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ABSTRACT

We show that variation in short-term nominal interest rates produces an endogenous response in the design of and commitment to corporate loan contracts. Interest rates are negatively related to the cash flow rights and positively related to the control rights granted to creditors. An implication of this contractual response is a sharp increase in the ex post renegotiation of contracts originated in low interest rate environments, as well as a muted effect of interest rate variation on the cost of debt capital. Our findings illustrate how the design of financial contracts in practice reflects a multi-dimensional tradeoff among contract features that aligns incentives and apportions risk among the contracting parties in a state-contingent manner.

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Despite a large body of evidence showing that nominal interest rates play a central role in the allocation of credit, there is relatively little evidence linking interest rates to the financial contracts defining that allocation. This dearth of evidence is troubling for at least three reasons. First, interest rates have a significant impact on the primitives governing the contracting problem between borrowers and lenders, namely, wealth and outside options. Second, interest rate variation may affect the objectives of the parties and their ability to commit to the terms of the contract. Finally, if financial contracts endogenously respond to variation in interest rates, then this response has potentially important implications for both borrowers and lenders.

The goal of this study is to identify the effect of interest rates on the design of and commitment to financial contracts using the syndicated loan market as a laboratory. We assemble a novel dataset of loan originations, amendments, market pricing, and covenant quality metrics from several sources to provide unique coverage of a market that channels almost one trillion U.S. dollars to corporate borrowers annually. Suppliers of capital in this market cover a broad spectrum of investors including traditional commercial banks, asset managers (e.g., mutual funds, hedge funds), and collateralized loan obligations (CLOs).

We start by showing that borrowers and lenders specify contract terms as a function of short-term nominal interest rates in order to balance the effects of price and nonprice terms. Low interest rates are associated with stronger cash flow rights for lenders in the form of higher credit spreads, higher fees, and an increased incidence of interest rate floors. The net effect of this response is that a 100 basis point decline in the short-term interest rate leads to an unconditional decline of only 76 basis points in the coupon rate of a new loan. In low-rate environments, the pass-through to borrowers is only 69 basis points.

Low interest rates are also associated with a significant change in the control rights afforded to lenders. Maturities shorten and covenant thresholds are set more tightly, consistent with stronger control rights for creditors. However, the fraction of loans designated as covenant-lite increases dramatically, implying weaker control rights for creditors.

What appear to be offsetting forces are in part a targeted response by lenders to curtail risks specific to low-rate environments. The increase in covenant-lite loans signifies a decrease in lenders' concerns about earnings shocks to borrowers, who are better able to weather such shocks when interest expenses are low. The tighter covenant thresholds signify heightened concerns about borrowers taking on too much debt when the cost of debt is low. Thus, the combination of covenant changes gives borrowers the latitude to incur earnings shocks without tripping covenants, while simultaneously limiting borrowers' capacity to take on additional leverage.

To understand the channels through which interest rates give rise to these responses, we exploit cross-sectional variation in the risk profiles of borrowers and lenders. For example, the interest rate elasticities of price-related loan terms for banks with a high income gap (Gomez et al. (2019)), which experience lower profits when interest rates fall, are two to four times larger in magnitude than those for less exposed banks. That is, the insurance provided by higher spreads and interest rate floors is largest for the banks that need it most.

We also find that riskier borrowers exhibit significantly more negative interest rate elasticities of loan price terms than less risky borrowers. Consequently, the total interest expense increases by less for riskier borrowers when interest rates increase, as suggested by several theories predicated on imperfect information (e.g., Stiglitz and Weiss (1981)). These results highlight both risk-sharing and incentive channels at play in the response of contracts to interest rate variation.

The importance of these channels is reinforced when we examine the widespread inclusion of interest rate floors in the context of investor composition. The insurance role these floors play for commercial banks is driven by the presence of fixed operating costs and a limited ability to pass all interest rate variation on to depositors (Drechsler et al. (2017)). For CLOs, which fund between one half and two thirds of institutional term loans, there is no need for insurance because the securitization is structured as a pass-through vehicle funded by floating-rate debt issuance. However, interest rate floors provide strong incentives for

CLO managers to provide credit because any excess interest generated by floors is passed on to the equity tranche that is often retained by the managers. In aggregate, interest rate floors created an additional $35.8 billion of interest income for lenders over our sample period and accounted for 7.3% of the total interest paid from 2010 to 2015.

A final implication of the contractual response to interest rates that we explore is a weakening of commitment to loan contracts. We observe a sharp increase in the propensity to renegotiate loans that are originated when interest rates are low. This effect is driven in part by the contractual changes themselves. Loans with interest rate floors are more likely to be renegotiated, whereas covenant-lite loans are less likely to be renegotiated due to the lower likelihood of covenant violations. Because most loan renegotiations are borrower-initiated, these patterns are consistent with borrowers wanting to remove the costly cash flow provisions conceded to lenders at origination in low-rate environments. Evidence on the actual contract changes made in renegotiation reaffirm this inference.

