recovery rate of a defaulted loan is below its market value, or, if the purchase price of a discount obligation is below its current market valuation, the CLO can build par by selling the defaulted or discounted loan.

This provides an explanation behind one of the main findings of this paper, namely, CLO managers sell their best risky loans while keeping the worst ones. This type of value-destructive trading – giving up the upside in good times for mitigating risk in bad times – may be a source of contagion across markets and pose risks to financial stability. I discuss this further in Section 6.3.

3 Data

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

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. In 2019, the CLO-i database covered 67-76% of the market, while in earlier years the coverage seems to have been between 46-65% of the market (Kundu (2021*a*); Benmelech, Dlugosz and Ivashina (2012)). Additional information on coverage and characteristics of the data are described in the Data section of Kundu (2021*b*). I restrict my analysis to firms which received a syndicated loan, as reflected by DealScan. The processed data covers a total of 1,631 distinct issuers.

To supplement the data on transaction prices reported in the CreditFlux CLO-i database, I collect additional financial data from WRDS-Thomson-Reuters' LPC DealScan, WRDS Bond Returns, and CRSP. I use data on primary issuance from WRDS-Thomson-Reuters' LPC DealScan. This database contains extensive and comprehensive data on the terms of loan pricing contracts that is sourced from both SEC filings and directly from lenders and borrowers. The processed data covers a total of 1,429 distinct issuers. In addition to primary issuance data, I use the WRDS Bond Database for retrieving information related to bond credit spreads and liquidity. The WRDS Bond Database provides comprehensive coverage of all traded corporate bond issues, sourced from TRACE Standard and TRACE Enhanced. The dataset includes information on bond types, monthly prices, returns, coupons, and yields. The processed dataset covers a total of 136 distinct issuers. I retrieve monthly equity returns from CRSP. CRSP provides information on individual securities, including identity information, price histories and trading volumes, delisting information, distribution history, and share outstanding values. The monthly Fama-French 5 factors used in my analysis are from Kenneth French's website. The processed data covers a total of 263 distinct issuers.

For firm characteristics, I use two databases from S&P Capital IQ: Compustat North America (Compustat) and Capital Structure. Compustat provides data on firm fundamentals from balance sheets, statements of cash flows, income statements, and supplemental data items. I describe the construction of firm-level variables in Section B. A limitation of my analysis is that Compustat only reports data for publicly held companies, whereas CLOs hold loans issued by both private and public firms. Hence, firm coverage is limited. The processed data covers a total of 457 distinct issuers. I use Capital Structure data to understand the dynamics of firm liquidity – specifically, data on lines of credit. This data is sourced from press releases, company websites, and stock exchanges as well as through direct feeds from SEC, SEDAR, ASX, and RNS. The processed dataset covers a total of 315 distinct issuers. Both datasets are collapsed to the quarterly frequency.

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

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

4 Motivation and Empirical Strategy

In this section, I describe the motivation and empirical strategy underlying my findings.

4.1 Motivation

CLO covenant constraints can influence managerial trading behavior. In this section, I present two pieces of evidence which demonstrate how covenant performance may determine trading decisions with unintended price effects.

First, I examine heterogeneity in price pressure around Chapter 11 bankruptcy defaults. In Figure 2, I plot the price pattern around bankruptcy defaults for three categories of loans:

the cumulative abnormal average returns (CAAR) for loans that are issued by distressed firms and held by constrained CLOs ("Dist. Constrained," shown in red), loans issued by distressed firms and held by unconstrained CLOs ("Dist. Unconstrained," shown in blue), and, non-distressed firms held by constrained CLOs ("Non-dist., Constrained," shown in red) around firm bankruptcy.[5] A CLO is constrained if its performance on the Interest Diversion constraint is below the median.[6] *Non-dist., Constrained* loans are loans that are issued by non-distressed firms and held by constrained CLOs. I match this set of non-distressed firms to distressed firms that *do* file for Chapter 11 bankruptcy based on similar industry and size characteristics. The *Non-dist., Constrained* set of firms present a counterfactual for how non-O&G non-risky firms held by constrained CLOs perform relative to non-O&G risky firms held by constrained CLOs. The average abnormal returns are normalized to zero, five quarters before bankruptcy default.

I find that distressed firms held by unconstrained CLOs as well as non-distressed firms held by constrained CLOs exhibit virtually no impairment around firm bankruptcies. However, distressed firms that are held by constrained CLOs exhibit price pressure with a significant decline and reversal around default. At its trough, loans held by constrained CLOs experience a 5% cumulative abnormal average return, relative to the return five quarters before default.[7] CLOs trade at fire sale prices upon experiencing capital constraints. The reversal is explained by subsequent positive abnormal returns which compensate liquidity providers.[8] These stylized facts motivate the study of how trading decisions and price patterns may be mechanical reactions of innocent bystanders in response to forced sales by CLO managers who encounter unrelated idiosyncratic shocks.

[5]The specification is

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

where $P_{i,t}$ of loan i on date t is a function of the $E_t(V_i)$, $Q_{i,t}$, and $A_{i,t}$ which denote the fundamental value, purchase indicator (-1 for sale), and half spread (spread around the fundamental loan value), change in fundamental value is Z, a function of the following: (1) 5-Year Treasury Constant Maturity Rate (match duration of average leveraged loan); (2) Barclay's Corporate IG Index Return; (3) Barclay's Corporate HY Index Return; (4) S&P 500 Index Return; (5) S&P/LSTA Leveraged Loan Index Return. $Z_{i,t-1,t}$ denotes the vector of these components from $t-1$ to t. Identifying assumptions are: $E(\nu_{i,t-1,t}) = 0$ and $\epsilon_{i,t-1,t} = \nu_{i,t-1,t} + Q_{i,t}\eta_{i,t} - Q_{i,t-1}\eta_{i,t-1}$. Origins of this specification are described in Section 4.1 of Kundu (2021*b*).

[6]Loans that fall in the Constrained category are analogous to loans issued by WidgetCo B held by CLO B. Loans that fall in the Unconstrained category are analogous to loans issued by WidgetCo A held by CLO A using the empirical framework of Section 4.2.

[7]Quarterly CAARs are likely to be smaller than monthly CAARs. Taking the average across a larger time horizon attenuates the influence of anomalous and egregiously abnormal trades.

[8]A common hypothesis is that information revelation explains these findings. If information revelation informed selling behavior, the price would fall to a new level and stabilize there. The lack of "flattening" in prices suggests that trades are not driven by new information. Other hypotheses as well as implications are discussion in Kundu (2021*b*).

Further, I examine the relation between the propensity to sell mark-to-market or risky loans and covenant performance in Table A.1. Risky loans are defined as loans rated CCC/Caa1 or worse in excess of the CCC/Caa1 limit, discount obligations or defaulted loans. I use a linear probability model, exploiting variation within manager-year to examine how distance to the covenant threshold affects the likelihood of a risky sale.[9] The outcome variable takes a value of 1 if the CLO sells risky loans, and 0 otherwise. I find that a one standard deviation loosening in the capital constraints – shown in Columns 3, 5, and 7 for the Interest Diversion, Junior OC, and Senior OC covenants, respectively – relative to the mean, is associated with a 3% decline in the likelihood of selling risky loans, after accounting for structural aspects of CLOs through additional arranger and trustee fixed effects. In addition, the R^2 of the Interest Diversion constraint is the largest among all the covenants.[10] The results from this exercise inform the choice to restrict the analysis to the capital constraints, and in particular, the Interest Diversion covenant – the most stringent capital constraint.

These two pieces of motivating evidence demonstrate that *(1)* covenants produce trading effects, and, *(2)* covenants produce price effects around bankruptcy default events.

4.2 Empirical Methodology

The ultimate objective of this paper is to identify how CLO covenants determine the transmission of shocks. However, reliance on explicit measures of CLO health through performance measures, including distance to covenant thresholds may raise concerns about non-random matching between CLOs and firms. To circumvent these selection concerns, I exploit cross-sectional variation in exposure to the oil and gas (O&G) industry before the shock as a measure of risk that directly affects the capital constraint. In addition, I exploit the timing of the O&G price plunge to analyze the impact of the shock.

Consider the following thought experiment, as depicted in Figure 3. There are two CLOs: CLO A and CLO B. CLO A does not hold any firms operating in the O&G industry. CLO B has a sizeable exposure to firms in the O&G industry. With the exception of O&G exposure, suppose that both CLOs both hold a similar portfolio of loans issued by comparable firms in their respective portfolios. When the O&G price plunge occurs, CLO A is unaffected as CLO A is not exposed to O&G. However, CLO B may operate closer to its covenant thresholds, as

[9]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 (Loumioti and Vasvari (2019)).

[10]The *propensity* of selling risky loans is most strongly associated with performance on the capital constraints (OC and ID covenants), while the *amount* exhibits greatest sensitivity to the liquidity constraints (IC covenants), as shown in Kundu (2021*b*). For a comprehensive examination of competing hypotheses and detailed discussion of the relation between covenants and trading patterns, I refer readers to Kundu (2021*b*).

many O&G firms may be in distress and fall back on interest/principal payments. If CLO A contains a loan issued by WidgetCo A and CLO B contains a loan issued by WidgetCo B – both of which are vulnerable to being fire sold – the main objective of this paper is to study if there are differential effects for WidgetCo A as compared with WidgetCo B, simply based on differences in the distance to covenant triggers. Broadly, how do idiosyncratic shocks propagate to other portfolio firms through CLO intermediaries?

4.3 Specification

The baseline specification is a Bartik-style exposure difference-in-differences design. The sample period of study is from 2013-2015.

$$\begin{aligned} Y_{f,t} &= \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t \\ &\quad + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_f + \alpha_{m,y} + \epsilon_{f,t} \end{aligned} \tag{5}$$

where f denotes the portfolio non-O&G firm ($f \in$ CLO c), t indexes the time, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the issuer amount-weighted average O&G share of non-O&G firm f across all CLOs before the shock occurs, in the pre-period. Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. For simplicity, I refer to the *Oil Shock* variable as *Post*, hereafter.[11] In addition, I use the phrase "a firm's exposure to O&G" as shorthand notation to refer to to a non-O&G firm's exposure to O&G through the CLOs.

There are several assumptions underlying this empirical specification. In the remaining section, I will establish credibility of this design.

4.3.1 Concern #1: Exogeneity

A common concern with difference-in-differences specifications for causal inference is the exogeneity of shocks. If the shock is not exogenous, the policy may be correlated with the errors, causing inconsistency of the estimators. I argue that the Oil & Gas price plunge is exogenous. Figure 4 exhibits the average crude oil price ($ per barrel) from 1960 through 2020.[12] The price precipitously dropped starting from June 2014 to 2016 – 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)).[13]

[11] Goldsmith-Pinkham, Sorkin and Swift (2020) recommends measuring controls in the same time period as the shares. As I directly include firm fixed effects, I do not add firm-specific controls to the regressions.

[12] See Figure A.1 for the monthly crude oil price trend.

[13] A plot of monthly crude oil prices from 2012-2018 is available in Figure A.1.

There are several major factors that contributed to the oil price plunge. First, booming shale production in the US and improvements in fracking technology reduced break-even prices of shale production; post-crisis financing conditions facilitated improvements in oil extraction through hydraulic fracking and horizontal drilling.[14] Given the shorter life cycle of these projects and lower capital costs relative to conventional extracting methods, shale oil is more elastic to oil price changes than crude oil (e.g., Baffes et al. (2015); Krane and Agerton (2015); McCracken (2015)). Second, OPEC announced a shift in policy, renouncing price targeting, partly, in response to the increasing shale share of global oil supply. Third, receding geopolitical tensions allowed oil production to function without disruption or conflict – hence, supply remained steady. Fourth, the appreciation of the dollar from June 2014 and June 2015 increased the local cost of oil in countries where the currency was not pegged to the dollar. This contributed to "weaker oil demand in those countries and greater supply from non-US dollar producers" (Baffes et al. (2015)). While some contemporaneous demand shocks also occurred contemporaneously, e.g., stock market turbulence experienced in China, consensus has formed around supply-driven factors as dominant contributors of the oil price plunge (e.g., Arezki and Blanchard (2014); Hamilton (2014)). Regardless of the exact source, the main point is that it is it is outside of the leveraged loan and CLO markets.

4.3.2 Concern #2 with Strategy: Selection

The second concern with the proposed identification strategy is that matching between CLOs and firms may not be *as good as random*. In other words, CLOs with higher O&G exposure may be structurally different from CLOs with lower O&G exposure. Specifically, there may be a concern that CLOs with higher O&G exposure employ different hedging strategies than CLOs with lower O&G exposure or purchase different loans. 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 refer to a CLO with *high O&G* exposure if its portfolio share in the O&G industry is above median. It has *low O&G* exposure otherwise.

First, portfolios are largely overlapping across CLOs. While the total value of outstanding CLOs increased from 2007 through 2019 – from \$308 billion to \$606 billion – the number of issuers across CLOs experienced a rather meager increase (International Monetary Fund (2020)). Kundu (2021*a*) reports that the median issuer's loans were held in 78 CLOs in the aftermath of the Great Financial Crisis. The similarity in portfolio holdings is in part driven by the standardization of covenants across CLO portfolios (Bozanic, Loumioti and Vasvari (2018);

[14] Further, increased biofuel production and extraction from Canadian oil sands also coincided with the price plunge.

Elkamhi and Nozawa (2020)). Thus, 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 (Federal Stability Board (2019)).

Second, I do not find that the capital constraint threshold varies with O&G exposure before the shock. This is shown in Table A.2. In this cross-sectional regression, I study whether there is a relation between the ID threshold and O&G exposure, fixing the time period to the last report date before the shock. I include issuer controls, and various fixed effects intended to control for rating, industry, issuer, and year. I do not find stable or statistically significant point estimates. This suggests that there is no relation between the covenant threshold and O&G exposure. Moreover, the O&G price plunge was not a foreseeable event, hence, the O&G shares may be viewed as randomly assigned. Furthermore, as the test threshold cannot be renegotiated, it is unlikely to be endogenous to CLO investment decisions and trading behavior.

Third, Figure A.2 demonstrates that differences in the investment of non-O&G industries is negligible in comparing CLOs with high O&G exposure – CLOs with O&G exposure above the 75^{th} percentile – to CLOs with low O&G exposure – CLOs with O&G exposure below the 25^{th} percentile, before the shock. I do not find material differences in the allocation of non-O&G industries; the second largest difference in industry allocation between CLOs with high O&G exposure and CLOs with low O&G exposure is more than twice as small as the difference in O&G exposure – on average, it is more than 34 times smaller across all non-O&G industries. The industry Herfindahl-Hischman Index (HHI) is 0.0552 for CLOs with low O&G exposure and 0.05409 for CLOs with high O&G exposure for non-O&G industries, before the shock. Hence, a CLO portfolio may be considered a combination of two distinct portfolios: a portfolio of O&G exposures, and, the "market" portfolio – a portfolio of non-O&G loans. Therefore, I rule out concerns of selection based on industry allocation.

Fourth, in Figure A.3, I compare the geographic concentration of investment for CLOs with high O&G exposure – CLOs with above-median O&G exposure – to CLOs with low O&G exposure – CLOs with below-median O&G exposure, before the shock. The location of the firm is identified using the *State* identifier in DealScan. Geographic concentration is very similar; the Herfindahl-Hirschman Index is 0.0501 for CLOs with low O&G exposure and is 0.0493 for CLOs with high O&G exposure. Therefore, I rule out concerns of selection based on geography.

Fifth, I draw comparisons between CLOs with high O&G exposure and CLOs with low O&G exposure, based on observable characteristics. In Table A.3, I compare characteristics of firms that are held by CLOs with high O&G exposure – CLOs with above-median O&G exposure – to CLOs with low O&G exposure – CLOs with below-median O&G exposure, before the shock. The distribution of characteristics across firms held by CLOs with high O&G exposure is comparable to that of firms held by CLOs with low O&G exposure in several dimensions, including, size, Tobin's Q, leverage, market-to-book equity ratio, investment growth, investment, cash flow, and tangibility.

Sixth, I conduct two additional tests to directly test the sensitivity to oil. First, I study whether non-O&G firms held by CLOs with high O&G exposure have the same dependency on the price of oil as compared to firms held by CLOs with low O&G exposure before and after the shock. Second, I study whether it can forecasted which CLO a non-O&G firm will be held by, based on the covariance between the firm's profitability and oil price in a cross-sectional specification, fixing the time period to the last report date before the shock. These results are presented in Tables A.4 and A.5. I do not find any statistically significant relation between a firm's profitability and the oil price deviation, nor does this relation differ for firms held by CLOs with high O&G share – CLOs with above-median O&G exposure. Using a linear probability model, I also do not find evidence of forecasting CLO selection based on the covariance between price and profitability. Thus, I rule out concerns about portfolio hedging with respect to O&G exposure.

4.3.3 O&G as a Measure of Risk

In this section, I study whether a CLO's exposure to O&G is a relevant proxy for performance on the capital constraints.

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

In Table 2, I study the relation between a CLO's exposure the O&G industry, and its distance from the Interest Diversion threshold. Note that this is a CLO's exposure to O&G – not firm's exposure to O&G.

$$ln(\frac{\text{Covenant Result}}{\text{Covenant Threshold}})_{c,t} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t$$
$$+ \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \gamma_0' X_{c,t} + \epsilon_{c,t} \quad (6)$$

where c denotes the CLO, t denotes the time, X denotes the vector of controls, consisting of age and size. Covenant Result is the reported value of the covenant. Covenant Threshold is the threshold associated with the covenant. CLO O&G Exposure$_c$ is the O&G share of CLO c 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, I include manager fixed effects to absorb differences across managerial style and preferences. From Columns 2-3, I add CLO controls and time fixed effects. In Column 4, I include CLO and year fixed effects. In Column 5, I include CLO, manager, arranger, trustee, and month-year fixed effects. The results suggest that a 1 pp increase in the O&G share before the shock is associated with a 0.0486-0.0847 standard deviations decline in the distance to the ID threshold, after the shock. This estimate is nontrivial, given that on average, CLOs operate within 5% of their thresholds (Table 1). The estimate is economically meaningful, statistically significant, and stable across all specifications.

Hence, O&G is a relevant proxy for risk, and by extension, a CLO's performance on its capital constraints.

4.3.4 Parallel Trends

In this section, I assess pre-trends to study if the baseline result is driven by pre-trends before the oil and gas plunge. For identification, the parallel trends assumption states that the relationships between the secondary loan price of a loan issued by a non-O&G issuer and firm exposure to the O&G industry, and, distance to the ID threshold and CLO exposure to the O&G industry would have followed common trends across CLOs both before and after the price plunge in the absence of the price plunge. However, I cannot assess the counterfactual scenario of what would have occurred in the absence of the price plunge. Therefore, I assess whether there is divergence between CLOs with greater O&G exposure relative to CLOs with lesser O&G exposure before to the shock – do they trend in parallel?