This paper builds on a large and growing empirical literature studying the design of financial contracts, much of which focuses on debt.[1] Our findings provide additional context for previous research by showing that loan contract design is not only multi-dimensional but that each dimension is state-contingent on interest rates. This state-contingency is important because it allows us to provide evidence of the insurance-incentive tradeoff at the root of most theories of financial contracting.

Evidence of this tradeoff also distinguishes our work from Cohen, Lee, and Stebunovs (2016) and Arscott (2018), both of whom argue that interest rate floors are a consequence of supply-side (i.e., lender) concerns. Our results show that borrowers are willing to accept

[1] A number of studies investigate particular aspects of corporate debt contracts including: pricing (e.g., Asquith, Beatty, and Weber (2005), Drucker and Puri (2009), Berg, Saunders, and Steffen (2016)), maturity (e.g., Flannery (1986), James (1987), Stohs and Mauer (1996), Demirguc-Kunt and Maksimovic (1999), Fan, Titman, and Twite (2012), Li, Loutskina, and Strahan (2019)), collateral (e.g., Benmelech and Bergman (2008), Benmelech (2009)), and covenants (e.g., Smith and Warner (1979), Malitz (1986), Berlin and Mester (1992), Bradley and Roberts (2015), Becker and Ivashina (2017), Green (2018), Berlin, Nini, and Yu (2019), Prilmeier and Stulz (2019)). Recent work in the macro-finance literature examines the interaction between debt contracts and the transmission of economic shocks (e.g., Chodorow-Reich and Falato (2019), Greenwald (2019)) and the effects of low rates on bank lending (e.g., Balloch and Koby (2019), Wang et al. (2019)).

these contract provisions because of concessions from lenders related to control rights and because of their relatively stronger financial position arising from low interest rates.

Our focus and message also differ from Black and Rosen (2016) and Paligorova and Santos (2017), who investigate the role of monetary policy in determining loan maturity and credit spreads, respectively. Our goal is not to identify the causal effects of monetary policy, though our findings have potential implications for monetary policy. Rather, our results show that financial contracts are particularly sensitive to variation in interest rates and are even made explicitly contingent on interest rates in order to apportion risk and incentives in an efficient manner. The nature of this contingency also distinguishes our work from Berger and Udell (1992), who show that fixed-rate loans are more common in high interest rate environments as opposed to the low-rate environments in which we find LIBOR floors. Further, our results highlight that lenders demand insurance from the loan contract, as well as borrowers. More broadly, our study contains an important message for macro-finance researchers, namely, that contracts are not exogenous with respect to the macroeconomic environment.

The remainder of the paper is organized as follows. Section 1 describes the construction of the sample. Section 2 develops our conceptual framework. Section 3 reports our results on the dependence of loan terms on short-term interest rates. Section 4 explores the economic channels underlying these results. Section 5 discusses the implications of our findings for the cost of borrowing and commitment to the contract. Section 6 concludes.

1 Data

1.1 Data Sources

We rely on loan-level data from three sources: IHS Markit's Loan Pricing and Performance database, Standard and Poor's Leveraged Commentary and Data, and Thompson-Reuters' Dealscan database. For brevity, we refer to these sources as Markit, S&P LCD, and Dealscan, respectively. Each database contains information on syndicated loan contracts; however, the loan coverage and scope of information differ.[2] Most of our analysis focuses on the Markit and Dealscan databases, which encompass most of the S&P LCD data based on conversations with data providers and our own analysis. The Internet Appendix contains analysis showing the consistency of our main results across datasets.

Our sample selection requires that loans in both the Markit and Dealscan samples meet the following requirements: U.S. dollar denominated, strictly positive loan principal, strictly positive maturity, nonnegative loan spread, and originated or renegotiated between January 1, 1997 and December 31, 2018. We restrict the Markit sample to first-lien secured loans to ensure comparability across contracts, excluding second-lien and unsecured loans which comprise less than ten percent of the sample.[3] We also exclude a small number of debtor-in-possession loans and loans rated CCC+ or lower from our sample because the issuers of these loans are in default or at imminent risk of default at the time of issuance. Finally, we exclude a small number of other loan types including hybrid facilities, bridge loans, letters of credit, and notes.

We also incorporate detailed loan covenant quality (LCQ) scores from Moody's Investors Service. Moody's analysts compile these scores for a nonrandom sample of 372 institutional term loans of at least $500 million principal amount with a public credit agreement from 2007 to 2018 (Moody's (2014)). We are able to match Moody's LCQ scores by issuer name, loan size and start date to 329 loans in the Markit sample.

Borrower and lender financial information is obtained from the Center for Research in Security Prices (CRSP), S&P Compustat, and Bank Holding Company FR Y-9C databases, accessed through Wharton Research Data Services. We download macroeconomic time series from the St. Louis Federal Reserve Economic Data (FRED) website. Further details on the data sources and variable definitions may be found in the Internet Appendix.

[2]Most syndicated loans involve privately held borrowers and are not subject to public disclosure, so contract information is sourced from the data providers' respective industry connections. Each of the databases contains between one-third and one-half of the approximately $3.5 trillion of broadly syndicated loans outstanding (Bank of America Merrill Lynch (2019)) at the end of our sample period.