In Figure 5, I study two features of the data. First, I study if pre-trends are parallel prior to the shock. Second, I study if the aforementioned relations differ *after* the shock.

Specifically, in Figure 5a, for a given firm, I chart the relation (point estimate) between the secondary loan price of a loan issued by firm f and firm f's O&G exposure, in six month increments surrounding the shock. In Figure 5b, for a given CLO, I chart the relation (point estimate) between the distance to the Interest Diversion threshold for CLO c and the CLO c's O&G exposure, in six month increments surrounding the shock.

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

In Figure 5a, the regression specification is:

$$P_{i,f,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{Firm O\&G Exposure})_f + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \delta_k \mathbb{1}_{k\leq t<k+6}$$
$$+ \theta_1 \text{Firm O\&G Exposure}_f + \alpha_f + \alpha_y + \epsilon_{i,f,t}. \tag{7}$$

In Figure 5b, the regression specification is:

$$ID_{c,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{CLO O\&G Exposure})_c + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \delta_k \mathbb{1}_{k\leq t<k+6}$$
$$+ \theta_1 \text{CLO O\&G Exposure}_c + \alpha_c + \alpha_y + \epsilon_{c,t}. \tag{8}$$

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

The β_i estimates prior to the shock are akin to placebo treatments; each of the β_i coefficients is a placebo test for whether the treatment has an effect. Under the parallel trends assumption, there should not be an effect before the treatment occurs. The findings are consistent with the assumption that prior to the shock, the relations between the secondary loan price of loans issued by non-O&G issuers and firm O&G exposure, and, distance to the ID threshold and and CLO O&G exposure is statistically indistinguishable from the last pre-treatment period – the 95% confidence intervals include the null.

After the shock occurs, the relations between firms' secondary loan prices and firms'

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

5 Results

In this section, I describe the main findings of the paper. First, I provide evidence of CLO fire sales. Second, I demonstrate that the fire sales have extensive implications on asset prices across several financial instruments. Third, I show that there are real effects at the firm-level.

5.1 CLOs Fire Sell Non-O&G Loans

I begin by examining the trading decisions of CLO managers at the transaction, CLO-issuer, and issuer level. In Table 3, I present the relation between firm O&G exposure and the transaction amount. The transaction amount is coded as negative if the transaction is a sale, and positive if the transaction is a purchase. In Column 1, I do not include any fixed effects. In Columns 2-6, I add additional fixed effects including manager, rating-industry, issuer-loan type, year, and month-year fixed effects. I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with 0.1062-0.1819 standard deviations decline in the transaction amount, after the shock.

Further, I investigate whether these patterns hold in net at the CLO-issuer pair level. I aggregate across all transactions of a given issuer for each CLO. These results are presented in Table A.6. In Column 1, I do not include any fixed effects. In Columns 2-6, I add additional fixed effects including manager, rating-industry, CLO-issuer, year, and month-year fixed effects. I find that a 1 pp increase in firm's exposure to O&G before the shock is associated with 0.1057-0.2377 standard deviations decline in the net transaction amount at the CLO-issuer level after the shock. Similarly, after aggregating all transactions to the issuer level in Table A.7, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with 0.0168-0.0295 standard deviations decline in the net transaction amount at the issuer-level, after the shock.

However, a reduction in the transaction amount or net transaction amount is not tantamount to an increase in the amount of sales; a decline in purchases may yield these findings. To directly test whether the amount of sales increases or purchases decline, I restrict the analysis to purchases and sales, separately, and aggregate to the issuer level. These results are presented in Table A.8. There is an increase in the total amount of selling, as reflected in Columns 4-6. Concretely, a 1 pp increase in a firm's exposure to O&G is associated with 0.0815-0.1095 standard deviations increase in the net sales at the issuer-level, after the shock. There is a positive change in the amount of net purchases after the O&G shock, however, the estimate is not statistically distinguishable from zero, as reflected in Columns 1-3.

Hence, selling increases in the degree of constraint.

5.2 Implications for Asset Prices

In this section, I discuss how firm exposure to O&G through CLOs is related to asset prices of instruments issued by non-O&G firms after the O&G price plunge.

First, I study how the secondary loan price per $100 of notional par, varies with a firm's exposure to O&G in Table 4. In Column 1, I do not include any fixed effects. I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline in the secondary loan price by $1.83, after the shock. Before the shock, a 1 pp increase in a firm's exposure to O&G before the shock is associated with an *increase* in the secondary loan price by $2.03 (per $100 par). The nearly equal and opposite signs reflect the boom and bust of O&G – consistent with the trading patterns before and after the shock in Table 3. This suggests that the prices of debt securities issued by innocent bystanders are expected to exhibit higher volatility when CLOs have larger exposure to more volatile sectors, like O&G.

In Columns 2-6, I add additional fixed effects including manager, rating-industry, issuer-loan type, year, and month-year. The inclusion of issuer-loan type fixed effects reduces the point estimate in Columns 5 and 6. Based on these columns, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline in the secondary loan price by $0.67-$1.82 (per $100 par), after the shock. Thus, secondary loans issued by non-O&G firms trade at a lower price after the shock, if the firm had higher exposure to O&G before the shock. The point estimates are economically meaningful and statistically significant across all specifications.

Given the small T dimension of the panel, the identifying assumption for the subsequent analyses are that issuer fixed effects fully control for demand throughout the sample period. A weaker identifying assumption is that changes in firm demand are sticky, relative to changes in supply. I include instrument-specific and sectoral controls, when applicable, as additional local demand controls. These controls account for other dimensions of heterogeneity in the data.

Time fixed effects are included to control for common shocks. Further, I conduct a falsification exercise in Section 5.4, confirming that the findings are not driven by changes in demand.

Next, I study how the spread associated with refinancing primary institutional loans varies with O&G exposure, after the shock in Table 5. The outcome variable is the All-In-Drawn spread, defined as the total annual spread above LIBOR for each dollar drawn from a loan. I classify a loan as *institutional* if it is a Term Loan that is not Term Loan A. I include issuer fixed effects across all specifications. The least conservative specification is presented in Column 1, while the most conservative is presented in Column 5, controlling for various dimensions of loan heterogeneity and common shocks. Across Columns 1-5, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with an increase in the primary loan spread by 13-23 bps, after the shock. In spite of the relatively small sample, I find strong significance across all specifications. This suggests that firms which seek refinancing after the shock experience higher spreads if they were more exposed to the O&G industry through CLOs before the shock.

Further, I study how the loan maturity and loan quantity of refinancing primary institutional loans varies with O&G exposure, after the shock in Tables A.9 and A.10, respectively. In Table A.9, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease in loan maturity by 2.97-4.60 months, after the shock. The point estimate is statistically significant, economically meaningful, and stable across all specifications. Furthermore, in Table A.10, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease in loan amount by 0.009-0.0677 standard deviations, after the shock. While the point estimates associated with the loan amount are economically meaningful and stable across all specifications, they are not statistically significant.

Next, I examine the sensitivity of bond credit spreads to firm O&G exposure after the shock. Past work has shown that banks are the main source of funding for riskier and more opaque firms, as banks have the ability to monitor borrowers (e.g., Diamond (1984); Diamond (1991); Petersen and Rajan (1994); Petersen and Rajan (1995); Bolton and Freixas (2000)). It is also well established that upon experiencing an aggregate shock, firms substitute from bank debt to public debt (e.g., Kashyap, Stein and Wilcox (1993); Adrian, Colla and Shin (2013); Becker and Ivashina (2014)). I investigate whether there is substitution by other market participants in Table 6. I include issuer and bond-type fixed effects across all specifications. I control for various dimensions of bond heterogeneity in Columns 2-6, including time to maturity, security-level, rating, investment-grade status, defaulted status, and fixed effects to control for common shocks. I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with an increase in the bond credit spread by 28-35 bps, after the shock. Furthermore, bond liquidity, as measured by the trade-weighted average bid-ask spread also widens, as shown in Table A.11; a 1 pp increase in a firm's exposure to O&G before the shock is associated with an increase in bond liquidity by 0.0260-0.0269 standard deviations, after the shock. These estimates are statistically significant, economically meaningful, and stable. These findings suggest that if outside investors are unable to discern a deterioration in firm fundamentals from a deterioration in CLO constraints, substitution by other market participants may be imperfect.

Next, given the difficulties of obtaining external financing, I study how firm liquidity is affected, as measured by the amount of credit available through revolving credit facilities. The results of this exercise are presented in Table 7. In Columns 1-3, the outcome variable is the quarterly change in the unused line of credit. In Column 4-6, the outcome variable is the quarterly change in the drawn line of credit. I include issuer fixed effects across all specifications. I add year fixed effects in Columns 2-4, and industry and month-year fixed effects in Columns 3-6. I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a 0.0275-0.0280 standard deviations decline in quarterly change in the unused line of credit and a 0.0342-0.0347 standard deviations increase in quarterly change in the drawn line of credit.[15] These point estimates are statistically significant, economically meaningful, and stable across all specifications.

In summary, a one percentage point increase in a firm's exposure to O&G before the shock is associated with 0.1062-0.1819 standard deviations decline in the transaction amount, \$0.67-\$1.82 decline in the secondary loan price, increase of 18-23 bps in the primary loan spread, increase of 28-35 bps in the bond credit spread, 0.0275-0.0280 standard deviations decline in the quarterly change in the unused line of credit, and a 0.0342-0.0347 standard deviations increase in the quarterly change in the drawn line of credit.

5.3 Implications for Corporate Outcomes

Thus far, it has been established the firm exposure to O&G through CLOs may have significant effects on the prices of various debt securities. In this section, I examine how the innocent bystanders respond.

I study whether firms make financial and real adjustments in Table 8 in response to experiencing intermediary constraint and a tightening of credit. I examine how a firm's exposure

[15]The low frequency (quarterly) of reporting suggests that the standard errors may be understated. To generate an upper-bound, I present the results from wild two-way cluster bootstrapping by issuer and quarter-year from 1,000 simulations in Table A.12. The differences are negligible in the t-statistics and p-values. I do not manually compute standard errors, per Roodman et al. (2019), as using the imputed standard errors for inference rely on the asymptotic normality of $\hat{\beta}$ which is not applicable when large-sample theory does not apply.

to O&G through CLOs can affect long-term debt growth in Column 1, cash flow in Column 2, real sales growth in Column 3, acquisitions in Column 4, investment in Column 5, R&D growth in Column 6, and employment growth in Column 7. A description on the construction of these variables is in Section B. I include issuer, industry, and quarter-year fixed effects across all columns. A 1 pp increase in a firm's exposure to O&G before the shock is associated with 0.0430 standard deviations decline in long-term debt growth, 0.0304 standard deviations decline in cash flow, 0.0378 standard deviations decline in investment, 0.0866 standard deviations decline in R&D growth, and 0.0447 standard deviations decline in employment growth, after the shock. These estimates are economically meaningful and statistically significant. Furthermore, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with statistically significant, yet economically minute declines in real sales growth and acquisitions. These results suggest that when intermediaries face constraints and credit supply is constrained, firms reduce their cash flow and scale back operations, as measured by these various dimensions of firm fundamentals. Hence, these findings demonstrate how intermediary distress may propagate to the firm level.

The financial and real adjustment of firm outcomes suggests that there may be a tangible effect on equity returns. In Table 9, I study how a firm's exposure to O&G through CLOs may affect its monthly equity return. Across all columns, I include issuer fixed effects. I include year fixed effects in Columns 2-4. I add the market model factors in Column 3 – the risk-free rate and market risk premium. In Column 4, I include the Fama-French three factors, adding SMB and HML to the specification of Column 3. In Column 5, I include the Fama-French five factors, adding RMW and CMA to the specification of Column 5. Specifically, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a 0.2918-0.2976 pp decline in monthly equity returns, after the shock. This point estimate is economically variable, statistically significant and stable. Thus, equity returns experience a decline in the O&G exposure of a firm, after the price plunge. Moreover, according to Column 1, a firm's exposure to O&G as well as the level of the price, as reflected by the *Post* variable, can explain 0.0616% of equity returns. Thus, O&G exposure can also predict and explain equity returns to some extent.

5.3.1 Cross-Sectional Effects

What types of firms are hit particularly hardest? To answer this question, I run a number of cross-sectional tests, studying the relation between firm O&G exposure and investment for several subsamples for firms. As firm financial and fundamental data is only available for publicly held companies, it is expected that the estimates will be larger for private or smaller firms, which may be more dependent on bank credit. While I cannot overcome the data limitation, I can study how the effects differ based on the bifurcation of firms by access to the bond market, size, age, sector, and timing of loan refinancing, shown in Table 10. I include issuer, industry, and quarter-year fixed effects throughout all specifications.

It is hypothesized that firms which are dependent on banks as a source of external financing are most susceptible to shocks faced by CLO intermediaries. To test this hypothesis, I segment firms based on access to the bond market. Firms that issued bonds are considered to be firms with access to the bond market. These firms are in Column 1. Firms that did not have issue any bonds are included Column 2. The decline in investment is driven by firms which did not have access to the bond market; a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease (increase) in investment by 0.1017 (0.0061) standard deviations for firms without (with) access to the bond market, after the shock.

Similarly, I segment firms based on size. I find that the decline in investment is larger for smaller firms. A firm is small if its size is below the median firm size across all firms. Based on Columns 3 and 4, a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease in investment by 0.0839 (0.0109) standard deviations for small (large) firms, after the shock. Further, segmenting based on median age in Columns 5 and 6, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease in investment by 0.0669 (0.0341) standard deviations for young (old) firms, after the shock. Hence, smaller firms and younger firms – firms that are more bank dependent – experience larger reductions relative to larger and older firms. I study how the combination of age and size generate a pecking order in the magnitude of the effect in Table A.13; large and old firms experience the smallest reduction to investment, followed by large and young firms, small and old firms, and small and young firms.

Further, I study whether there are differences in investment based on firm sector. In Columns 7 and 8, I segment firms based on sector-type. A firm is tradable if the firm is in the manufacturing, agriculture, forestry, fishing and hunting, mining, or management of companies and enterprises industries. It is nontradable otherwise. I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease in investment by 0.0418 (0.0358) standard deviations for tradable (non-tradable) firms after the shock. I assess the statistical significance of these differences below.

Lastly, in Columns 9 and 10, I study how the timing of loan refinancing affects firm investment, among firms that do not have access to the bond market. In Column 9, the set of firms consist of those which had last refinanced *after* the shock within the sample period. The set of firms in Column 10 are those which had last refinanced *before* the shock within the sample period. I find that among the firms which are dependent on bank financing, those which had last refinanced before the shock fare worse than those which had refinanced even after the shock; a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease in investment by 0.1083 (0.0684) standard deviations after the price plunge, for firms which had last refinanced before (after) the shock, after the price plunge.

Further, I study how the combination of access to the bond market and timing of refinancing generate a pecking order in the magnitude of the effect in Table A.14; the change in investment is highest for firms with access to the bond market which had last refinanced after the shock, followed by firms with access to the bond market which had last refinanced before the shock, firms with no access to the bond market which had last refinanced after the shock, and firms with no access to the bond market which had last refinanced before the shock.

While the point estimates associated with *no access*, *small*, *young*, *tradable*, and *before shock* refinancing are all economically meaningful, it is unclear whether the differences between the subsamples are statistically significant. To assess statistical significance of the difference of the subsamples, I run difference-in-difference-in-differences empirical specifications and report the significant findings in Table A.15. I find that the point estimates by size and access to the bond market are statistically distinct. Hence, the findings of this analysis corroborate the hypothesis that firms which are more bank-dependent drive the aggregate decline in investment, shown in Table 8.

5.4 Robustness

I conduct a battery of robustness tests to check if the results are robust to alternative specifications, measures, and definitions in addition to the supplemental results referenced in the previous sections.

First, to identify whether the findings are truly driven by changes in supply, I conduct a falsification test. 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-Drawn spreads associated with these facilities should exhibit a similar increase in response to changes in demand. If the findings are driven by intermediary constraint, namely, O&G exposure – not changes in demand – the All-In-Drawn spread should not exhibit any sensitivity to firm O&G exposure, after the shock as firm fundamental quality has not deteriorated. The results of this exercise are presented in Table A.16 for revolving lines of credit and Term Loans A. I do not find evidence of any increase in the All-In-Drawn Spread for these facilities. Thus, I rule out that the findings are driven by changes in demand.

Second, there may be a concern that omitted variable bias (OVB) is driving the results. To ensure that the results are not driven by OVB, I conduct two placebo tests. I randomize the O&G share from a uniform distribution and run 1,000 Monte-Carlo simulations of two conservative regression specifications: Column 5 of Table 4 and Column 4 of Table 5, respectively. The results of this exercise ensure that the baseline results are not driven by OVB, as long as the structure of omitted variables is identical across CLOs. The point estimate of the interaction term from 1,000 Monte-Carlo simulations are presented in Figure A.4. The outcome variable is the secondary loan price in Figure A.4a and the All-In-Drawn spread in Figure A.4b. The "true" estimated point estimates lie outside of the graph. The t-statistics for tests of the null hypothesis – the mean estimate is equal to zero – are -0.7503 and 0.7690 in Figures A.4a and A.4b, respectively. Hence, the null hypothesis that the mean is equal to zero cannot be rejected in either case. This confirms that OVB does not drive the results; firm exposure to O&G is crucial for the findings.