[3]Dealscan does not provide comprehensive data on security, so our results based solely on the Dealscan sample do not apply this restriction.

1.2 Sample Characteristics

Panel A of Figure 1 reports the aggregate amount of new originations in the U.S. syndicated loan market over the past two decades using the Markit data. The market peaked in 2007 at over \$600 billion of issuance, collapsed in the financial crisis of 2008 and 2009, and rapidly recovered to near pre-crisis levels by 2011.

The figure distinguishes among loan types to recognize an important segmentation in the syndicated loan market. Pro rata tranches are held primarily by commercial banks and include revolving lines of credit and term loan A facilities. The former loan type may be drawn down and repaid over the life of the loan. The latter are typically fully drawn at origination and paid back according to an amortization schedule. Institutional tranches, also called term loan B facilities, are structured specifically for institutional (i.e., nonbank) investors, though some banks do invest in these tranches.[4]

Examples of these nonbank investors include private equity funds, hedge funds, mutual funds, and collateralized loan obligations (CLOs). Panel B of Figure 1 presents the temporal distribution of institutional tranche investors using data from S&P LCD. CLOs are the most prominent investor type, responsible for the majority of funding during our sample period. Hedge funds, loan mutual funds, and high-yield bond funds provide most of the remaining funding, with insurance companies and finance companies accounting for a small share.

Panel C of Figure 1 provides information on the loan-level credit ratings of new originations in the Markit data. Most of the loans in our sample are not rated by a credit rating agency.[5] Among the loans that are rated, most are in the BB or B categories, below the investment-grade cutoff. The lack of investment-grade firms in the sample is unsurprising in light of their tendency not to borrow from banks (Rauh and Sufi (2010)).

[4]We pool the pro rata and institutional loans throughout our main analysis to simplify the exposition. The Internet Appendix provides supplementary results showing that our main findings are qualitatively similar in both segments of the market.

[5]The lack of a loan-level rating reflects an absence of demand for a rating by syndicate members (e.g., as a public signal to ease secondary market trading) or the issuer, but does not imply that the issuer lacks access to public debt markets. We incorporate long-term issuer credit ratings from S&P Compustat in our analysis of economic mechanisms to obtain a clearer signal of an issuer's outside options.

Table 1 reports summary statistics for the Markit and Dealscan samples. The Markit data include information on loan amendments (i.e., renegotiations), which we define as any event that involves a loan being modified or replaced prior to maturity. Approximately two thirds of the loan observations are new originations (Panel A) and one third are amendments (Panel B). The median Markit loan origination is $100 million dollars, matures in five years, and has a loan spread of 3.25% above LIBOR, the most common benchmark rate for loans in our sample.

Almost 30% of loans contain an interest rate floor, with levels ranging from zero to 7%, which affects the relation between the loan coupon rate and market interest rates. Without a floor, the coupon rate is computed as the sum of a base interest rate that varies over time (e.g., LIBOR) and a loan spread that is fixed at issuance.[6] Interest rate floors place a bound on how low the base rate can go, effectively converting the loan to a fixed-rate instrument when the base rate is below the floor. For example, suppose the loan spread is 3% and the level of the floor is 2%. If LIBOR is 1%, then the floor binds and the annualized coupon rate is 5%. If instead LIBOR is 4%, then the floor is not binding and the coupon rate is 7%.

Covenant-lite loans, which have incurrence covenants instead of traditional maintenance covenants, account for 6% of our sample. An example is useful for understanding the difference in covenant types. Consider a leverage covenant restricting the debt-to-EBITDA ratio to remain below four. With a maintenance covenant, should the borrower's debt-to-EBITDA ratio rise above four for any reason, the borrower would be considered in violation of the covenant and in technical default, absent a waiver from the lender. With an incurrence covenant, the borrower must take an action (e.g., issue debt) that generates a debt-to-EBITDA ratio greater than four in order to be in violation. For instance, if the borrower's debt-to-EBITDA ratio rises above four because of an earnings shock, the borrower would not be in violation of the incurrence covenant.[7]

[6]Some loan spreads vary according to a predetermined schedule linking the spread to a borrower risk metric, such as credit ratings or leverage. These performance pricing measures are present in one-fifth of loans in the Dealscan sample.

[7]See Becker and Ivashina (2017) and Berlin and Nini (2017) for more details on covenant-lite loans.

Panel C reveals that the Dealscan sample is substantially larger and contains different loan information. These differences are a consequence of Markit's objective of providing price quotes for tradeable loan instruments versus Dealscan's culling of SEC filings and use of private contacts in the financial sector. Of particular interest in Dealscan are the fee and covenant data. One-time upfront fees for structuring and processing the loan are nontrivial, averaging 0.79% of the loan amount.[8] Dealscan also provides information on a host of different covenants. We focus on the debt-to-EBITDA (i.e., leverage) covenant that restricts a borrower's leverage ratio to remain below that threshold. This is the most common covenant and among the least difficult to measure using publicly available financial data according to Demerjian and Owens (2016). However, recent research by Ivashina and Vallee (2019) and Badawi and de Fontenay (2020) show that judicious definitions of EBITDA are another means by which lender control rights are weakened. The typical loan requires the firm to maintain a debt level that is no more than 4.4 times its operating earnings.