Third, I rule out the results are driven by anomalous characteristics of O&G exposure. In Table A.17, I verify that the results are robust to alternative measures of issuer exposure to CLOs by replicating two conservative regression specifications: Column 5 of Table 4 and Column 4 of Table 5, respectively for various measures of issuer exposure. In Columns 1 and 2, the measure of issuer exposure for firm f is constructed by taking an issuer amount-weighted average of the distance to the ID threshold ($ln(\frac{\text{Covenant Result})}{\text{Current Threshold}})$) across all CLOs, before the shock occurs. Based on Columns 1 and 2, I find that a one standard deviation decrease in a firm's exposure to the constraint before the shock is associated with a decrease of \$0.42 in the secondary loan price, and an increase of 12 bps for the All-In-Drawn spread. In Columns 3 and 4, the measure of issuer exposure for firm f is the equal-weighted average O&G share of firm f across all CLOs before the shock occurs. These columns indicate that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline in the secondary loan price by \$0.45 and increase in All-In-Drawn spread by 20 bps. In Columns 5 and 6, the measure of issuer exposure for firm f is the loan-frequency equal-weighted average O&G share of firm f across all CLOs before the shock occurs. Note, this differs from the definition used in Column 3 and 4 in which there is one entry for each issuer held in a CLO (collapsing across loans). Columns 5 and 6 indicate that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline in the secondary loan price by \$0.83 and increase in All-In-Drawn spread by 21 bps. In Columns 7 and 8, the measure of issuer exposure for firm f is the loan-frequency value-weighted average O&G share of firm f across all CLOs before the shock occurs. These columns indicate that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline in the secondary loan price by \$0.80 and increase in All-In-Drawn spread by 20 bps. Lastly, in Columns 9 and 10, the measure of issuer exposure for firm f is the loan-amount value-weighted average O&G share of firm f across all CLOs before the shock occurs. These columns indicate that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline in the secondary loan price by \$0.83 and increase in All-In-Drawn spread by 21 bps. This check confirms that the results are robust to other measures of issuer exposure.[16]

Lastly, I consider how the results differ under an alternative empirical specification in which I directly use the log-transformed oil price instead of the indicator variable for the price plunge. I plot the marginal effects – the slope of various outcome variables on price, while holding the value of the O&G share constant between 0 and 1 in Figure A.5. As the crude price is higher, it is expected that firms with greater O&G exposure will perform experience higher secondary loan prices and lower All-In-Drawn spreads. Conversely, when the crude price is lower, firms with greater O&G exposure will perform experience lower secondary loan prices and higher All-In-Drawn spreads. The plots of Figure A.5 are consistent with these hypotheses. This result also reinforces the result that the prices of debt securities have higher volatility when their exposure to volatile sectors is higher.

6 Mechanism

In this section, I will first describe how price effects in the secondary loan market can propagate across debt instruments and why other investors do not step in. Then, I will explore the persistence of the O&G shock. Lastly, I will connect the incentives of CLO managers to actions they take in managing their portfolios to elucidate the underlying mechanism that sets off the effects described in Section 5.

6.1 What Causes Contagion?

CLO fire sales in the secondary loan market can spur contagion across debt instruments. This can be explained by a variation of a no-arbitrage argument. A prospective buyer who seeks exposure to a specific firm may purchase any form of debt secondary issuance, primary issuance, bonds, etc. CLOs constitute marginal investors in the secondary loan market which is illiquid relative to other capital markets. When they become constrained, CLOs sell loans

[16] I have replicated the entire analysis taking CLO structure into consideration by running the regressions at the $Issuer - CLO - Time$ level. The main findings are robust and available upon request.

issued by innocent bystanders to generate slack in their constraints (discussed more in detail in Section 6.3). As the spread associated with secondary loans widens, other forms of debt also experience a widening of spreads. This is because in market equilibrium, the expected rate of return for any form of debt issued by a firm is equalized. For the affected innocent bystanders, the secondary market spread becomes the effective cost of capital. Thus, the real costs of fire sales may exacerbate credit crunches by contracting credit as described in Diamond and Rajan (2011).

This begs the question: why do other investors not step in to eliminate excess returns? More than half of the total volume of leveraged loans is held by banks, which typically retain amortizing Term Loans A and revolving credit facilities while selling the non-amortizing Term Loans B and below to non-bank participants including CLOs, mutual funds, pension funds, and insurers (Kundu (2021*a*)). During periods of crisis, like the O&G price plunge, the most natural buyers of leveraged loans – other CLOs – may be unable to purchase absorb excess supply due to similar constraints. "Outsiders" or non-specialists may have valuations below that of CLOs, which can lead to depressed prices (Shleifer and Vishny (1992)). The limited investor base, coupled with the relatively illiquid secondary loan market suggests that large-scale redemptions may have tremendous impact and produce persistent dislocations in prices as the total purchase by prospective buyers may be insufficient to offset the price decline. In light of the regulatory and risk-based capital constraints that banks, insurance and pension companies are subject to, such investors may not be able to absorb excess supply despite the prospects of profitability. Furthermore, less regulated financial institutions, including hedge funds and mutual funds which specialize in distressed loans may face limits to arbitrage (Shleifer and Vishny (1997)). Performance-based arbitrage may be ineffective when arbitrageurs, including less regulated entities, fear further mispricing and are fully invested. This can explain why the effects persist, as discussed next.

6.2 Persistence and Dynamic Effects

Forced sales in the relatively illiquid secondary loan market may increase the effective cost of capital across debt markets in market equilibrium. In this section, I discuss the persistence and dynamic effects of the shock. This is important for establishing the plausibility in the link between financial market dislocations and real effects.

For assessing persistence of the initial shock, I conduct several Jordà style linear projections, as shown in Figure 6. The coefficients in these figures are estimated from the following regression:

$$Y + f, t + h - Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure}_f \times \text{Post}_t) + \beta_2\text{Firm O\&G Exposure}_f + \beta_3\text{Post}_t + \alpha_f + \alpha_y + \epsilon_{f,t}. \tag{9}$$

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

The results of the linear projection are shown in Figure 6. Figure 6a and Figure 6b show the responses of the secondary loan price and bond credit spread. Figure 6c and 6d show the responses of leverage and investment. Figures 6a and 6b indicate that asset prices fall and spreads increase for four quarters. There is an inflection after four quarters. Prices begin increasing and spreads start declining. It takes a total of seven quarters for prices and spreads to revert back towards zero. The dynamic effects of firm O&G exposure on bond credit spreads and equity returns shown in Figure A.6 are consistent with financial variables exhibiting an instantaneous response. However, firm characteristics respond after a lag. Leverage does not respond until four quarters after the initial shock, as shown in Figure 6c. It shows signs of reversal after seven quarters. Investment declines two months after the initial shock, and falls until the seventh quarter, after which it reverts back towards zero, as shown in Figure 6d. These findings suggest that asset prices start falling from the inception of the shock, while firm fundamental characteristics begin their descent with a lag. All outcomes exhibit a consistent reversal after seven quarters.

Hence, the dislocation in asset prices endures long enough for real effects to materialize. Persistence arises from financial frictions which may magnify the time for the price to recover and the magnitude of deviation.[17] This finding suggests that a temporary episode of distress can damage firms for a longer-term – an externality of "short-termist" damage control, discussed further in Section 6.3.

[17]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)).

6.3 Contractual Arbitrage and CLO Portfolio Effects

As described in Section 2.1, the piecewise nature of the accounting of covenant constraints can distort the incentives of CLO managers. If CLO managers face a sizeable number of downgrades and defaults in their portfolio, their capital constraints may tighten. This is a result of the accounting rules associated with the measurement of capital constraints.

The capital constraints are effectively measures of leverage, defined as the ratio of total value of assets to total value of liabilities. Assets are marked at book value, unless a loan has experienced default, is rated CCC/Caa1 or below, putting the CLO in excess of its limit, or is a discount obligation. Under these circumstances, a loan is marked to the lower of market value and recovery value, lowest market values of the CCC/Caa1 bucket, or purchase price until the loan trades above a threshold (typically 90) for more than 30 days, respectively. Therefore, a slew of adverse credit events may tighten a CLO's capital constraints by increasing the share of defaulted, CCC/Caa1 or discount obligations – inputs to the capital constraints.

Among the loans in the aforementioned categories of distress, CLOs are incentivized to sell the best of their riskiest loans while keeping the worst ones. If the share of loans rated CCC/Caa1 or below in a portfolio is above its limit, the excess loans are marked at the *lowest* market value of all loans in this segment. The CLO can then maximize improvements to the capital constraint by selling loans in the CCC/Caa1 category in descending order of market value.[18] This is illustrated in Section 2.1. Similarly, with regard to defaulted loans, if the projected recovery value of a loan is lower than its market value, a CLO can maximize improvements to the total value of assets as accounted for in the capital constraints by selling loans in descending order of the difference between market value and recovery value. This may be likely with rating agencies which provide corporate ratings in lieu of individual loan ratings. As leveraged loans are senior secured loans, the loan recovery rate may be higher than the recovery rate of of a company as a whole. Lastly, with discount obligations, CLOs can similarly exploit differences between the purchase price and market value to improve their capital constraints. In all three instances, managers can exploit loopholes as the accounting of covenants does not follow a continuous function.

The design of CLO managerial contracts suggest that when managers experience constraint, they may sell riskier loans. While the purported aims of the covenants are to ensure that CLOs which operate close to their covenant thresholds appropriately derisk, it is ambiguous whether constrained CLOs actually do derisk. An alternative story may be that CLOs "gamble for resurrection" by shifting their industry composition to the riskiest sector. I study

[18] This assumes that there is heterogeneity in loan prices within the CCC/Caa1 bin.

this by comparing the change in industry composition (non-O&G industries) among CLOs with high O&G exposure, before and after the shock. This is shown in Figure A.2. 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.

Further, while exploiting the differential accounting rules may generate large improvements to the OC constraints, CLOs may alternatively generate improvements by selling loans which trade above par while purchasing those below par. To study this, I study the propensity to sell risky loans as reflected by the loan price. Using a linear probability model, in Panel A of Table 11, I study how the likelihood of selling a loan that trades above par changes in response to firm O&G exposure after the O&G price plunge. The outcome variable takes a value 1 if the loan that is sold trades above $100 per $100 of notional par, and 0 otherwise. In Panel B of Table 11, I study how the likelihood of selling a loan that trades below par changes in response to firm O&G exposure after the O&G price plunge. The outcome variable takes a value 1 if the loan that is sold trades below $90 per $100 of notional par (typical threshold for discount obligations), and 0 otherwise. I include combinations of rating-industry, issuer-loan type, year, and month-year fixed effects in Columns 1-5. I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decrease in the probability of selling loans above par by 4-11%, after the shock. A 1 pp increase in a firm's exposure to O&G before the shock is associated with an increase in the probability of selling loans below par by 2-4%, after the shock. This simple exercise suggests that upon experiencing constraint, CLOs are more likely to sell loans that trade below par than above par. This is plausible as replicating the par gains generated by the spread between the accounted value of a loan and the market value of a loan through above-par sales and below-par buying may require a greater volume of transactions. I ensure that these findings are robust by studying whether these relationships hold under consideration of CLO O&G exposure (rather than firm O&G exposure). These results are shown in Table A.18.

If CLO managers sell riskier loans upon experiencing constraint, it is expected that the composition of the CLO portfolios may also change. First, I study whether the interest rate associated with individual loans changes with firm O&G exposure, after the shock. This is presented in Table 12. I include index and time (year in Columns 1-4, month-year in Column 5) fixed effects across all columns. In Column 1, I include issuer fixed effects. Manager or CLO fixed effects are included to control for differences across managers and CLOs in Columns 2-4. In Columns 5-6, I include CLO-issuer fixed effects and CLO-issuer-loan type fixed effects in Column 6. In Column 7, I additionally control for loan tenor and rating. In the most conservative specifications, variations of the CLO-issuer fixed effects absorb heterogeneity across CLO-issuer pairs, and may be interpreted as a within CLO-issuer estimator. I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline in the interest rate by 9-13 bps. This relationship holds under consideration of CLO O&G exposure (rather than firm O&G exposure), as shown in Table A.19. Hence, this finding suggests that the riskiness of a loan, as reflected by the interest rate, declines in the degree of constraint.

I directly test whether the incidence and amount of risky loans changes with the degree to constraint. First, I study whether the incidence of defaulted loans declines in the degree of constraint in Table 13. The outcome variable takes a value of 1 if the loan has defaulted, and 0 otherwise. 82% of all defaulted loans have a rating CCC/Caa1 or below; the non-CCC/Caa1 loans are mostly concentrated among single-B rated loans. The fixed effects structure in this analysis is identical to that discussed for Table 12 for Columns 1-6, without any index fixed effects. The results indicate that a 1 pp increase in a firm's share of O&G before the shock is associated with a decline in the probability that a loan is defaulted by 0.16-0.33%. Thus, the probability that a defaulted loan is held by CLOs decreases in the degree of constraint. For robustness, I apply an alternative definition of *risky* loans, using an indicator for whether a loan is rated CCC or below. This is shown in Table A.20. The magnitude is larger; a 1 pp increase in a firm's share of O&G before the shock is associated with a decline in the probability that a loan is defaulted by 0.8172-0.9971%. Second, I study whether these findings are consistent with aggregate changes that occur at the CLO-level, exploiting cross-sectional variation in CLO exposure to O&G before the shock. In Table 14, I study how a CLO's exposure to O&G affects the share of defaulted and risky (sum of defaulted and CCC share) loans held in a given CLO portfolio in Columns 1-3 and Columns 4-6, respectively. The results indicate that a 1 pp increase in a CLO's share of O&G before the shock is associated with a decline in the share of defaulted loans by 0.0552-0.0566 standard deviations, after the shock. Further, a 1 pp increase in a CLO's share of O&G before the shock is associated with a decline in the share of risky loans by 0.0325-0.0337 standard deviations, after the shock. The point estimates are economically meaningful, statistically significant, and stable.

Consistent with the motives established by contractual arbitrage, CLO managers do de-risk and sell riskier loans upon experiencing constraint. This suggests that the financial and real effects ought to be more pronounced for the risky segment of firms held in CLO portfolios. I define a firm as *risky* if it has experienced a loan default in the sample period. A firm is otherwise *non-risky*. In Table 15, I compare how the secondary loan price, All-In-Drawn spread, and investment outcomes differ for risky and non-risky firms, after including a battery of fixed effects and control variables. I find that the aggregate declines in secondary loan price, All-In-Drawn spread, and investment are driven primarily by risky firms. A 1 pp increase in a firm's exposure to O&G before the shock is associated with a decline of $2.32 in the secondary loan price (per $100 par), 56 bps increase in the All-In-Drawn spread, and 0.12 standard deviations decline in investment, after the shock. These point estimates are economically meaningful, statistically significant, and stable. These findings contrast with the statistically insignificant estimates produced for non-risky firms; a 1 pp increase in a firm's exposure to O&G before the shock is associated with an increase of $0.34 in the secondary loan price (per $100 par), 11 bps increase in the All-In-Drawn spread, and 0.02 standard deviations decline in investment, after the shock. I test whether these differences are statistically significant in Table A.21.

Thus, the findings are consistent withe contractual arbitrage.

7 External Validity

In this section, I study whether the proposed mechanism may be externally validated using the COVID-19 shock. I conduct my analysis for a relatively benign macroeconomic period – from 2013-2015. This is a period in which financial markets were calm and relatively liquid. While the effects emanating from a financially tranquil period may be temperate, it raises concerns of what may occur when markets become more illiquid during times of stress. 90% of CLOs are exposed to the top 50 US borrowers, and 80% are exposed to the top five borrowers (Federal Stability Board (2019)). Default can impose negative externalities on other firms held in the CLO portfolio or the same industry. This can have especially deleterious effects if issuers simultaneously default. I replicate the baseline result using the COVID-19 shock for external validity and study how the magnitude changes under more adverse shocks. The identifying assumption for this analysis is that COVID-19 is not an aggregate shock, but rather a series of industry-wide shocks across several vulnerable industries.

The time period for this analysis is from Jan 1, 2020-May 6, 2020. I limit the analysis to this time period based on the analysis of Foley-Fisher, Gorton and Verani (2020), which shows that a structural break in the standard deviation of AAA-rated CLO prices occurred then, coinciding with the 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. Moreover, *Post* variable takes a value of 0 before March 1, 2020 and 1, afterwards.

The methodology for the construction of the shock is the same as the baseline analysis. I study how the point estimate changes under different proxies for the capital constraint. This is shown in Table 16, in which I replicate the most conservative specification of Table 4 with issuer-loan type and month-year fixed effects, under different proxies. The capital constraint is proxied by O&G exposure in Column 1 as in the baseline analysis, automobile and automotive exposure in Column 2, retail exposure in Column 3, consumer goods exposure in Column 4, transportation (consumer) exposure in Column 5, transportation (cargo) in Column 6, O&G and auto exposures in Column 7, retail and consumer goods exposures in Column 8, and all exposures (O&G, automobiles, retail, consumer goods, transportation, and cargo) in Column 9.[19] These industries were the most vulnerable during the COVID-19 pandemic. I verify that CLO exposure to these industries affect distance to the ID constraint in Table A.22.

As in the baseline analysis, I study how the outcome varies for firms which are not in the industry designated in the column header. In Column 1, I find that a 1 pp increase in a firm's exposure to O&G before the shock is associated with a \$0.91 decline in the secondary loan price, after the shock – 35% higher than during the O&G shock. In Column 2, I find that a 1 pp increase in a firm's exposure to automobiles before the shock is associated with a \$0.75 decline in the secondary loan price, after the shock. The magnitude is higher when using consumer goods and retail as individual proxies for the capital constraint. According to Columns 3 and 4, a 1 pp increase in a firm's exposure to retail and consumer goods before the shock is associated with declines of \$1.42 and \$2.04 in the secondary loan price, for the respective exposures, after the shock. In Column 5 and 6, I study how the estimate differs using different measures of transportation: consumer and cargo respectively. I find that a 1 pp increase in a firm's exposure to consumer transportation and cargo transportation before the shock is associated with declines of \$0.84 and \$3.15 for the respective proxies for the capital constraints. In Column 7, 8, and 9, I combine the O&G and auto exposures, retail and goods exposures, and all exposures, respectively, and study how outcomes are affected for firms which are not in the industries that comprise the exposures. These columns indicate that a 1 pp increase in the exposure before the shock is associated with a \$0.6923-\$1.6799 decline in the secondary loan price, after the shock. The estimate across all columns is larger in magnitude than that of the baseline table. Hence, the effect is expected to be larger during crisis periods with limited intervention.

8 Conclusion

This paper demonstrates how covenants provide a mechanism for diffuse, idiosyncratic or sectoral shocks to snowball into larger shocks through CLO intermediaries. When CLOs ex-

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

perience shocks, they may operate closer to their capital constraints. The piecewise nature of accounting associated with the covenant constraints induces CLOs to sell unrelated, riskier loans in their portfolio to alleviate covenant constraints. This type of contractual arbitrage poses systemic concerns. Given the illiquidity of corporate debt markets, including the secondary loan market, forced sales may have substantial financial and real effects. Thus, fire sales originating from the CLO market may exacerbate credit crunches, by propagating shocks through capital markets.