Finally, Panel D summarizes the sample obtained by merging Markit and Dealscan. Markit and Dealscan do not share common loan identifiers, but they do contain common variables (e.g., borrower name, basic loan terms) that we use to merge these datasets. Specifically, we match loans across the two datasets using the following criteria: same borrower name, start dates within 30 days of one another, end dates within 365 days of one another, loan amounts within 25% of one another. The flexibility along contract dimensions reflects different data recording mechanisms across the providers. We are able to match approximately 25% of the loans in Markit to a facility in Dealscan.

Loans in the merged sample are larger on average but otherwise have similar characteristics to the full Markit and Dealscan samples. We use the Dealscan-Compustat link tables from Chava and Roberts (2008) and Schwert (2018) to obtain borrower and lender characteristics for the matched sample. We have lender characteristics, which we compute as equal-weighted averages of the banks receiving a lead arranger credit, for almost all of

[8] Commitment fees are another important source of fee income for lenders but are typically only included in revolving lines of credit. We provide evidence related to commitment fees in the Internet Appendix.

the matched loans. Detailed data on bank balance sheets (e.g., deposit funding) and income statements (e.g., interest margins) are only available for U.S. bank holding companies. The top arrangers in our sample are JPMorgan Chase (co-lead on 14% of loans), Bank of America (14%), Credit Suisse (7%), Citigroup (5%), and Wells Fargo (5%). We have borrower characteristics for only about one third of the matched sample because many of the loans are to private firms.

While Table 1 makes clear the heterogeneity of our loan samples, it should also be noted that the average loan in the Markit sample is riskier than the population average syndicated loan. This distinction is most easily seen by a comparison of the average spread across Markit and Dealscan loans. The former is nearly 100 basis points higher than the latter, and well above the 250 basis points threshold demarcating "leveraged" loans from the broader loan market. Thus, our sample is precisely one in which risk sharing and incentive provision are likely to be important.

2 Conceptual Framework

The starting point for financial contracting in our setting is one in which a wealth constrained borrower seeks investment financing from a lender (Freixas and Rochet (2008)). The borrower's program is:

$$\begin{aligned} &\max_{R(\cdot)} E\left[u_B\left(y - R(y)\right)\right] \\ &\text{s.t.} \;\; E\left[u_L\left(R(y)\right)\right] \geq U_L^O, \end{aligned} \tag{1}$$

where u_B and u_L are the respective utility functions of the borrower and lender, U_L^0 is the reservation utility of the lender, y is the random payoff from the borrower's investment, and $R(y)$ is the repayment scheme, or contract, between the borrower and the lender.

Wilson (1968) shows that the optimal repayment scheme exhibits a strong sensitivity to the investment payoff in a manner that reflects the relative risk aversion of the two agents.

The sensitivity of the repayment scheme to y is high when the borrower is more risk-averse, and low when the lender is more risk-averse. Thus, the optimal contract is one in which only risk-sharing matters.

2.1 Cash Flow Rights

However, risk-sharing alone cannot explain the nature of debt contracts, most of which exhibit little performance sensitivity. Early work to rectify this shortcoming took several different approaches. Townsend (1979), Diamond (1984), Gale and Hellwig (1985), and Bolton and Scharfstein (1990) explore how the repayment scheme is affected by the lender's inability to costlessly observe the investment payoff y. Innes (1990) and Diamond (1991) examine how the lender's inability to observe the actions of the borrower, which determine the lender's payoff, affects the repayment scheme.

In these settings, the contract performs two functions: risk-sharing and incentive provision. While the carrots and sticks these theories use for incentive provision vary (e.g., pecuniary and non-pecuniary penalties, the promise of future financing), the repayment schemes are structured to provide borrowers with proper incentives, which range from truthful reporting of investment income to exertion of sufficient effort.

Put differently, these theories suggest that the optimal contract strikes a balance between incentives and insurance through the allocation of cash flow rights. They also identify the channels through which interest rates could affect contract design, namely: the risk tolerance of the parties (Borio and Zhu (2012)), the attractiveness of the parties' outside options, and the costs of punishing the borrower for deviation from truth-telling or optimal effort exertion.

If one assumes that lenders face borrowers with different risk characteristics observable only by the borrower, then lenders may modify the pricing mechanism in an effort to screen borrowers of different types. Some examples include a loan interest rate that is a decreasing function of the borrower's collateral (Bester (1985) and Besanko and Thakor (1987)) or an increasing function of the loan size (Freixas and Laffont (1990)). Thus, interest rates can also affect financial contracts via their impact on collateral values and loan sizes.[9]

2.2 Control Rights

The theories discussed above rely on limiting the observability of outcomes or actions to restrict the contract space. The incomplete contracting literature relies on transaction costs which include unforeseen contingencies, the actual cost of writing a complete contract, and the cost of enforcing the contract (Tirole (2006)). These costs preclude a complete description of the state space or limit contract enforcement by third parties such as courts.