CLOs may be characterized as shadow banking institutions, as they are not subject to direct oversight, and operate as unregulated financial intermediaries. Given that regulatory bodies have limited supervisory authority to directly address the risks originating from CLOs and leveraged loans, future theoretical work on the design of optimal contracts with consideration of welfare effects can inform the tradeoffs associated with different contractual and policy proposals. The impact of reform remains ambiguous with regard to covenants. Some proposals to reduce balance sheet shrinkage in the CLO context may entail making modifications to the frequency and accounting of covenants. On the one hand, greater stringency of covenants via current accounting and reporting methods generates more credit in the economy ex-ante by ensuring that debt claims have minimal risk in most states of the world (DeMarzo (2005)). However, as I show in this work, in some states, they can increase social costs through fire sales, price pressure, and amplification. Conversely, increasing the laxity of covenants by altering the frequency at which they bind or the measurement of constraints may reduce the effective cost of fire sales in some states of the world, but it may also increase the risk of debt claims and limit control rights by inadequately addressing agency frictions. This can reduce the amount of credit ex-ante. Hence, it is unclear what the efficient contract design is, ex-ante, from a policy standpoint. Furthermore, there are additional considerations in informing intervention, ex-post. In and of itself, a forced sale of assets below their long-run fundamental valuations is not considered to be sufficient for regulatory intervention (Stein (2013)). However, when a fire sale creates externalities or welfare effects, it may merit regulatory intervention. In these instances, macroprudential tools may be most useful to minimize the social costs associated with reductions in balance sheet capacity, originating from the shadow banking sector.[20]

The joint consideration of contractual design and welfare remains an avenue of future research for deepening our understanding of how covenants act as latent sources of amplification.

[20] Hanson, Kashyap and Stein (2011) propose a macroprudential approach to *control the social costs associated with excessive balance sheet shrinkage on the part of multiple financial institutions hit with a common shock.*

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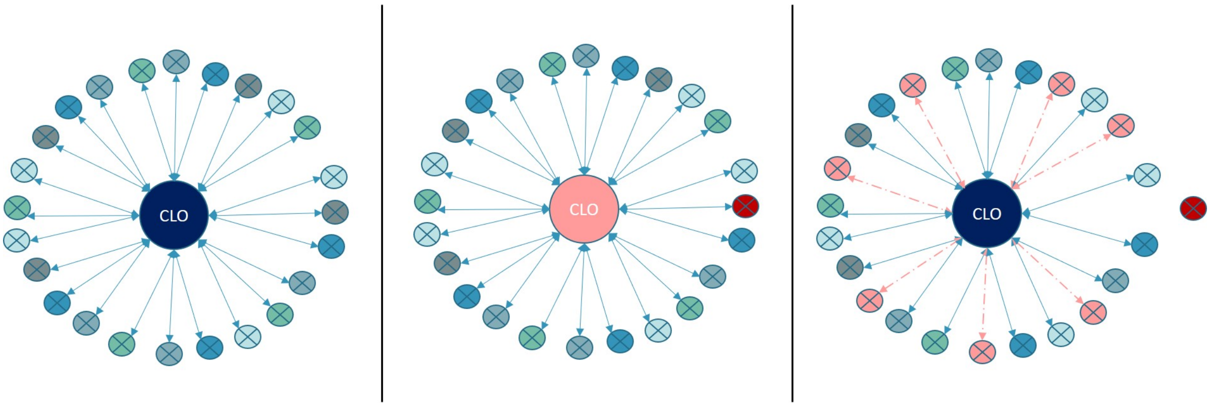
9 Figures and Tables

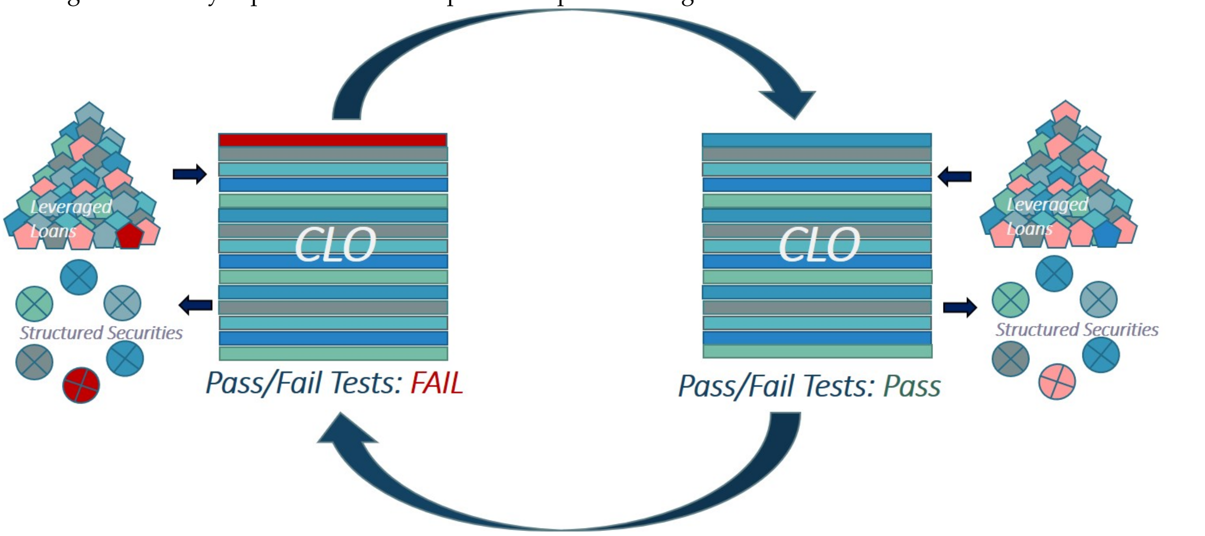
9.1 Figures

Figure 1: Research Setup: Potential for Financial Contagion



(a) Network of Firms and CLOs

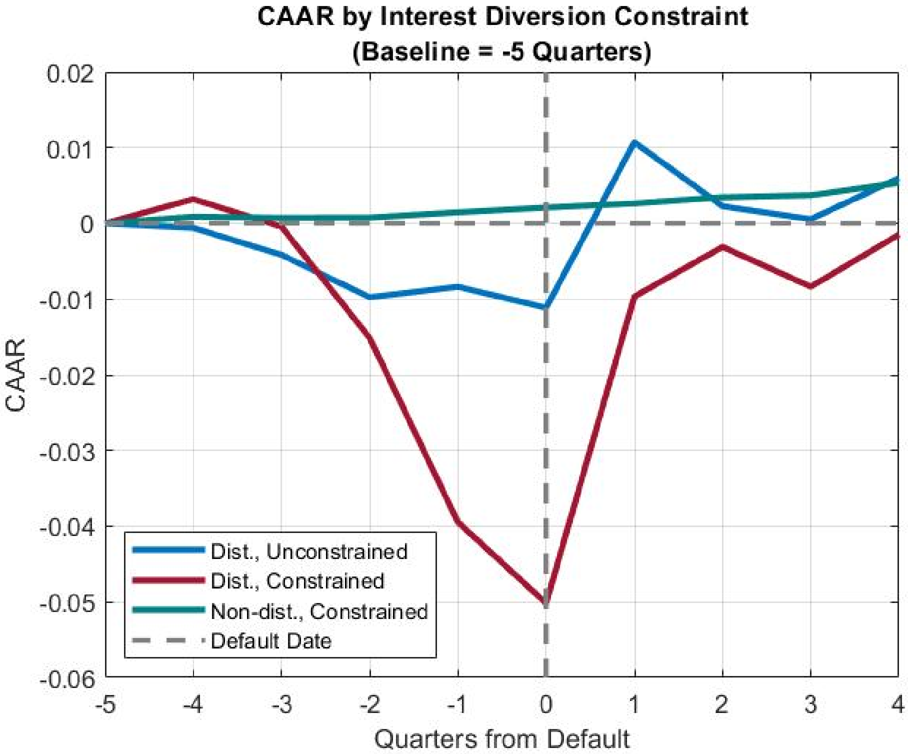
Notes: The diagram consists of the three figures which represent CLO portfolios. The center circle of each diagram represents a CLO while the outer circles represent firms. The spokes represent connections between firms and CLOs. Firms are connected to each other through the intermediary, the CLO. The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



(b) Cycle of Distress

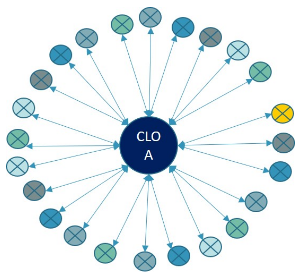
Notes: The figure demonstrates the link between CLO portfolio constraints and the quality of leveraged loans. The CLO is in violation of its covenant constraints, because of a loan that is near-default (left figure). To comply with the covenant, the may generate slack in the constraint by divesting itself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

Figure 2: Motivation: Heterogeneity in CAAR around Defaults

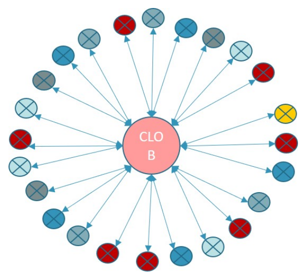


Notes: The figure compares the cumulative abnormal average returns (CAAR) for relatively constrained and unconstrained CLOs. The red line plots the CAAR for distressed loans held by constrained CLOs. The blue line plots the CAAR for distressed loans held by unconstrained CLOs. The green line plots the CAAR for non-distressed loans held by constrained CLOs. The sample of non-distressed loans held by constrained CLOs is generated by matching distressed firms to their non-distressed counterparts that operate in the same industry and size categories. *Constrained* and *unconstrained* are defined relative to the median. The abnormal return is generated from the following regression: $ln(\frac{P_{i,t}}{P_{i,t-1}}) \approx \alpha + \beta Z_{i,t-1,t} + \gamma_0(Q_{i,t} - Q_{i,t-1}) + \gamma_1(Q_{i,t}ln(S_{i,t}) - Q_{i,t-1}ln(S_{i,t-1})) + \epsilon_{i,t-1,t}$, where P is the observed price, Z is a vector of fundamental value of i, Q is a purchase indicator, S is the trade size, ϵ is the error, i denotes the loan, and t denotes the day. These abnormal returns are averaged by quarters from default, and accumulated. The CAAR, five quarters before default, is normalized to be 0. The x-axis plots months from default. The y-axis plots the CAAR.

Figure 3: Thought Experiment



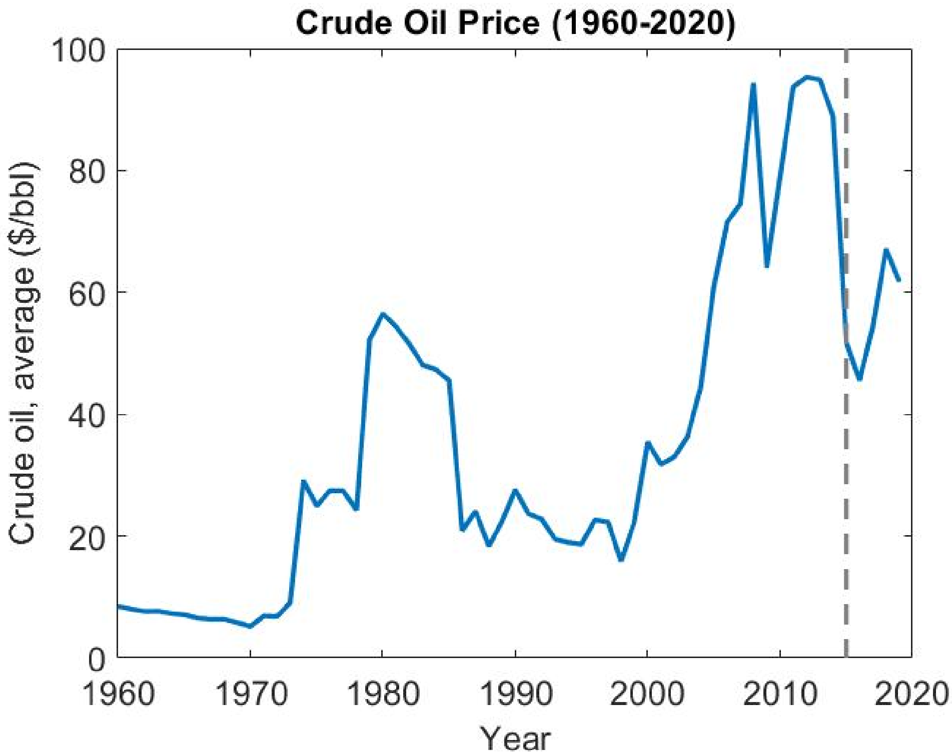
(a) Unconstrained



(b) Constrained

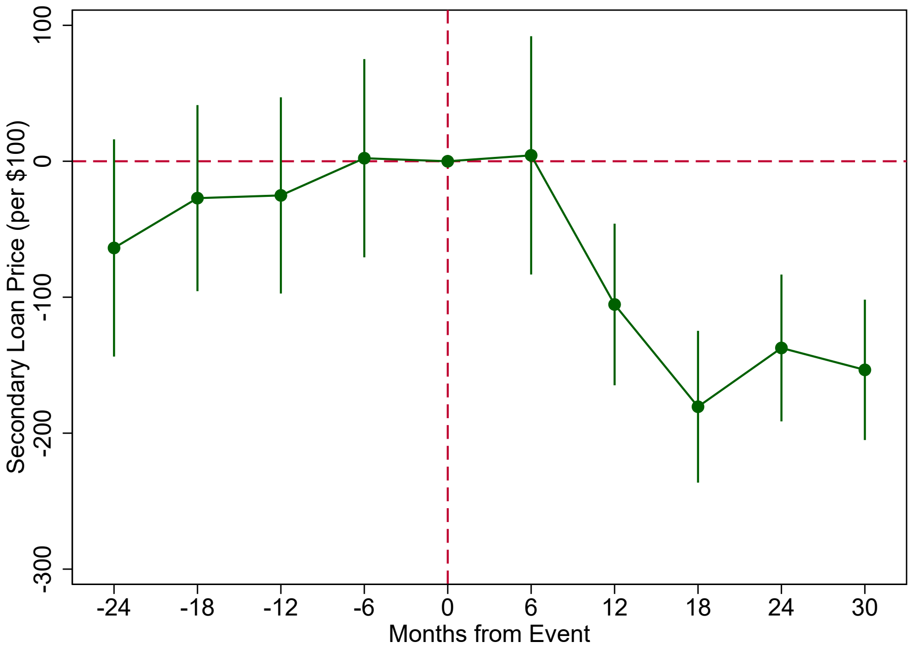
Notes: The figure illustrates the thought experiment belying the empirical strategy. There are two CLOs: CLO A and CLO B. CLO A does not hold any firms operating in the Oil & Gas industry ("Unconstrained"). CLO B has a sizeable exposure to firms in the O&G industry ("Constrained"). When the O&G price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

Figure 4: Crude Oil Price (1960-2020)

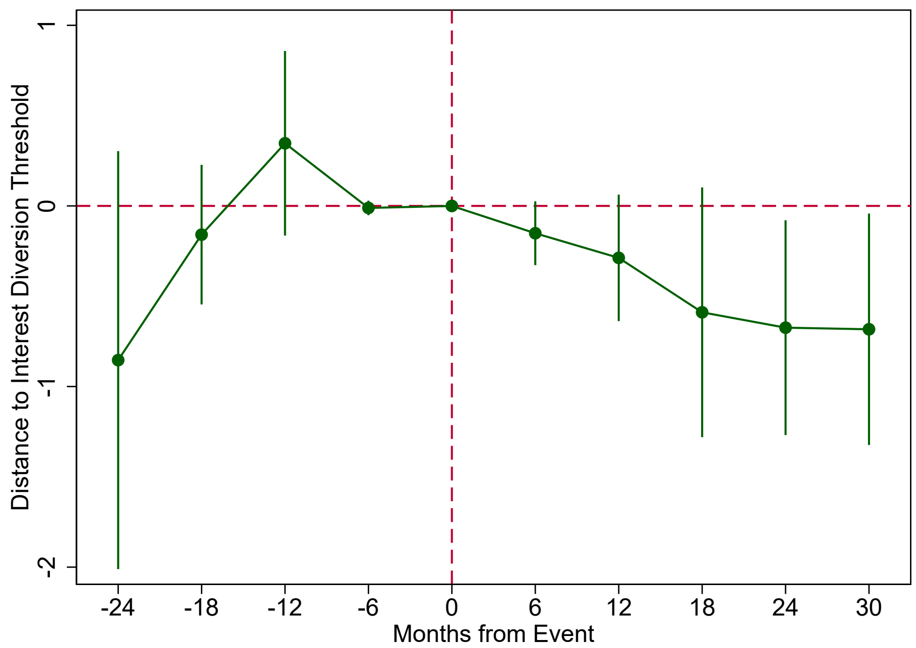


Notes: The figure shows the crude oil price from 1960-2020. The price is reported as the annual average $ per barrel. The x-axis reports the year. The y-axis reports the price. The dotted gray line denotes the price plunge. The monthly price around the price plunge is plotted in Figure A.1.

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



(a) Secondary Loan Price



(b) Distance to Interest Diversion Threshold

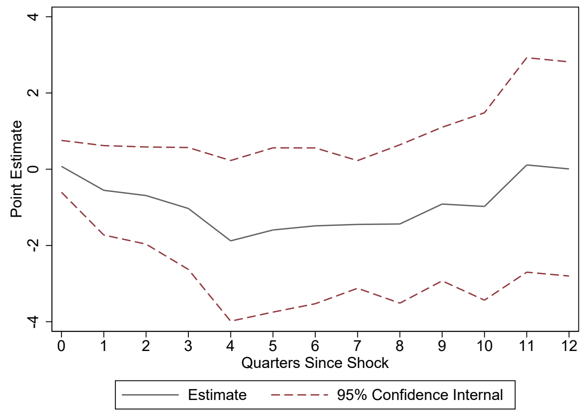
Notes: The figures present pre-trends. The baseline specifications of Figures 5a and Figure 5b take the following respective forms:

$$P_{i,f,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{Firm O\&G Exposure})_f + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \delta_k \mathbb{1}_{k\leq t<k+6} + \theta_1 \text{Firm O\&G Exposure}_f + \alpha_f + \alpha_y + \epsilon_{i,f,t}$$

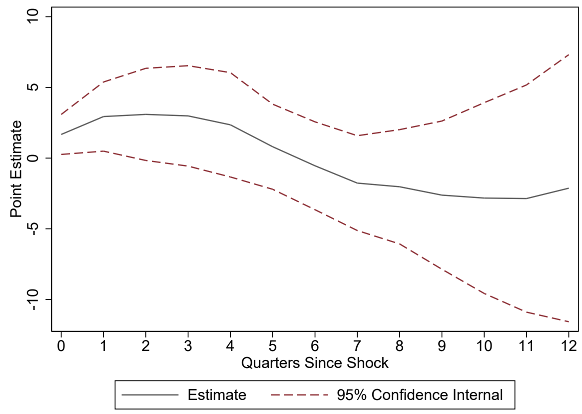
$$ID_{c,t} = \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \beta_k \mathbb{1}_{k\leq t<k+6} \times (\text{CLO O\&G Exposure})_c + \sum_{\substack{k=-24 \\ k=k+6 \\ k\neq 0}}^{30} \delta_k \mathbb{1}_{k\leq t<k+6} + \theta_1 \text{CLO O\&G Exposure}_c + \alpha_c + \alpha_y + \epsilon_{c,t}$$

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

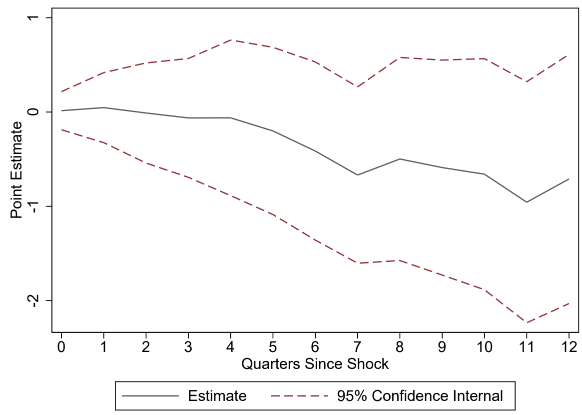
Figure 6: Heterogeneous Dynamics in Response to O&G Shock: Jordà Linear Projections



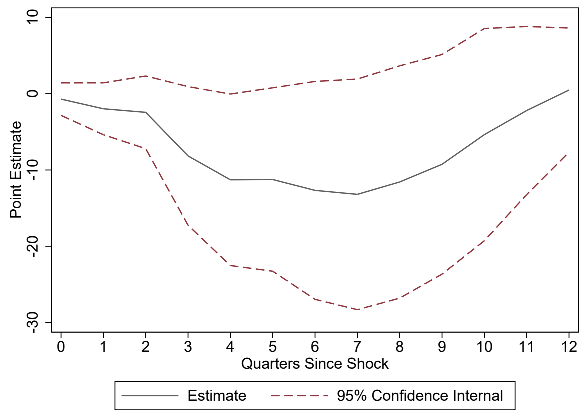
(a) Secondary Loan Price



(b) Bond Yield



(c) Leverage



(d) Investment

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 the ln(secondary loan price) of a firm's loans (top left), ln(bond yield) (top right), leverage (bottom left), ln(CapEx) (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.