The central role of contracts in this setting is the allocation of decision or control rights. Incomplete contracts allocate control rights to the parties in a state-contingent manner aimed at minimizing inefficiencies. Because the allocation is often based on a verifiable signal that is imperfectly correlated with the true state (e.g., Aghion and Bolton (1992)), ex post inefficiencies result in the need for renegotiation. Thus, incomplete contracting theories reconcile the observation that loan contracts are often contingent on observables and are commonly renegotiated.[10]

The primary role of interest rates in an incomplete contracting setting lies in their impact on the allocation of control and bargaining power. For example, Hart and Moore (1994) emphasize the central role of human capital, or collateral more broadly, and its limitations as a commitment device to secure project financing. Myers and Rajan (1998) emphasize the importance of asset liquidity, which plays dual roles. Liquid assets aid in securing financing but also increase the threat of asset substitution. Precisely how interest rates affect the design of loan contracts in this setting is an empirical question.

[9]To be precise, nominal interest rate variation will affect asset values as long as inflation does not affect expected nominal cash flows in an offsetting manner. We discuss this issue further in light of our findings.

[10]Many aspects of a loan are contingent on observable metrics including covenants (Dichev and Skinner (2002)) and pricing (Asquith, Beatty, and Weber (2005)). See Roberts and Sufi (2009) and Roberts (2015) for evidence on bank loan renegotiations.

2.3 Commitment

When contracts are complete and information asymmetric, contracts may fail to be sequentially optimal, thus leading to renegotiation, because the objectives of the contracting parties change over time (Dewatripont and Maskin (1990)). Objectives may change due to information acquisition or irreversible decisions. In our setting, the former is the more likely rationale for observed renegotiation.[11]

As discussed, one motivation for the loan contract is the balancing of risk-sharing and allocative efficiency. Once the relationship is underway, information about the factors giving rise to the risk may be revealed, thereby mitigating, if not eliminating, concerns about risk-sharing. Thus, it will be in the interest of both parties to undo the original balance through renegotiation. Interest rate variation is a key risk factor for both borrowers and lenders and is thus likely to play a role in renegotiation. The role of interest rates depends on the interest rate sensitivity (i.e., risk exposure) of the contracting parties.

The incomplete contracting literature comes to a similar conclusion. The revelation of new information generates ex post surplus and a need for renegotiation. An additional consideration is that renegotiation is anticipated, if not contractible, so there is the opportunity for contractual renegotiation design (Aghion, Dewatripont, and Rey (1994)). Contracts are designed to allocate bargaining power in renegotiation. Because the states on which bargaining powers and default options are made contingent are likely correlated with interest rates, loan contracts will be shaped by interest rates through a renegotiation channel, in addition to the risk and incentive channels discussed above.

[11]While some corporate decisions are plausibly irreversible (e.g., effort exertion, risky investments), those decisions can occur at any point in time during the life of the contract. So while contracts are in part aimed at aligning incentives and insuring risk, there is no irreversible decision taken during the life of the contract the eliminates scope for "bad" behavior by borrowers.

3 Aggregate Contractual Response to Interest Rates

This section characterizes how contracts respond to interest rate variation by examining aggregate patterns in the data. The goal is to identify the reduced-form relations between contract features and interest rates, the latter of which are plausibly exogenous with respect to the design of syndicated loan contracts.[12] There are, however, two limitations of this analysis. First, it cannot help us understand the channels through which interest rates affect contract design. Second, it cannot identify tradeoffs among contract features. We explore these issues in subsequent sections.

3.1 Cash Flow Rights

Figure 2 presents quarterly time-series plots of three-month LIBOR and principal-weighted averages of the different components of the loan pricing mechanism: the loan spread, fees, and interest rate floors. All of these variables are measured in percentage terms. We focus on the three-month LIBOR rate as our measure of short-term interest rates because it is the standard base rate for syndicated loans and provides a measure of financing costs for financial intermediaries. Alternative measures, such as the Treasury bill rate or the Fed Funds rate, are highly correlated with LIBOR and lead to similar results and conclusions.

Panel A reveals a noticeable negative relation between LIBOR and loan spreads both in terms of trends and cycles. After more than a decade since the financial crisis and a 238% increase in the level of the S&P 500 index, credit spreads in the last quarter of 2018 averaged 3.01% compared to an average of 2.19% over the entire pre-crisis period. A broadly similar relation to LIBOR is observed in upfront fees (Panel B).

Panel C shows that LIBOR floors were present in a small fraction of loans from 2002 to 2007, but quickly took off after the crisis, appearing in 60% of new loans towards the end of our sample period. Interestingly, interest rate floors are *not* entirely an artifact of the

[12] While an economically significant source of funding for firms, the syndicated loan market is small relative to other asset classes (e.g., mortgages) on the balance sheets of financial intermediaries, so reverse causality is unlikely in this setting.

financial crisis; a nontrivial number of loans contained floors as far back as 2002, during the period of relatively low rates following the bursting of the dot-com bubble.