Table 1: Summary Statistics

	N	Q1	Median	Q3	Mean	Std. Dev.
Dist. to ID Constraint ($\frac{\text{Covenant Result}}{\text{Covenant Threshold}}$)	2,076	1.0334	1.0410	1.0513	1.0525	0.0457
Issuer O&G Exposure	6,638	0.0085	0.0174	0.0296	0.0206	0.0197
CLO O&G Exposure	728	0.0000	0.0105	0.0284	0.0200	0.0425
Transaction Amount	767,099	-333,333	174,694	964,286	306,403	1,344,868
Net Transaction Amount (CLO-Issuer)	492,242	-440,000	400,000	1,196,000	477,491.8	1,831,333
Net Transaction Amount (Issuer)	43,370	-1,875,345	748,110	4,588,151	5,419,449	34,569,201
Transaction Price	129,439	99	99.75	100	97.6138	9.4910
All-in-Drawn Spread (Term Loans)	1,515	325	400	500	431.2657	185.8061
Facility Maturity (Term Loans)	1,529	59	72	84	67.7620	19.9434
ln(Facility Amount) (Term Loans)	1,557	18.6030	19.3568	20.0499	19.2968	1.1747
Bond Credit Spread	10,074	1.3643	2.2835	3.5152	3.3514	5.0587
Bond Avg Bid/Ask Spread	16,211	0.0020	0.0033	0.0059	0.0047	0.0101
Equity Returns	6,543	-0.0433	0.0107	0.0639	0.0125	0.1143
Firm Liquidity Growth	2,159	0.2181	0.5965	0.8544	0.5373	0.3458
Debt Growth (Long-term)	2,876	-0.0161	-0.0010	0.0257	0.0207	0.2203
Cash Flow	2,864	0.0911	0.1297	0.1871	0.1437	0.1609
Payout	2,874	0.0000	0.0049	0.0260	0.0217	0.0425
Real Sales Growth	3,106	-0.0008	0.0000	0.0006	-0.0001	0.0028
Acquisitions	2,895	0.0000	0.0000	0.0042	0.0277	0.1408
Investment	2,951	2.3889	3.6350	4.9624	3.6293	2.0316
R&D	1,054	0.0000	0.0030	0.0194	0.0181	0.0470
Investment Growth	2,863	-0.5396	0.3737	0.6084	0.0007	0.9948
R&D Growth	961	0.0000	0.0000	0.0255	0.0075	0.1424
ln(Employment)	2,958	0.8771	1.6605	2.8332	1.8675	1.2196
Interest Rate	2,436,473	3.6938	4.2500	5.5000	4.7169	1.9335
CCC Share	10,433	1.9208	3.5312	5.4370	4.2946	3.9729
Defaulted Share	9,961	0.0000	0.5455	1.9578	3.7893	12.5261
Risky Share	9,953	3.0481	4.8052	7.6096	8.2925	13.2265

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

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

Distance to ID Threshold	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-8.4685***	-6.8861***	-4.8620**	-5.3021***	-5.0278***
	(2.7227)	(2.2409)	(2.0709)	(1.7027)	(1.7324)
O&G Share	-4.4361	-1.1044	2.6474		
	(9.1609)	(6.4653)	(5.1389)		
Post	0.4342***	0.1336		0.2251***	
	(0.1475)	(0.1269)		(0.0689)	
CLO Controls		✓	✓		
CLO FE				✓	✓
Manager FE	✓	✓	✓		✓
Arranger FE					✓
Trustee FE					✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	2,074	2,074	2,073	2,071	2,071
R^2	0.3321	0.3761	0.4600	0.6516	0.6590

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

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

Notes: The table presents the relation between CLO O&G exposure and distance to the Interest Diversion covenant. The baseline regression specification takes the form $Y_{c,t} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \gamma_0' X_{c,t} + \epsilon_{c,t}$ 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, 3) and CLO size (Column 3). CLO O&G Exposure$_c$ is the O&G share of CLO c before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by CLO and month-year.

Table 3: Transaction-Level Trading Effects

Transaction Amount	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-10.6236***	-10.6611***	-10.5829***	-18.1895***	-14.6684***	-15.4259***
	(3.1164)	(3.1178)	(3.0750)	(3.1357)	(3.4942)	(3.6833)
O&G Share	8.8026***	8.8774***	8.7749***	18.3566***		
	(2.7668)	(2.7589)	(2.7474)	(3.0193)		
Post	0.1474	0.2108**			0.2641**	
	(0.0901)	(0.0938)			(0.1112)	
Manager FE			✓			
Rating-Industry FE				✓		
Issuer-Loan Type FE					✓	✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	129,420	129,420	129,417	117,829	129,132	129,132
R^2	0.0041	0.0045	0.0360	0.0276	0.0758	0.0809

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 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 and month-year.

Table 4: Secondary Loan Price and O&G Exposure

Transaction Price (per $100 par)	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share $\times$ Post	-183.2513**	-182.2391**	-167.3053**	-117.6534**	-80.1203**	-67.2475*
	(87.0920)	(87.2499)	(76.8085)	(53.7648)	(37.8763)	(38.3255)
O&G Share	203.5656**	202.2806**	176.1811**	28.8967		
	(79.1487)	(79.3677)	(68.5560)	(41.9329)		
Post	5.8047**	5.4327**			2.0054	
	(2.5469)	(2.6602)			(1.2828)	
	(2.3205)					
Manager FE			✓			
Rating-Industry FE				✓		
Issuer-Loan Type FE					✓	✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	57,866	57,866	57,860	52,778	57,593	57,593
R^2	0.0096	0.0097	0.0712	0.4039	0.5963	0.6037

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 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 and month-year.

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

All-In-Drawn Spread	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	1330.7793*	1836.0276**	1950.0807**	2298.1633**	2011.9126***	1805.9003**
	(664.3646)	(824.2271)	(858.0182)	(905.7835)	(719.3401)	(751.5813)
Post	-51.0069**	-67.6588**	-56.5767	-47.2713	-50.9940	
	(23.4295)	(27.7596)	(36.9653)	(37.6329)	(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	615	589	589	586	567	567
R^2	0.7007	0.6774	0.6809	0.9103	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 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 6: Bond Credit Spread and O&G Exposure

Bond Credit Spread	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	34.9984*	34.6940*	35.3794*	27.9393*	27.6554*
	(18.6704)	(18.5913)	(18.8925)	(14.4879)	(14.4997)
Post	-0.3541	-0.4753	-0.4942	-0.2478	
	(0.4036)	(0.4719)	(0.4683)	(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	10,072	10,072	10,072	9,876	9,876
R^2	0.5235	0.5314	0.5600	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. The baseline regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Time to Maturity} + \gamma_0 X_{i,t} + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the bond credit spread of bond i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of controls associated with bond i including bond type, security level, rating, investment-grade indicator, and defaulted status, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table 7: Firm Liquidity and O&G Exposure

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔUndrawn	ΔUndrawn	ΔUndrawn	ΔDrawn	ΔDrawn	ΔDrawn
O&G Share × Post	-2.7562***	-2.7586***	-2.8037***	3.4348**	3.4228*	3.4679*
	(0.7305)	(0.6779)	(0.6180)	(1.5346)	(1.6450)	(1.6166)
Post	0.0395	0.0335		-0.0699*	-0.1524***	
	(0.0280)	(0.0798)		(0.0332)	(0.0300)	
Issuer FE	✓	✓	✓	✓	✓	✓
Industry FE			✓			✓
Year FE		✓			✓	
Quarter-Year FE			✓			✓
N	2,111	2,111	2,111	2,111	2,111	2,111
R^2	0.0278	0.0279	0.0345	0.0240	0.0252	0.0311

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 $\Delta(\frac{\text{Unused}}{\text{Total Firm Liquidity}})$ in Columns 1-3, and $\Delta(\frac{\text{Drawn}}{\text{Total Firm Liquidity}})$ 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 two-way clustered by issuer and quarter-year.

Table 8: Firm Adjustments and O&G Exposure

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

Standard errors are clustered by issuer in parentheses

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

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

Table 9: Equity Returns and O&G Exposure

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

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

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

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

Table 10: Investment in the Cross-Section and O&G Exposure

	Bond Access		**Size**		**Age**		**Sector**		**Loan Refinancing**	
Investment	Access	No Access	Large	Small	Old	Young	Non-Tradable	Tradable	After Shock	Before Shock
O&G Share × Post	0.6071	-10.1692***	-1.0910	-8.3904**	-3.4139	-6.6943*	-3.5808	-4.1799*	-6.8414	-10.8335**
	(1.8207)	(3.8819)	(2.1925)	(3.8836)	(2.7878)	(4.0073)	(3.2080)	(2.3159)	(8.3901)	(4.6397)
Issuer FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	1,661	1,320	1,710	1,271	1,037	957	1,961	1,020	441	708
R^2	0.1645	0.1961	0.2050	0.1547	0.1553	0.1694	0.1531	0.2395	0.2920	0.1924

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, sector, and loan refinancing. The baseline regression specification takes the form $I_{ft} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{q,y} + \alpha_f + \alpha_d + \epsilon_{f,t}$ where I_{ft} denotes (standardized) investment of firm f at time t ($f \in$ CLO c), d denotes the industry, and q, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. I present the results from this baseline regression for various sub-samples. In Columns 1 and 2, I segment firms based on access to the bond market; firms with access to the bond market are in Column 1 and firms without access are in Column 2. In Columns 3 and 4, I segment firms based on size; firms designated as small are in Column 3 and firms designated as large are in Column 4. In Columns 5 and 6, I segment firms based on age; firms designated as young are in Column 5 and firms designated as old are in Column 6. In Columns 7 and 8, I segment firms based on sector; firms in the nontradable sector are in Column 7 and firms in the tradable sector (2-digit NAICS codes of 31, 32, 322, 11, 21, 55) are in Column 8. In Columns 9 and 10, I segment firms without access to the bond-market based on timing of loan refinancing; firms which had last refinanced before the shock in the sample period are in Column 9 and firms which had last refinanced after the shock in the sample period are in Column 10. Standard errors are clustered by issuer.

Table 11: Selling Propensity by Secondary Loan Price Relative to Par and O&G Exposure

Panel A

$1_{(\text{loan price}>100)}$	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-4.1718*	-4.2856*	-10.6127***	-10.1198***	-8.2741***
	(2.2533)	(2.2552)	(2.0205)	(2.0834)	(2.0135)
O&G Share	4.8383**	4.8588**	10.2958***		
	(1.9162)	(1.9243)	(1.9891)		
Post	0.0257	-0.0290		0.0800	
	(0.0792)	(0.0745)		(0.0743)	
	(0.0565)				
Rating-Industry FE			✓		
Issuer-Loan Type FE				✓	✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	57,867	57,867	52,779	57,594	57,594
R^2	0.0106	0.0143	0.1683	0.2567	0.3234

Panel B

$1_{(\text{loan price}<90)}$	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	4.0665**	4.0575**	2.7707**	2.3389***	2.0049**
	(1.7222)	(1.7377)	(1.0981)	(0.8326)	(0.8445)
O&G Share	-3.9977**	-3.9910**	0.1073		
	(1.5206)	(1.5387)	(0.8197)		
Post	-0.1156**	-0.1160**		-0.0696**	
	(0.0495)	(0.0530)		(0.0264)	
Rating-Industry FE			✓		
Issuer-Loan Type FE				✓	✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	57,867	57,867	52,779	57,594	57,594
R^2	0.0061	0.0061	0.3231	0.5565	0.5656

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 firm O&G exposure and propensity to sell loans issued by non-O&G firms by price categorization. The baseline regression specification takes the form $\mathbb{1}_{(price \leqslant p)_{i,t}} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{f,l} + \gamma_0 Z_f + \alpha_{m,y} + \epsilon_{i,t}$ where $\mathbb{1}_{(price \leqslant p)_{i},t}$ is an indicator that takes a value 1 if the transacted price of secondary loan price issued by firm f at time t ($i \in f \in$ CLO c) is greater than p =\$100 in Panel A, and below p =\$90 in Panel B per \$100 of notional par, 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 and month-year.

Table 12: Interest Rate of Loans and O&G Exposure

Interest Rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)
O&G Share × Post	-9.4742***	-9.5623***	-10.0295***	-10.8229***	-11.6142**	-11.1660**	-12.6541**
	(3.2362)	(3.1641)	(3.0074)	(2.9103)	(4.3163)	(4.1978)	(4.8578)
Post	0.2504**	0.2414**	0.2154**	0.2351**	0.2696**		
	(0.0928)	(0.0921)	(0.0899)	(0.0871)	(0.1222)		
Tenor							0.0004***
							(0.0000)
Manager FE		✓					
CLO-Issuer-Loan Type FE						✓	✓
CLO-Issuer FE					✓		
Issuer FE	✓	✓	✓	✓			
CLO FE			✓	✓			
Loan Type FE				✓	✓		
Index FE	✓	✓	✓	✓	✓	✓	✓
Rating FE							✓
Year FE	✓	✓	✓	✓	✓		
Month-Year FE						✓	✓
N	2,754,178	2,754,177	2,754,176	2,750,126	2,738,751	2,733,737	2,477,250
R^2	0.7366	0.7388	0.7434	0.8185	0.9098	0.9388	0.9404

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 firm O&G exposure and transaction amount for non-O&G firms. The baseline regression specification takes the form Interest $\text{Rate}_{i,c,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 Z_i + \gamma_0 X_c + \alpha_{l,f,c} + \alpha_{m,y} + \epsilon_{i,c,t}$ where where Interest $\text{Rate}_{i,t}$ denotes the interest rate of loan i issued by firm f and held in CLO c at time t ($f \in$ CLO c), l denotes the loan-type, m, y denote the month and year respectively, r denotes the index name, Z is a vector of loan controls including loan type and issuer, and X is a vector of CLO controls including manager and CLO indicators. 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 and month-year.

Table 13: CLO Defaulted Loans and O&G Exposure

$\mathbb{1}_{\text{defaulted loan}}$	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-0.2164**	-0.2281**	-0.2013**	-0.3316***	-0.2391**	-0.1632*
	(0.1022)	(0.1003)	(0.0893)	(0.0908)	(0.0974)	(0.0891)
Post	0.0027	0.0030	0.0045*	0.0086***	0.0075***	
	(0.0026)	(0.0026)	(0.0023)	(0.0024)	(0.0026)	
Manager FE		✓				
CLO-Issuer-Loan Type FE						✓
CLO-Issuer FE					✓	
Issuer FE	✓	✓	✓	✓		
CLO FE			✓	✓		
Loan Type FE				✓	✓	
Year FE	✓	✓	✓	✓	✓	
Month-Year FE						✓
N	3,416,878	3,416,878	3,416,874	3,411,591	3,398,147	3,390,168
R^2	0.5641	0.5661	0.5734	0.5895	0.7632	0.8091

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 firm O&G exposure and transaction amount for non-O&G firms. The baseline regression specification takes the form $\mathbb{1}_{(\text{defaulted loan})i,c,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 X_c + \alpha_{l,f,c} + \alpha_{m,y} + \epsilon_{i,c,t}$ where $\mathbb{1}_{(\text{defaulted loan})i,t}$ denotes whether loan i issued by firm f and held by CLO c at time t has defaulted ($f \in$ CLO c), l denotes the loan type, m, y denote the month and year respectively, and X is a vector of CLO controls including manager and CLO indicators. 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 and month-year.

Table 14: CLO Risk and O&G Exposure

	Default Share			Risky Share		
O&G Share × Post	-5.6612***	-5.6461***	-5.5190***	-3.2446*	-3.3366*	-3.2747*
	(1.8225)	(1.8251)	(1.8317)	(1.7255)	(1.7313)	(1.7409)
Post	0.3598***	0.2479***		0.2274***	0.1236*	
	(0.0736)	(0.0756)		(0.0627)	(0.0641)	
CLO FE	✓	✓	✓	✓	✓	✓
Manager FE			✓			✓
Trustee FE			✓			✓
Arranger FE			✓			✓
Year FE		✓			✓	
Month-Year FE			✓			✓
N	9,941	9,941	9,852	9,933	9,933	9,844
R^2	0.6254	0.6275	0.6328	0.7077	0.7096	0.7148

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 distressed and risky assets. The baseline regression specification takes the form $Y_{c,t} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \gamma_0' X_c + \alpha_{m,y}\epsilon_{c,t}$ where $Y_{c,t}$ is the (standardized) percent of distressed loans (Columns 1-3) and (standardized) percent of risky loans (Columns 4-6) in CLO c at time t, m, y denote the month and year respectively, and X denotes the vector of time-invariant controls, consisting of current CLO, manager, trustee, and arranger indicators. 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 15: Comparison of Effects by Risk and O&G Exposure

	Secondary Loan Price		**All-In-Drawn Spread**		**Investment**	
	Non-Risky	Risky	Non-Risky	Risky	Non-Risky	Risky
O&G Share $\times$ Post	33.7732	-232.3941***	1088.0890	5648.7368*	-2.1211	-12.1223**
	(31.3956)	(84.2303)	(732.2927)	(2883.8527)	(2.0926)	(5.0355)
Maturity Control			✓	✓		
Issuer-Loan Type FE	✓	✓				
Issuer FE			✓	✓	✓	✓
Secured FE			✓	✓		
Purpose FE			✓	✓		
Distribution FE			✓	✓		
Seniority FE			✓	✓		
Loan Type FE			✓	✓		
Country of Syndication FE			✓	✓		
Industry FE					✓	✓
Rating FE					✓	✓
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 $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity} + \gamma_0 X_i + \alpha_{m/q,y} + \alpha_f + \alpha_I + \epsilon_{i,t}$ 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), 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, I denotes the industry, and $m/q, y$ 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 *risky* firms which are firms that have a rating CCC or below, or are defaulted. The results for *non-risky firms* are reported in Columns 1, 3, and 5. Standard errors are two-way clustered by CLO and month-year (Col. 1, 2), issuer and month-year (Col. 3, 4), and issuer (Col. 5, 6) in parentheses.

Table 16: Secondary Loan Price and COVID-19 Exposure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Transaction Price (per $100 par)	O&G	Auto	Retail	Consumer Goods	Transportation	Cargo	O&G and Auto	Retail and Goods	All (Col 1-6)
COVID-19 Share $\times$ 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

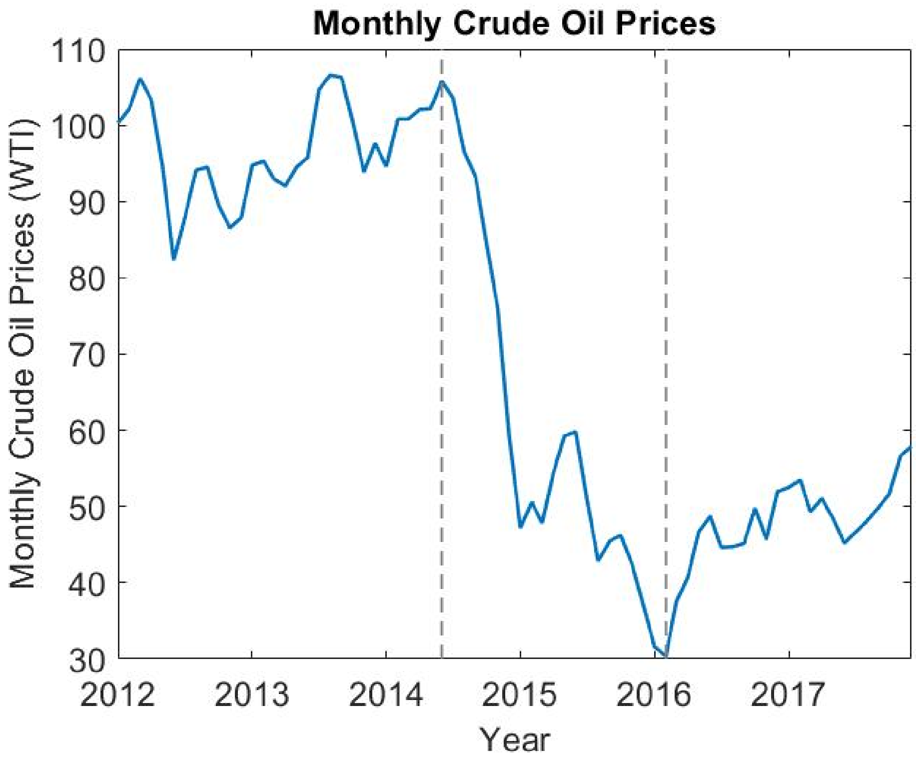
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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.

Appendix A Figures and Tables

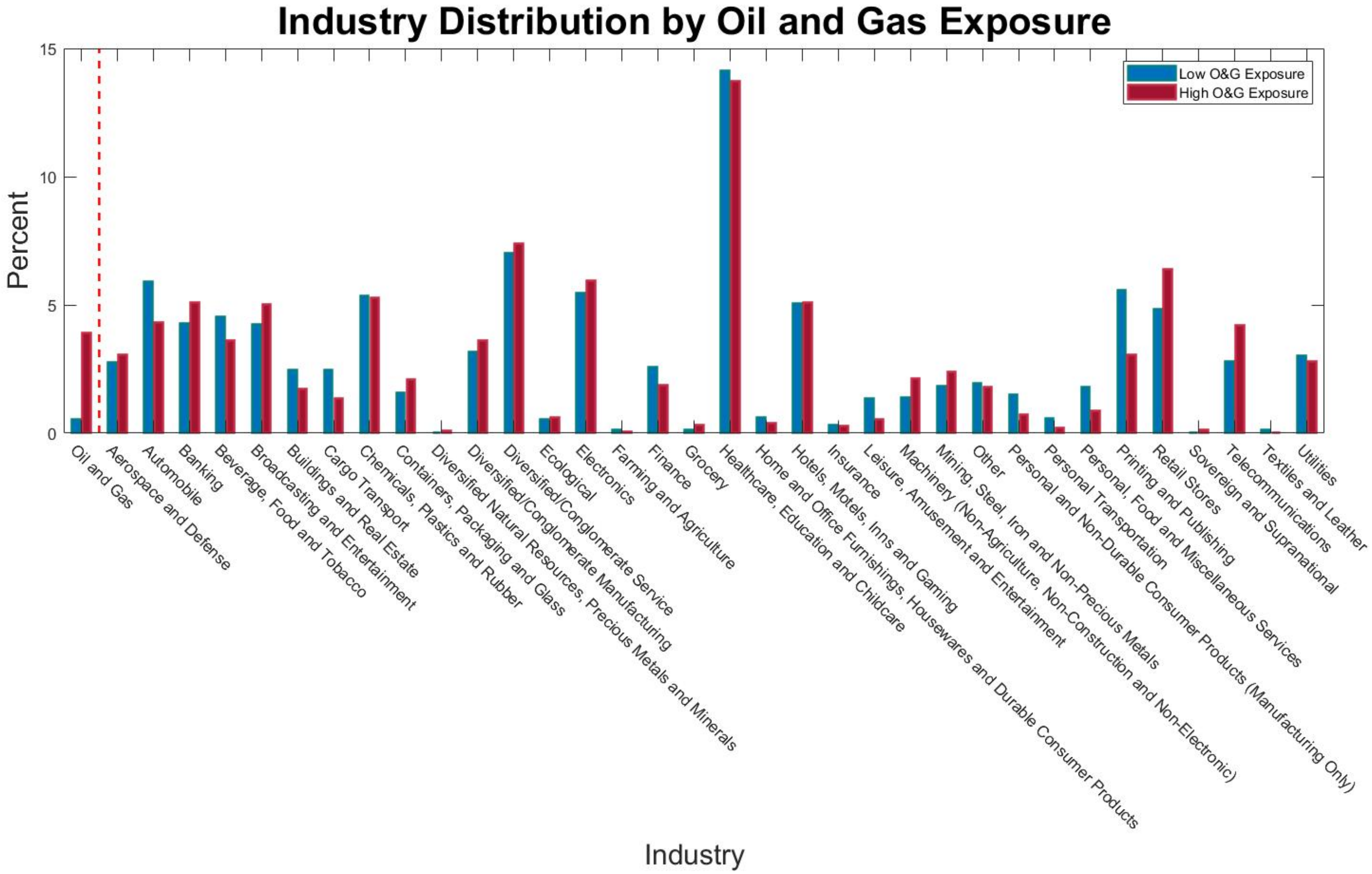
A.1 Figures

Figure A.1: Monthly Crude Oil Prices (2012-2018)



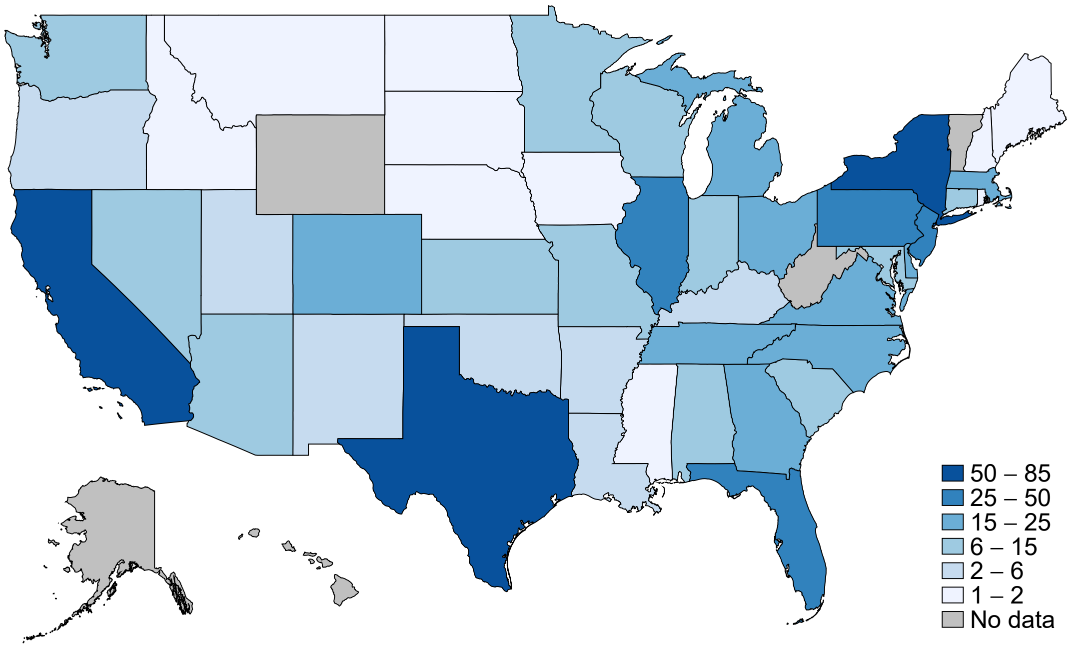
Notes: The figure shows the crude oil price from 2012-2018. The price is reported as the monthly average $ per barrel of crude oil (WTI). The x-axis reports the year. The y-axis reports the price. The dotted gray line denotes the price plunge period.

Figure A.2: Industry Composition by CLO O&G Exposure

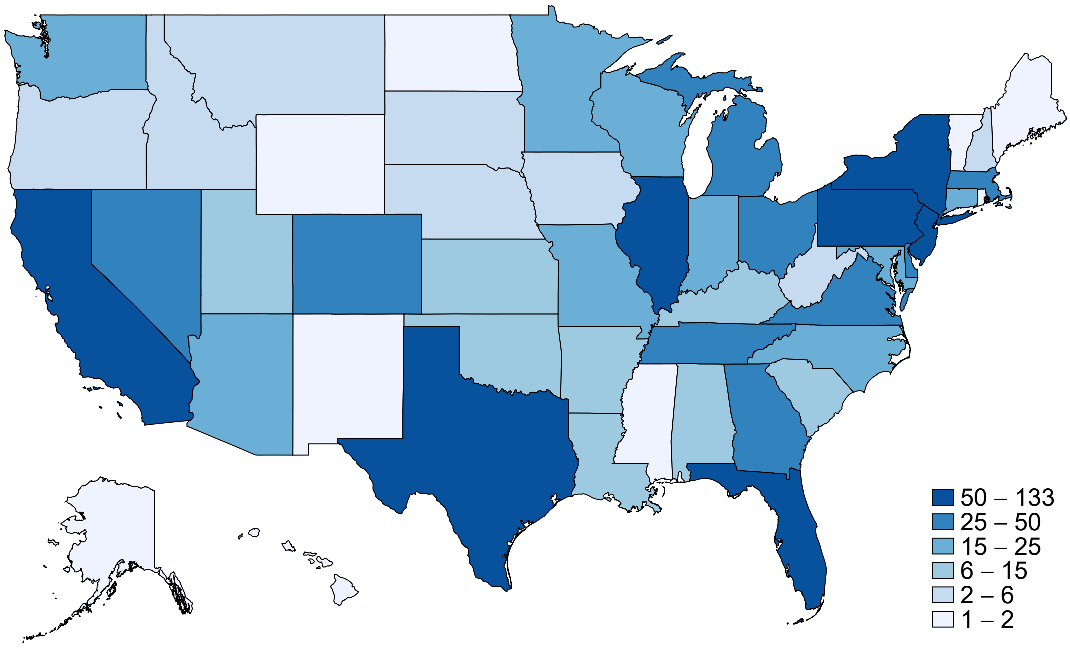


Notes: In this figure, I compare the industry distribution for CLOs with high O&G exposure to CLOs with low O&G exposure, before the shock. CLOs with O&G exposure above the 75^{th} percentile of all O&G exposures have *high* O&G exposure, while CLOs with O&G exposure below the 25^{th} percentile have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

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



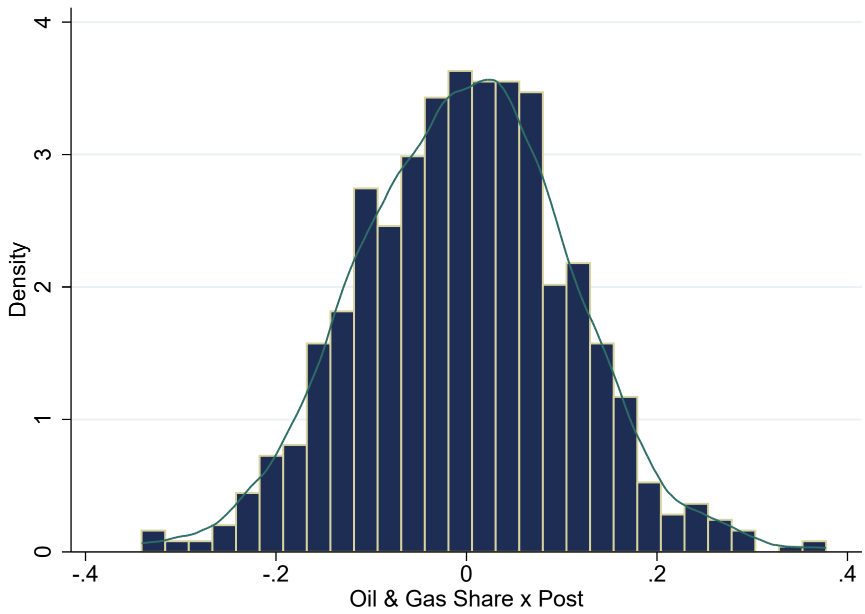
(a) Low O&G Exposure



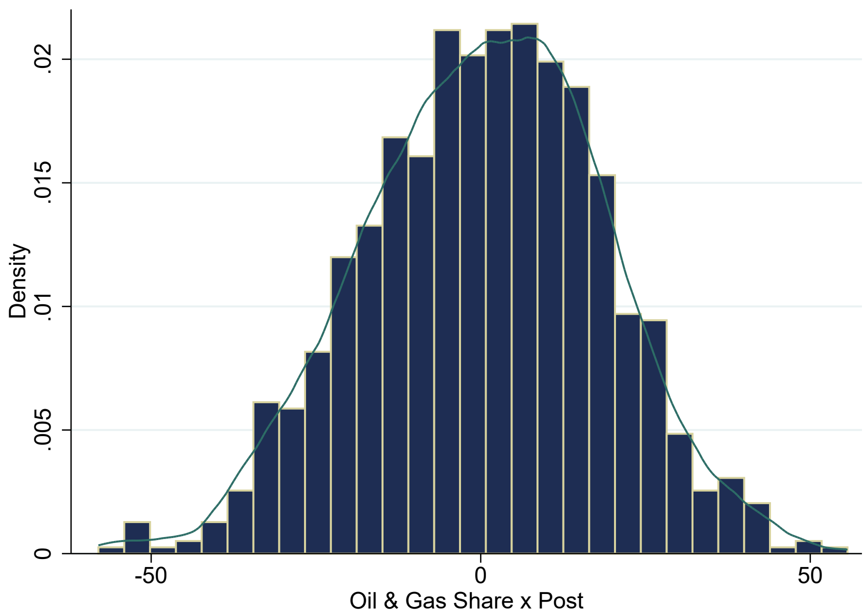
(b) High O&G Exposure

Notes: In this figure, I compare 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 number of firms headquartered in each state. Gray shading signifies that data is unavailable for that state. Darker blue shading reflects a greater number of firms in that state. The top figure shows the geographic distribution of firm headquarters for CLOs with low O&G exposure. The bottom figure shows the geographic distribution of firm headquarters for CLOs with high O&G exposure. For CLOs with low O&G exposure, the Herfindahl-Hirschman Index is 0.0501, while it is 0.0493 for CLOs with high O&G exposure.

Figure A.4: Placebo Tests



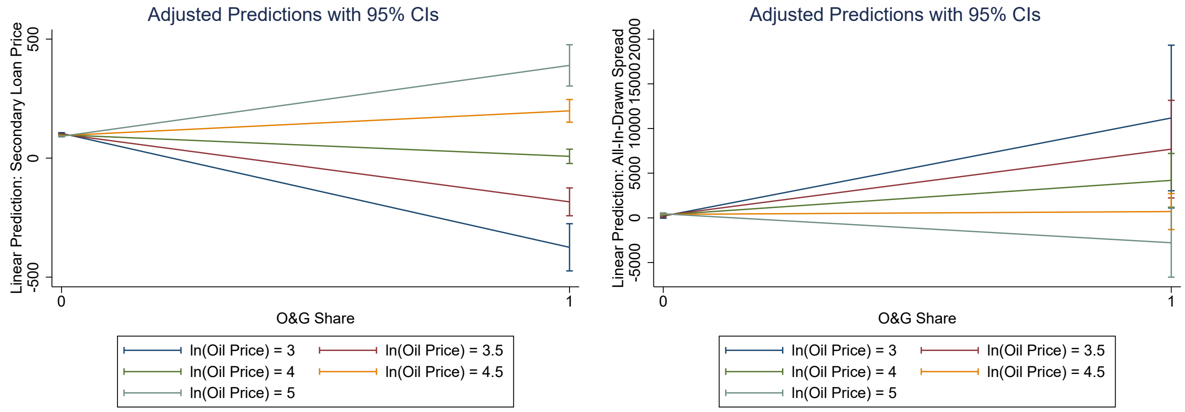
(a) Secondary Loan Price



(b) All-In-Drawn Spread

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 price, f denotes the portfolio firm ($f \in$ CLO c), t indexes the time, m denotes the month, and y denotes the year, and $Y_{i,t} = \beta_0 + \beta_1(\text{Placebo O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Placebo O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the All-In-Drawn 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. Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. The t-statistics for Figure A.4a and A.4b are -0.7503 and 0.7690, respectively, hence, the null hypothesis that the average difference is equal to zero cannot be rejected in either case.