Finally, Panel D shows that the average level of the floors spiked to over 3% immediately following the onset of the financial crisis, then declined rapidly to the current level of approximately 0.30%. This suggests that interest rate floors are not only a consequence of lenders' concerns about the prospect of negative interest rates. The average floor level is always above zero and for most of our sample period, until shortly after the Federal Reserve began raising rates in late 2015, floors were set above the current level of LIBOR, which has not fallen below zero in the U.S.

To more clearly tease out these aggregate relations, Panel A of Table 2 presents time-series regression estimates. Our regression specification is:

$$\begin{aligned} y_t &= \alpha + \beta X_t + \mu_t \\ \mu_t &= \rho \mu_{t-1} + \varepsilon_t, \end{aligned} \tag{2}$$

where y_t is the contract term of interest and X_t is a vector of covariates including the short-term interest rate. We model the residual term using an AR(1) process to improve model fit and account for persistence in the dependent variable.[13] To ensure that the interest rate is not simply a proxy for other measures of economic activity or investor expectations, we incorporate several macroeconomic controls including a recession indicator, GDP growth, and the trailing 12-month S&P 500 index return.

Additional specifications that both limit and expand the set of control variables result in quantitatively similar estimates and, as such, are relegated to the Internet Appendix. One notable exception is the LIBOR forward rate, which we use as a proxy for future interest rate

[13] In unreported analysis, we explore alternative specifications, including an OLS regression with time trends and a first-differences regression. The regression with time trends leads to similar coefficient estimates but has worse model fit and leads to unrealistic out-of-sample forecasts. The first-differences specification is equivalent to the model in equation (2) with $\rho = 1$, which reduces the outcome variables to near white noise and, with the short time series, results in almost no statistically significant coefficients.

expectations. The correlation between the spot and one-year forward rates is 0.99, making it practically impossible to distinguish between these variables. Thus, interpretation of the role of interest rates in our setting must be broadened slightly to reflect both current conditions and near-term expectations.

The table reveals negative relations between LIBOR and the components of the loan pricing mechanism. A one percent decrease in LIBOR coincides with the following increases in price-related contract terms (computed relative to the average contract value in parentheses):

- Spread: 0.16% (4%),
- Upfront fee: 0.08% (10%),
- Probability of LIBOR floor: 1.0% (3%, statistically insignificant), and
- Level of LIBOR floor: 0.22% (24%).

In sum, the contractual response to low interest rates is to allocate more cash flow rights to lenders through each component of the pricing mechanism.

3.2 Control Rights

Figure 3 presents the relation between LIBOR and nonprice contract terms. Whereas interest rates exhibit a strong negative relation with loan price terms, there appear to be largely positive relations between interest rates and nonprice terms. Loan maturities (Panel A) are strongly positively correlated with LIBOR, consistent with Black and Rosen's (2016) findings in the pre-crisis period. The average maturity in the post-crisis period is about six months shorter than the average maturity in the few years prior to the crisis.[14] Covenant-lite loans did increase significantly before the onset of the crisis, but took off in the low interest rate environment after 2009, consistent with evidence in Becker and Ivashina (2017) and Berlin, Nini, and Yu (2019).

[14] We remove one outlier 20-year loan to AMR for $35 billion in the first quarter of 2001.

Panels C explores the leverage covenant limiting borrowers' debt-to-EBITDA ratios. While there are many different financial covenants appearing in loan contracts, the debt-to-EBITDA ratio is the most common (Chava and Roberts (2008)). The plot shows a positive correlation between interest rates and the covenant threshold, which ranges from 4.0 to 5.5. A more relevant measure of covenant risk, and thus lender control rights, is the distance between the threshold and the borrower's leverage at origination. However, recent research has identified difficulties with the measurement of this distance using data not classified as material nonpublic information (MNPI) (see Ivashina and Vallee (2019) and Badawi and de Fontenay (2020)). We discuss the implications of this research for our findings below.

Panel B of Table 2 presents time-series regression estimates for the nonprice terms. The results confirm the aggregate relations in Figure 3. In response to a one percent decrease in LIBOR, we observe the following decreases (computed relative to the average contract value in parentheses):

- Maturity: 2 months (3%),
- Probability of covenant-lite: -0.3% (5%, statistically insignificant), and
- Debt-to-EBITDA threshold: 0.09 times EBITDA (2%).

Like the cash flow rights examined in the prior section, the control rights afforded to creditors respond to variation interest rates, but the response of these nonprice terms is more nuanced. While shorter maturities and tighter covenant thresholds suggest that control rights are stronger in low-rate environments, the rise in covenant-lite contracts suggests a weakening of control rights. We postpone a deeper discussion of this relation until after we identify the economic channels through which interest rates affect contract design.

4 Economic Channels behind the Contractual Response

While the results above show that contract features are robustly related to interest rate variation, the mechanisms behind these relations are ambiguous. To motivate our analysis into these mechanisms, consider the optimal repayment scheme R^* from program (1). This scheme is a function of the preferences of the borrower and the lender, u_B and u_L, and the outside option of the lender, U_L^O. Because of the problem's symmetry, the outside option of the borrower, U_B^O, is equally relevant. These are the primitives of the financial contracting problem and, as such, the effect of interest rates on contract design must move through these channels. If one constrains the contract space by limiting observability by the lender or introducing transaction costs, then additional channels may be present. For example, the audit cost of Townsend (1979), the non-pecuniary punishment of Diamond (1984), collateral (Hart and Moore (1994)) and asset liquidity (Myers and Rajan (1998)) provide alternative channels through which interest rates may affect the contract.

4.1 Empirical Approach

Our empirical strategy is to exploit loan-level variation in these channels as a function of interest rates. To see the connection between our empirical analysis and the conceptual framework outlined above, we begin by assuming that the optimal repayment function can be expressed as a linear function of theoretical primitives corresponding to the parties' preferences, outside options, and any costs associated with constraints on the contracting space.

$$R^*(u_B, u_L, U_L^O, U_B^O, Costs) = \beta_0 + \beta_1 u_b + \beta_2 u_L + \beta_3 U_B^O + \beta_4 U_L^O + \Gamma' Costs + \varepsilon. \qquad (3)$$

The utility functions and outside options in equation (3) should be interpreted as notational stand-ins for the deep parameters of program (1) representing preferences and outside options. Likewise, costs may be multi-dimensional, so Γ corresponds to a vector of coefficients.

Each of these primitives is in turn a function of the interest rate. For example, the risk tolerance of borrowers is affected by interest rates through their impact on interest expense and asset values. Similarly, the risk tolerance of lenders is affected by interest rates through their impact on profit margins. Thus, our empirical specification is a regression in which the short-term nominal interest rate enters directly and is interacted with empirical proxies for the primitives of the contract design problem.

To be exact, we estimate the following regression:

$$y_{fbt} = \alpha + \beta r_t + \gamma' \mathbf{X}_{fbt} + \delta' \mathbf{X}_{fbt} \times r_t + \varepsilon_{fbt}, \tag{4}$$

where y_{fbt} is a contract term of a loan to firm f arranged by bank b at time t, $\mathbf{X}_{fbt}$ is a vector of borrower and lender characteristics, and r is the prevailing 3-month LIBOR rate. Our main specification does not include fixed effects because removing the across-bank and across-firm variation induces collinearity between short-term interest rate and the interaction terms. In the Internet Appendix, we show that the main results are qualitatively similar when the regression includes either bank or firm fixed effects.

We use the income gap of lead arrangers, which measures the exposure of their profits to rate changes, as a proxy for the constraints faced by lenders and the attendant effects on their preferences. Following Gomez et al. (2019), we define a bank's income gap as the difference between the book values of its assets and liabilities that mature or reprice within one year. Intuitively, banks with a high income gap are relatively worse (better) off after an decrease (increase) in short-term interest rates because they experience a decrease (increase) in interest income from assets that exceeds the parallel change in the interest expense of liabilities. Empirically, the income gap is measured using Call Report data as:

$$
\begin{aligned}
\text{Income Gap} \;=\; & \text{Earning assets repricing or maturing within one year} \\
& - \;\text{Long-term debt repricing within one year} \\
& - \;\text{Long-term debt scheduled to mature within one year} \\
& - \;\text{Variable-rate preferred stock} \\
& - \;\text{Interest-bearing deposits repricing or maturing within one year}
\end{aligned} \tag{5}
$$

We scale this measure by the book value of assets to ensure comparability across banks. The mean (median) income gap in our sample is 28% (30%). Among the most active lead arrangers, JPMorgan and Citigroup have low income gaps, while Goldman Sachs and Morgan Stanley have high income gaps. In the Internet Appendix, we show that our regression estimates are similar after controlling for bank size and capital ratios.

We use the credit ratings of borrowers to proxy for their risk tolerance, outside options, and the conflict of interest between their shareholders and lenders. Firms with a public credit rating have better access to outside financing than unrated firms. Among firms with a rating, those with a lower rating are at greater risk of default from a drop in operating performance or a spike in interest expense. To measure a borrower's credit rating, we use both loan-level ratings from Markit and long-term issuer ratings from S&P Compustat to form a set of rating indicators. Specifically, we define a loan as unrated if neither the loan nor the issuer have a credit rating and there are no other rated loans to the issuer with the same start date. Thus, unrated loans have no public signal of quality from a credit rating agency. To measure the credit quality of rated loans, we use the loan-level rating when available, the long-term issuer rating if there is no loan-level rating, and finally, the rating of another loan to the issuer on the same date if neither a loan-level nor a long-term issuer rating are available. We exclude a small number of loans rated CCC+ or lower, as well as firms rated CCC+ or lower while the loan is unrated, from the sample to mitigate the impact of distressed borrowers on the results.

Table 3 reports estimates of these regressions for the price and nonprice terms examined in our earlier analysis. We report the coefficients of interest and list the remaining covariates in the table's caption. To ease the interpretation of our estimates, we report the interest rate sensitivity of each term for lenders and borrowers of different types in the bottom of each panel. Because of the interaction effects, the marginal interest rate effect is a function of the interaction variables,

$$\frac{\partial y}{\partial r} = \beta + \delta' \mathbf{X}. \tag{6}$$

We report the interest rate sensitivity of borrowers in each rating category, with investment-grade issuers as the omitted group, as well as for banks with high and low income gaps, defined as two standard deviations above or below the mean.