Figure A.5: Alternative Empirical Specification

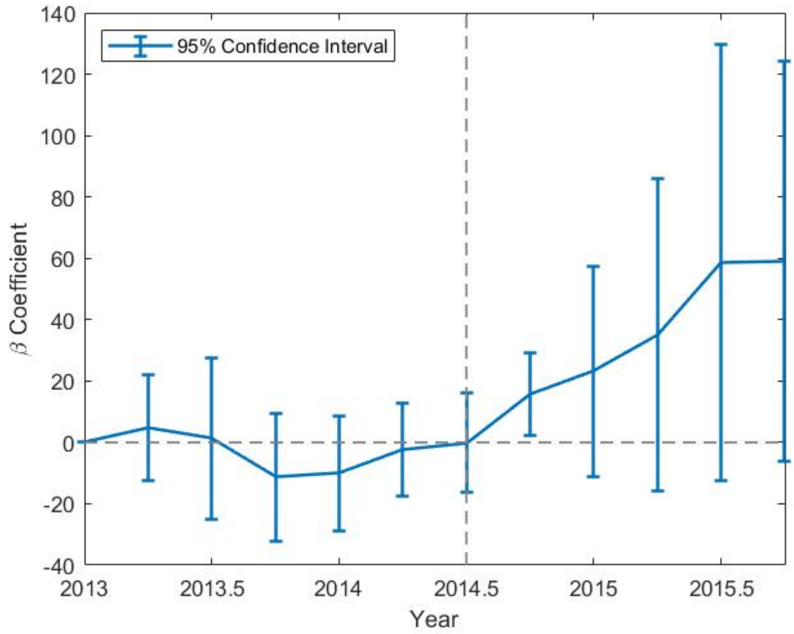


(a) Secondary Loan Price

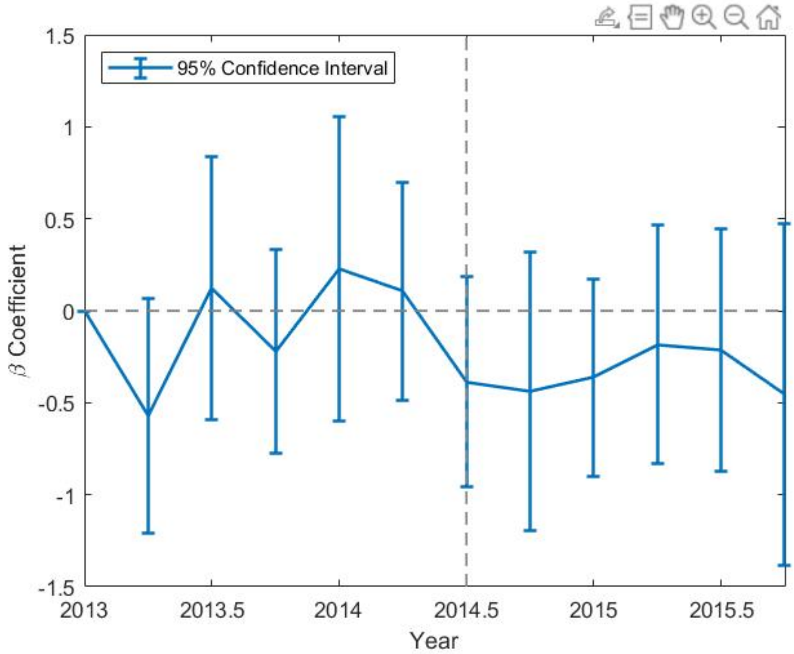
(b) All-In-Drawn Spread

Notes: In this figure, I plot 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 price of loan i at time t issued by firm f ($i \in f \in$ CLO c), and y denotes the year for the top figure. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2 ln(\text{Oil Price}_t)) + \beta_3(\text{Firm O\&G Exposure}_f \times ln(\text{Oil Price}_t))) + \alpha_y + \epsilon_{i,t}$ where $Y_{i,t}$ is the All-In-Drawn loan spread of loan i at time t, issued by firm f ($i \in f \in$ CLO c), and y denotes the year respectively in the bottom figure. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs. Temporal variation comes from the log oil price.

Figure A.6: Dynamic Effects of Firm O&G Exposure on Bond Credit Spreads and Equity Returns



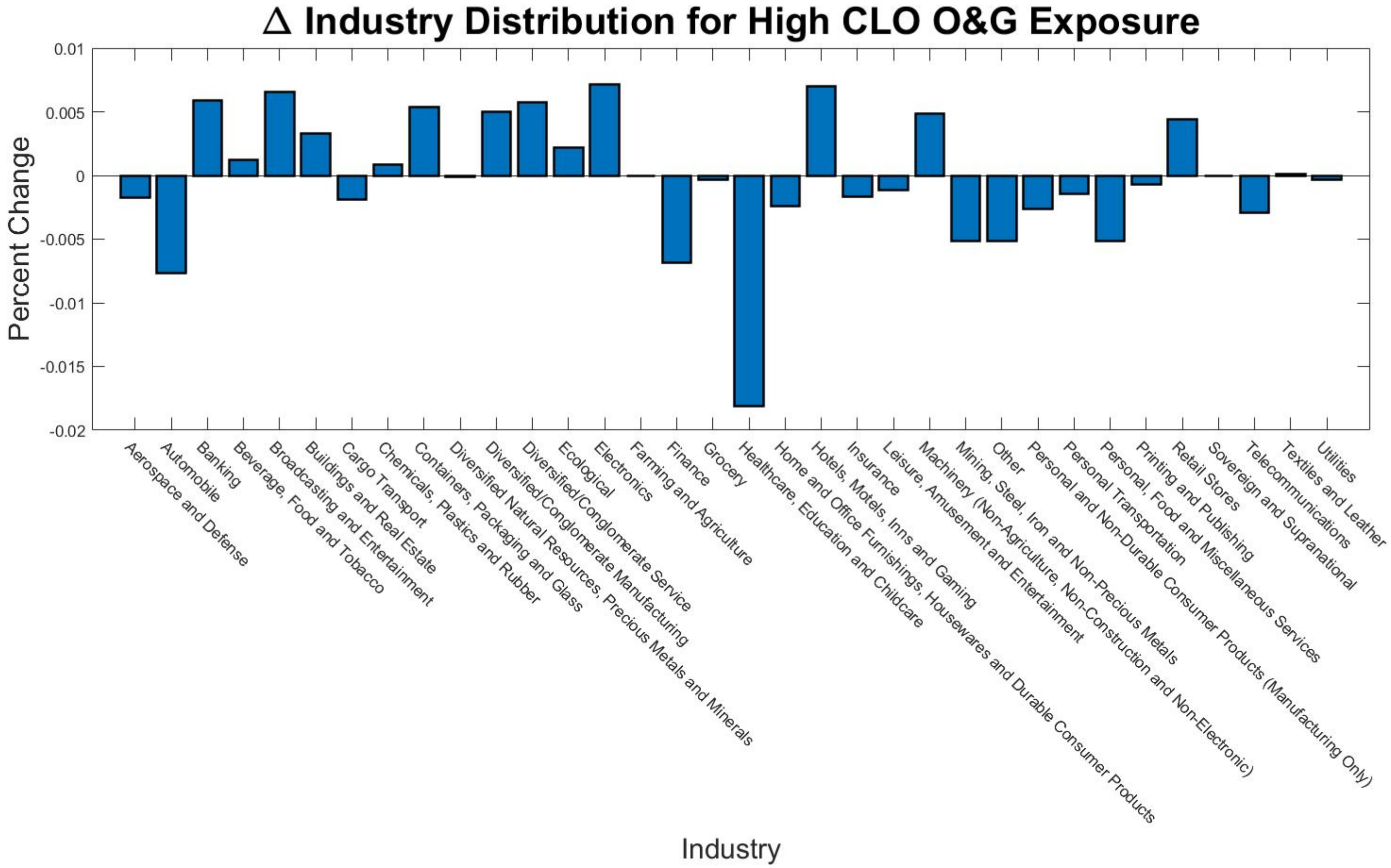
(a) Bond Credit Spreads



(b) Equity Returns

Notes: The figure plots the coefficients and the associated 95% confidence intervals of the interaction term from the following regression at the firm-CLO and quarter-year levels: $Y_{f,t} = \beta_0 + \sum_{k=2013}^{2015}\sum_{q=1}^{4}\beta_{4*(k-2013)+q}(\text{Firm O\&G Exposure}_f \times \mathbb{1}_{t \in kqt}) + \beta_{13}\text{Firm O\&G Exposure}_f + \gamma_0' X_{f,t} + \alpha_f + \alpha_y + \epsilon_{f,t}$ where $Y_{f,t}$ is the monthly bond credit spread (top figure) or equity return (bottom figure), f denotes the portfolio firm ($f \in$ CLO c), t indexes the month, q denotes the quarter, and y denotes the year. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while $\mathbb{1}_{t \in Quarter-Year}$ is an indicator variable that takes a value of 1 if the time period corresponds to quarter-year kq. I include the bond type – convertible, debenture, medium term note, medium term note zero – in Figure A.6a, and risk-free rate, small-minus-big, high-minus-low, and market return factors in Figure A.6b. The x-axis indicates the year. The y-axis indicates the point estimate of the interaction term. Standard errors are clustered by issuer.

Figure A.7: Change in Industry Composition for Constrained CLOs



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

A.2 Tables

Table A.1: Extensive Margin: Distressed Loans and Covenant Results (Table 2 of Kundu (2021*b*))

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

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

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

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

Table A.2: Interest Diversion Threshold and O&G Exposure

ln(ID Threshold)	(1)	(2)	(3)	(4)	(5)
O&G Share	4.7835	-13.3219	6.4127	-12.5161	-22.5949
	(7.0591)	(14.2926)	(7.3806)	(16.5032)	(27.8942)
Constant	-0.2888				
	(0.2588)				
CLO Controls		✓	✓	✓	✓
Manager FE		✓		✓	✓
Arranger FE					✓
Trustee FE					✓
Year FE			✓	✓	
Month-Year FE					✓
N	111	87	111	85	66
R^2	0.0076	0.6094	0.1663	0.6351	0.9278

Robust standard errors in parentheses

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

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

Table A.3: 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: In this table, I compare characteristics of firms with high CLO O&G exposure to firms with low CLO O&G exposure, before the shock. CLOs with above-median O&G exposure have *high* O&G exposure while CLOs with below median O&G exposure have *low* O&G exposure. The characteristics of interest are: size, Tobin's Q, leverage, marke-to-book ratio, investment growth, investment, cash flow, and tangibility. The number of observations, first quartile, median, third quartile, mean, and standard deviation associated with each variable are in Columns 2-7, respectively.

Table A.4: Firm Profitability and O&G Exposure

Profitability	(1)	(2)	(3)	(4)	(5)	(6)	(7)
High O&G Share × ln(Oil Price)	-0.2819	-0.0175	-0.1830	-0.0897	-0.1814	-0.2101	-0.1245
	(0.2076)	(0.2441)	(0.1975)	(0.2492)	(0.1980)	(0.2735)	(0.2451)
High O&G Share	1.2262	0.1315		0.3187		0.8548	
	(0.9175)	(1.0860)		(1.1164)		(1.2445)	
ln(Oil Price)	0.5968***	0.2661	0.3979**	0.4030	0.4278**	0.4750*	0.2660
	(0.1715)	(0.2244)	(0.1685)	(0.2442)	(0.2130)	(0.2671)	(0.2540)
Issuer Controls						✓	✓
Rating FE		✓					
Industry FE		✓					
Rating-Industry FE				✓		✓	
Issuer FE			✓		✓		✓
Year FE				✓	✓	✓	✓
N	6,486	4,456	6,470	4,451	6,470	2,951	4,385
R^2	0.0059	0.1360	0.4075	0.2299	0.4079	0.3229	0.4911

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 profitability. The baseline regression specification takes the form $RoA_{f,t} = \beta_0 + \beta_1(\text{High O\&G Exposure})_f + \beta_2(\ln(\text{Oil Price}))_t + \beta_3(\text{High O\&G Exposure}_f \times \ln(\text{Oil Price})_t) + \gamma_0' X_{f,t} + \epsilon_{f,t}$ where $RoA_{f,t}$ is the (standardized) profitability of firm f at time t, and X denotes the vector of issuer controls, consisting of size, tangibility, leverage, net worth, and market-to-book ratio. Firms with above-median CLO O&G exposure have *High* O&G exposure. ln(Oil Price)$_t$ is a continuous variable, indicating the oil price. Standard errors are clustered by issuer.

Table A.5: CLO Selection by Covariance of Oil Price and Firm Profitability

$1_{\text{High CLO O\&G Share}}$	(1)	(2)	(3)	(4)	(5)	(6)
Covariance(Oil Price, Firm Profitability)	-1.7779	-2.0157	-1.3314	-3.4276	0.5745	-0.6339
	(5.4906)	(2.5317)	(2.8732)	(5.4548)	(0.3715)	(1.2001)
CLO Age			-0.0033***	-0.0033***		-0.0033***
			(0.0005)	(0.0005)		(0.0011)
Defaulted Share			-0.0192***	-0.0235***		-0.0182*
			(0.0060)	(0.0065)		(0.0094)
Risky Share			0.0035	0.0064**		0.0052
			(0.0021)	(0.0029)		(0.0064)
Firm Size					-0.0039***	-0.0011
					(0.0011)	(0.0007)
Firm Tangibility					0.0104***	-0.0026*
					(0.0036)	(0.0015)
Firm Leverage					0.0129	-0.0009
					(0.0105)	(0.0057)
Firm Net Worth					0.0175**	0.0009
					(0.0089)	(0.0052)
Firm Market-to-Book Ratio					-0.0001	-0.0000
					(0.0001)	(0.0000)
Constant	0.7510***					
	(0.0226)					
Manager-Arranger-Trustee FE					✓	✓
Rating-Industry FE				✓		✓
Rating FE			✓			
Industry FE			✓			
Manager FE		✓				
CLO Type FE						✓
Year FE				✓	✓	
Month-Year FE						✓
N	9,201	9,200	9,073	8,053	7,110	6,023
R^2	0.0000	0.3283	0.1238	0.1658	0.8504	0.9011

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 (Column 2-6), age (Columns 3, 4, 6), defaulted share (Columns 3, 4, 6), and risky share (Columns, 3, 4, 6). Issuer controls include size, tangibility, leverage, net worth, and market-to-book ratio in Columns 5 and 6. Standard errors are two-way clustered by CLO and issuer.

Table A.6: CLO-Level Trading Effects

Transaction Amount	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-10.6608***	-10.5710***	-10.7245***	-15.1090***	-13.8098***	-23.7717***
	(2.8455)	(2.8312)	(2.8491)	(3.0963)	(3.1822)	(6.9345)
O&G Share	9.3300***	9.2784***	9.3794***	16.3223***		
	(2.3471)	(2.3175)	(2.4150)	(2.9078)		
Post	0.1315	0.1715*			0.2070*	
	(0.0860)	(0.0915)			(0.1088)	
Manager FE			✓			
Rating-Industry FE				✓		
CLO-Issuer FE						✓
Year FE		✓			✓	
Month-Year FE			✓	✓		✓
N	86,082	86,082	86,077	77,970	85,977	55,203
R^2	0.0053	0.0057	0.0469	0.0343	0.0650	0.4329

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 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 and month-year.

Table A.7: Issuer-Level Trading Effects

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

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

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

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

Table A.8: Issuer-Level Selling Effects

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

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

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

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

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

Maturity (Months)	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-297.0095*	-395.4002**	-395.2332**	-408.0260**	-409.4155*	-460.2031**
	(157.4307)	(184.6172)	(184.9694)	(187.8888)	(228.5919)	(222.3893)
Post	8.2354	11.0521*	13.2475*	14.3619*	13.6066	
	(4.8912)	(5.8000)	(7.4260)	(7.5606)	(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	620	592	592	589	582	582
R^2	0.6289	0.5970	0.5981	0.6368	0.6895	0.7240

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

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

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

Table A.10: Primary Non-Institutional Loan Amount and O&G Exposure

ln(Loan Amount)	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-0.9048	-5.0442	-4.7797	-6.7672	-4.6737	-5.8864
	(6.3562)	(7.1042)	(7.0378)	(7.4648)	(6.5940)	(7.9274)
Post	-0.1627	-0.0502	0.1435	0.1900	0.1400	
	(0.2146)	(0.2411)	(0.2920)	(0.3176)	(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	633	604	604	601	582	582
R^2	0.6268	0.6180	0.6206	0.6627	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 $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the (standardized) ln(loan amount) of loan i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.11: Bond Liquidity and O&G Exposure

Bond Liquidity	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	2.6539*	2.6237*	2.6952*	2.6098*	2.6049*
	(1.5525)	(1.5427)	(1.5816)	(1.3025)	(1.3013)
Post	-0.0158	-0.0298	-0.0307	-0.0473	
	(0.0198)	(0.0319)	(0.0326)	(0.0296)	
Time to Maturity				0.0173***	0.0174***
				(0.0025)	(0.0026)
Issuer FE	✓	✓	✓	✓	✓
Bond Type FE	✓	✓	✓	✓	✓
Security Level FE			✓	✓	✓
Rating FE				✓	✓
IG FE				✓	✓
Defaulted FE				✓	✓
Year FE		✓	✓	✓	
Month-Year FE					✓
N	16,209	16,209	16,209	9,955	9,955
R^2	0.0950	0.0958	0.0981	0.3025	0.3083

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

Table A.12: Firm Liquidity and O&G Exposure (Wild Cluster Bootstrap)

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔUndrawn	ΔUndrawn	ΔUndrawn	ΔDrawn	ΔDrawn	ΔDrawn
O&G Share × Post	-2.7562	-2.7586	-2.7848	3.4348	3.4228	3.4349
	(0.0232)	(0.0241)	(0.0172)	(0.0681)	(0.0611)	(0.0752)
Post	0.0395	0.0335		-0.0699*	-0.1524	
	(0.2767)	(0.744)		(0.0964)	(0.124)	
Issuer FE	✓	✓	✓	✓	✓	✓
Year FE		✓			✓	
Quarter-Year FE			✓			✓
N	2,111	2,111	2,111	2,111	2,111	2,111
R^2	0.0278	0.0279	0.0335	0.0240	0.0252	0.0284

p-values from wild two-way cluster bootstrap by issuer and quarter-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 $Y_{f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{q,y} + \alpha_f + \epsilon_{f,t}$ where $Y_{f,t}$ are various measures of liquidity for firm f at time t ($f \in$ CLO c), 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 $\Delta(\frac{\text{Unused}}{\text{Total Firm Liquidity}})$ in Columns 1-3, and $\Delta(\frac{\text{Drawn}}{\text{Total Firm Liquidity}})$ in Columns 4-6, where *Total Firm Liquidity* is defined as the sum of the total line of credit and cash and cash equivalents. The p-values from wild two-way cluster bootstrapping by issuer and quarter-year are in parentheses.

Table A.13: Investment by Size and Age

	Large Firms Firms		Small Firms	
Investment	Old	Young	Old	Young
O&G Share × Post	-2.6067	-1.9838	-3.6740	-13.8896**
	(2.9691)	(3.5640)	(5.0767)	(5.2621)
Issuer FE	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓
N	591	448	446	509
R^2	0.1880	0.1856	0.1497	0.1858

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 size and age. The baseline regression specification takes the form $I_{ft} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{q,y} + \alpha_f + \epsilon_{f,t}$ where I_{ft} denotes investment of firm f at time t ($f \in$ CLO c), 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 present the results for large firms, while in Columns 3 and 4, I present the results for small firms. Columns 1 and 3 consist of old firms, while Columns 2 and 4 consist of young firms. Standard errors are clustered by issuer.

Table A.14: Investment by Bank Dependence and Timing of Refinancing

	Last Refinancing After Shock		Last Refinancing Before Shock	
Investment	Bond Access	No Bond Access	Access	No Bond Access
O&G Share × Post	3.6552	-6.8414	-0.7585	-10.8335**
	(2.9749)	(8.3901)	(1.4469)	(4.6397)
Issuer FE	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓
Quarter-Year FE	✓	✓	✓	✓
N	769	441	636	708
R^2	0.1853	0.2920	0.1317	0.1924

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 timing of loan refinancing. The baseline regression specification takes the form $I_{ft} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \alpha_{q,y} + \alpha_f + \epsilon_{f,t}$ where I_{ft} denotes investment of firm f at time t ($f \in$ CLO c), 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 present the results for firms which had last refinanced after the shock in the sample period, while in Columns 3 and 4, I present the results for firms which had last refinanced before the shock in the sample period. In Columns 1 and 3, firms have access to the bond market, while in Columns 2 and 4, firms do not have access to the bond market. Standard errors are clustered by issuer.

Table A.15: Triple-Difference: Constrained Firms and Investment

Investment	(1)	(2)
No Access × O&G Share × Post	-10.8285**	
	(4.2396)	
Small × O&G Share × Post		-7.2847*
		(4.4064)
No Access × Post	0.2040	
	(0.1245)	
Small × Post		0.1940
		(0.1350)
O&G Share × Post	0.6152	-1.0657
	(1.8073)	(2.1684)
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 (standardized) investment of firm f at time t ($f \in$ CLO c), d denotes the industry, and q, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. In Column 1, a firm is *constrained* if it does not have access to the corporate bond market. In Column 2, a firm is *constrained* if it is small.

Table A.16: Falsification Test: Primary Non-Institutional Loan Spread and O&G Exposure

All-In-Drawn Spread	(1)	(2)	(3)	(4)	(5)	(6)
O&G Share × Post	-40.3666	161.3654	135.2760	250.2754	197.1342	-142.2520
	(248.2369)	(262.9362)	(268.0703)	(259.5060)	(194.2592)	(223.3746)
Post	-17.6838*	-27.0345**	-15.4694	-18.6264	-14.3602	
	(9.6592)	(11.1942)	(18.8218)	(16.9834)	(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	610	440	440	438	432	432
R^2	0.8716	0.8518	0.8528	0.8769	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 $Y_{i,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity} + \gamma_0 X_i + \alpha_{m,y} + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the All-In-Drawn loan spread of loan i at time t issued by firm f ($i \in f \in$ CLO c), and X is the vector of non-time varying controls associated with loan i including secured status, purpose, distribution method, seniority, loan type, and country of syndication, and m, y denote the month and year respectively. Firm O&G Exposure$_f$ measures the weighted average of O&G share of firm f across all CLOs before the shock occurs, while Oil Shock$_t$ is an indicator variable that takes a value of 1 if the O&G price plunge has occurred, and 0 otherwise. Standard errors are two-way clustered by issuer and month-year.

Table A.17: Alternative Measures of Issuer Exposure to CLOs

	CLO Health (ID Cov.)		Equal Weights		Equal Weighting (Loan Frequency)		Value Weighting (Loan Frequency)		Value Weighting (Loan Amount)	
	Secondary Price	All-In-Drawn	Secondary Price	All-In-Drawn	Secondary Price	All-In-Drawn	Secondary Price	All-In-Drawn	Secondary Price	All-In-Drawn
Issuer Exposure × Post	0.4248***	-12.4521*	-44.9946*	2051.6695***	-82.5273***	2102.7887***	-80.1203***	2024.8176***	-82.6503***	2102.7887***
	(0.1111)	(6.8618)	(24.9657)	(703.6106)	(31.3736)	(719.7521)	(30.8555)	(712.6827)	(31.3846)	(719.7521)
Post	-0.1237	8.9954	1.0911	-51.7958*	2.0636**	-53.4040*	2.0054*	-51.4677*	2.0668**	-53.4040*
	(0.3315)	(14.9394)	(0.8473)	(28.4214)	(1.0430)	(28.9912)	(1.0336)	(28.5252)	(1.0434)	(28.9912)
Issuer-Loan Type FE	✓		✓		✓		✓		✓	
Issuer FE		✓		✓		✓		✓		✓
Maturity Control		✓		✓		✓		✓		✓
Secured FE		✓		✓		✓		✓		✓
Purpose FE		✓		✓		✓		✓		✓
Country of Syndication FE		✓		✓		✓		✓		✓
Distribution FE		✓		✓		✓		✓		✓
Seniority FE		✓		✓		✓		✓		✓
Loan Type FE		✓		✓		✓		✓		✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	55,994	517	107,922	567	57,593	567	57,593	567	57,593	567
R^2	0.5782	0.9160	0.5887	0.9215	0.5963	0.9217	0.5963	0.9215	0.5963	0.9217

Standard errors are clustered by CLO (Col. 1, 3, 5, 7, 9) and Issuer (Col. 2, 4, 6, 8) 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 (Columns 1, 3, 5, 7, 9) and All-In-Drawn Spread (Columns 2, 4, 6, 8, 10) for non-O&G firms. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm Exposure}_f \times \text{Oil Shock}_t) + \alpha_{f,l} + \alpha_y + \epsilon_{i,t}$ 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 y denotes the year in Columns 1, 3, 5, 7, and 9. The regression specification takes the form $Y_{i,t} = \beta_0 + \beta_1(\text{Firm Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm Exposure}_f \times \text{Oil Shock}_t) + \beta_4\text{Maturity} + \gamma_0 X_i + \alpha_y + \alpha_f + \epsilon_{i,t}$ where $Y_{i,t}$ is the All-In-Drawn 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 y denotes the year respectively in Columns 2, 4, 6, 8, and 10. In Columns 1-2, Firm Exposure$_f$ measures the weighted average of distance to the Interest Diversion constraint ($ln(\frac{\text{Current Performance}}{\text{Current Threshold}})$) of a firm f across all CLOs before the shock occurs. In Columns 3-4, Firm 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 5-6, Firm 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 7-8, Firm 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 9-10, Firm 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 in Columns 1, 3, 5, 7, 9, and by issuer in Columns 2, 4, 6, 8, 10.

Table A.18: Selling Propensity by Secondary Loan Price Relative to Par and CLO O&G Exposure

Panel A					
$1_{(\text{loan price}>100)}$	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-1.6731**	-1.7769***	-1.4571**	-2.0619***	-1.7187***
	(0.6254)	(0.6168)	(0.5515)	(0.5987)	(0.5366)
O&G Share	2.4821***	2.4962***	1.7836***	1.3470***	1.1687***
	(0.4672)	(0.4637)	(0.4589)	(0.3925)	(0.3993)
Post	-0.0600	-0.0941**		-0.1170**	
	(0.0370)	(0.0413)		(0.0432)	
Rating-Industry FE			✓		
Issuer-Loan Type FE				✓	✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	35,279	35,279	31,829	34,985	34,985
R^2	0.0204	0.0223	0.1578	0.2827	0.3203

Panel B					
$1_{(\text{loan price}<90)_i,t}$	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	0.7432*	0.7510**	0.4323*	0.4425**	0.3902**
	(0.3681)	(0.3653)	(0.2415)	(0.2045)	(0.1922)
O&G Share	-1.5565***	-1.5564***	-0.3653**	-0.3948**	-0.3655**
	(0.3049)	(0.3014)	(0.1499)	(0.1506)	(0.1477)
Post	-0.0039	-0.0003		-0.0222*	
	(0.0178)	(0.0210)		(0.0126)	
	(0.0130)				
Rating-Industry FE			✓		
Issuer-Loan Type FE				✓	✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	35,279	35,279	31,829	34,985	34,985
R^2	0.0098	0.0099	0.3628	0.5752	0.5819

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 propensity to sell loans issued by non-O&G firms by price categorization. The baseline regression specification takes the form $\mathbb{1}_{(price \leqslant p)_{i,t}} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \alpha_f + \alpha_l + \alpha_{m,y} + \epsilon_{i,t}$ where $\mathbb{1}_{(price \leqslant p)_{i,t}}$ is an indicator that takes a value 1 if the transacted price of secondary loan price issued by firm f at time t ($i \in f \in$ CLO c) is greater than p =\$100 in Panel A, and below p =\$90 in Panel B per \$100 of notional par, Z is a vector of firm controls including rating and industry, m, y denote the month and year respectively, and l denotes the loan-type. CLO O&G Exposure$_f$ measures the O&G share of a given 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 A.19: Interest Rate of Loans and O&G Exposure

Interest Rate	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-1.9507***	-2.1007***	-1.5329**	-1.7283***	-1.8714***
	(0.5977)	(0.5511)	(0.5703)	(0.5737)	(0.5710)
O&G Share	3.0023***	3.9032***			
	(0.5690)	(0.6270)			
Post	0.0382	0.0312	0.0055	0.0102	
	(0.0240)	(0.0239)	(0.0263)	(0.0257)	
Manager FE		✓			
CLO FE			✓	✓	✓
Issue Type FE				✓	✓
Issuer FE	✓	✓	✓	✓	✓
Index FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	
Month-Year FE					✓
N	1,967,665	1,967,665	1,967,664	1,963,614	1,963,614
R^2	0.7689	0.7709	0.7739	0.8358	0.8370

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 loan interest rate for non-O&G firms. The baseline regression specification takes the form $\text{Interest Rate}_{i,c,t} = \beta_0 + \beta_1(\text{CLO O\&G Exposure})_c + \beta_2(\text{Oil Shock})_t + \beta_3(\text{CLO O\&G Exposure}_c \times \text{Oil Shock}_t) + \gamma_0 X_c + \alpha_f + \alpha_l + \alpha_{m,y} + \alpha_r + \epsilon_{i,c,t}$ where $\text{Interest Rate}_{i,t}$ denotes the interest rate of loan i issued by firm f and held in CLO c at time t ($f \in$ CLO c), l denotes the loan type, m, y denote the month and year respectively, r denotes the index name, and X is a vector of CLO controls including manager and CLO indicators. 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 A.20: CLO CCC Loans and O&G Exposure

$\mathbb{1}_{\text{CCC loan}}$	(1)	(2)	(3)	(4)	(5)
O&G Share × Post	-0.9022***	-0.8593***	-0.8172***	-0.9962***	-0.9971***
	(0.2857)	(0.2769)	(0.2734)	(0.2925)	(0.2920)
Post	0.0223***	0.0212***	0.0228***	0.0284***	
	(0.0074)	(0.0071)	(0.0073)	(0.0078)	
Manager FE		✓			
CLO FE			✓	✓	✓
Issuer FE	✓	✓	✓	✓	✓
Loan Type FE				✓	✓
Year FE	✓	✓	✓	✓	
Month-Year FE					✓
N	3,416,878	3,416,878	3,416,874	3,411,591	3,411,591
R^2	0.5287	0.5331	0.5429	0.5530	0.5534

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 firm O&G exposure and likelihood of CCC and below rated loans. The baseline regression specification takes the form $\mathbb{1}_{(\text{CCC loan})i,c,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \gamma_0 Z_i + \gamma_0 X_c + \alpha_{l,f,c} + \alpha_{m,y} + \epsilon_{i,c,t}$ where $\mathbb{1}_{(\text{CCC loan})i,c,t}$ denotes whether loan i issued by firm f and held by CLO c at time t has a rating of CCC or below ($f \in$ CLO c), l denotes the loan type, m, y denote the month and year respectively, Z is a vector of loan controls including loan type and issuer, and X is a vector of CLO controls including manager and CLO indicators. 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 and month-year.

Table A.21: Triple-Difference: Risky Firms and Firm Outcomes

	(1) Secondary Loan Price	(2) All-In-Drawn Spread	(3) Investment
Risky × O&G Share × Post	-270.7383***	1494.2151	-10.0547*
	(86.1335)	(2159.2770)	(5.2123)
Risky × Post	6.6826***	-31.0497	0.2241
	(2.3895)	(61.7280)	(0.1526)
O&G Share × Post 36.3184	1631.8741*	-2.1114	
	(32.6817)	(923.1815)	(2.0887)
Maturity Control		✓	
Issuer-Loan Type FE	✓		
Issuer FE		✓	✓
Secured FE		✓	
Purpose FE		✓	
Distribution FE		✓	
Seniority FE		✓	
Loan Type FE		✓	
Country of Syndication FE		✓	
Industry FE			✓
Rating FE			✓
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 $Y_{i,f,t} = \beta_0 + \beta_1(\text{Firm O\&G Exposure})_f + \beta_2(\text{Oil Shock})_t + \beta_3(\text{Firm O\&G Exposure}_f \times \text{Oil Shock}_t) + \beta_4(\text{Constrained}_f \times \text{Oil Shock}_t) + \beta_5(\text{Constrained}_f \times \text{Oil Shock}_t \times \text{Firm O\&G Exposure}_f) + \beta_6\text{Constrained}_f + \beta_7(\text{Constrained}_f \times \text{Firm O\&G Exposure}_f) + \alpha_{q,y} + \alpha_f + \alpha_I + \epsilon_{f,t}$ where $Y_{i,f,t})$ denotes the secondary loan price in Column 1, All-In-Drawn Spread in Column 2, and (standardized) Investment in Column 3 for firm f at time t (loan $i \in f \in$ CLO c), I denotes the industry, and q, y denote the month and year respectively. 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.

Table A.22: Distance to Interest Diversion Covenant and COVID-19 Exposure

Distance to ID Threshold	(1)	(2)	(3)	(4)	(5)
COVID-19 Share × Post	-3.8025***	-3.9675***	-3.9104***	-4.6904***	-4.5172***
	(1.1159)	(1.0992)	(1.1022)	(1.0007)	(1.0437)
COVID-19 Share	-9.0717***	-4.2903	-3.9119		
	(2.4115)	(2.3778)	(2.3942)		
Post	-0.3228**	-0.2494*		-0.2197*	
	(0.1286)	(0.1237)		(0.1120)	
CLO Controls		✓	✓		
CLO FE				✓	✓
Manager FE	✓	✓	✓		✓
Arranger FE					✓
Trustee FE					✓
Year FE		✓		✓	
Month-Year FE			✓		✓
N	4,986	4,986	4,986	4,984	4,955
R^2	0.6001	0.6546	0.7221	0.8180	0.8885

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 $Y_{c,t} = \beta_0 + \beta_1(\text{CLO COVID-19 Exposure})_c + \beta_2(\text{COVID-19 Shock})_t + \beta_3(\text{CLO COVID-19 Exposure}_c \times \text{COVID-19 Shock}_t) + \gamma_0' X_{c,t} + \epsilon_{c,t}$ 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, 3) and CLO size (Column 3). CLO COVID-19$_c$ is the share of CLO c in industries most vulnerable to COVID-19 – Oil & Gas; Automobiles; Retail; Durable Consumer Goods; Transportation: Cargo; Transportation: Consumer. COVID-19 Shock$_t$ is an indicator variable that takes a value of 1 after the onset of the pandemic, and 0 otherwise. Standard errors are two-way clustered by CLO and month-year.

Appendix B Data Construction of Firm-Level Variables

In this section, I describe the definition of variables.

B.1 Variables

1. *Debt Growth (long-term)* is defined as the log difference in long-term debt ($\Delta ln(\texttt{dlttq})$).

2. *Real Sales Growth* is defined as the log difference in long-term debt ($\Delta ln(\frac{\texttt{saleq}}{GDPDEF_{2009}})$), adjusted by a GDP deflator. The GDP deflator is `GDPDEF` series from FRED. All sales values are converted to 2009 dollar terms.

3. *Investment (Capital Stock Growth)* is defined as the log difference of capital stock. For each firm, the initial value of capital stock is equal to the level of gross plant, property and equipment (`ppegt`). This is k_{it+1} for firm i. The evolution of k_{it+1} is computed using changes in net plant, property and equipment (`ppent`). Missing observations of net plant, property, and equipment are estimated, using linear interpolation of values right before and after the observation, only if there are not two or more consecutive missing observations. This definition is used in Ottonello and Winberry (2020).

4. *R&D Growth* is defined as the log difference in R&D expenditures ($\Delta ln(\texttt{xrdq})$)

5. *Acquisitions* is the ratio of acquisitions expenditures (`acq`) to total assets (`atq`).

6. *Cash Flow* is the ratio of the operating income before depreciation (`ebitda`) to cash adjusted, total assets (`atq-cheq`).

7. *Employment Growth* is defined as the log difference in employment ($\Delta ln(\texttt{emp})$)

8. *Tobin's Q* is the ratio of market value of assets to book value of assets. First, I compute the market value of equity – the product of price close at quarter and common shares outstanding (`prccq` $\times$ `cshoq`). Then, I compute the market value of assets as the sum of the market value of equity, total assets (`atq`), and deferred taxes and investment tax credit (`txditcq`), minus the book value of common stock (`ceqq`). Lastly, I take the ratio of the market value of assets to the book value of assets (`atq`).

9. *Investment Growth* is the difference in the log of capital expenditures (Δ ln(`capxy`)).

10. *Market-to-Equity* is the ratio of the cash-adjusted market value of equity (`prccq` $\times$ `cshoq` - `cheq`) to cash-adjusted stockholders equity (`teqq` - `cheq`)

11. *Tangibility* is the ratio of capital stock (k_{it}) to the cash-adjusted total assets (`atq-cheq`). The capital stock is defined as described in *Investment*.

12. *Leverage* is the ratio of total debt (`dlcq+dltttq`) to total assets (`atq`).

13. *Profitability* is the return on assets, defined as the ratio of net income (`niq`) to total assets (`atq`).