4.2 Cash Flow Rights

Panel A of Table 3 reports estimates of the regression described above for the price-related contract terms. The first row shows that the level of LIBOR is negatively correlated with each of the pricing components, consistent with the aggregate results discussed above, though the correlation with the presence of a floor is statistically weak.

The first column reveals that the negative relation between loan spreads and LIBOR is amplified for lenders with a large income gap and for borrowers with high credit risk or few alternative financing options. The spread on a new loan from a high-income-gap bank increases by 20 basis points in response to a 1% decrease in LIBOR, in contrast to the 10 basis point increase in loan spread for a low-income-gap bank. Put differently, banks that are most susceptible to low interest rates demand greater compensation from borrowers. While this result might suggest an assortative matching in which riskier firms borrow from riskier lenders, as proxied by exposure to reductions in interest rates, Schwert (2018) shows that the selection mechanism is the opposite; more constrained (and risky) borrowers select less constrained and more stable lenders.

We also observe that the spread response to declining interest rates is increasing with borrower risk. B-rated borrowers see their spreads rise by 33 basis points in response to a 1% decrease in LIBOR, while BB-rated and investment-grade borrowers see increases of 20 and 15 basis points, respectively. The unrated interaction coefficient implies that spreads increase by more (20 basis points) in response to decreases in interest rates for unrated firms relative to investment-grade firms. This is consistent with rated firms having better outside options (i.e., bond issuance) than unrated firms. It is possible that unrated status also captures credit risk not encapsulated in the included ratings dummies. However, the coefficients on the rating indicators suggest that unrated loans are of similar average quality to BB-rated loans.

The second column shows that a 1% decline in interest rates is associated with a 28 basis point increase in fees by high income gap banks, but only a 6 basis point fee increase by low income gap banks. We see no similar heterogeneity in the effect of borrower credit risk on fee sensitivity to interest rates.

The third column shows that the increase in the likelihood of a LIBOR floor in response to a drop in rates is four times higher for high-income-gap banks than for the average bank, whereas low-income-gap banks actually exhibit the opposite sensitivity of floor inclusion to rate changes. This finding suggests that floors play an important role in stabilizing the profitability of banks' lending operations in low-rate environments. In line with the spread estimates, the interest rate sensitivity of floor inclusion is significantly stronger for loans with worse credit ratings and for unrated borrowers. The last column reveals results for the level of the floor that are broadly consistent with those already discussed.

In sum, the loan price response to interest rate variation is highly sensitive to the risk of the contracting parties. Interest rate variation appears to move through the risk profiles of both lenders and borrowers, as well as the outside options of borrowers.

4.3 Control Rights

Panel B of Table 3 presents analogous results for the control rights included in loan contracts. In general, we see less evidence of heterogeneity in interest rate sensitivities.

Covenant-lite status is the exception, with the increased fraction of covenant-lite contracts in low-rate environments driven by high-income-gap banks and lower-quality borrowers. Banks with a high income gap are 1.4% more likely to offer covenant-lite terms when rates are 1% lower, while low-income-gap banks exhibit the opposite sensitivity. The sensitivity for investment-grade borrowers is statistically insignificant, while BB-rated and B-rated borrowers see the likelihood of covenant-lite terms go up by 1.1% and 2.4%, respectively, when LIBOR is 1% lower. These patterns are consistent with lenders trading off weaker control rights with stronger cash flow rights when rates are low. We provide additional analysis of this potential market-clearing mechanism shortly.

To shed more light on the economic interpretation of these patterns, we relate our coarse measure of covenant-lite status to detailed loan covenant quality (LCQ) scores from Moody's. Table 4 reports regressions of LCQ scores on the covenant-lite indicator, with higher LCQ scores corresponding to weaker lender protections.[15] Consistent with the interpretation of covenant-lite as the absence of maintenance covenants, the financial covenants LCQ score category shows the strongest correlation with the covenant-lite indicator. However, we also observe significant associations between covenant-lite status and the looser restrictions on the incurrence of additional debt, value transfers to equity and junior creditors, and investments in risky assets. Overall, the evidence in Table 4 suggests that covenant-lite status is associated with weakening lender protections across the board.

[15] We regress the LCQ scores on the covenant-lite indicator instead of incorporating them into the framework from Table 3, which requires a merge between Markit and Dealscan, to maximize the observation count. The Internet Appendix contains additional details on the matched sample of LCQ scores.

4.4 Discussion

4.4.1 Risk-Sharing

The results thus far suggest an important role for risk-sharing in shaping the design of loan contracts. At first glance, this interpretation might appear counterintuitive. Why would large firms — borrowers and lenders — exhibit risk aversion? There are several reasons, beginning with incentive distortions and lack of diversification on the part of management. More telling, however, are the risk-management practices in place at most firms, particularly financial institutions.

Consider the response of price-related terms to low interest rates. When interest rates are low, a borrower's financial position is stronger for two reasons. First, lower interest rates lead to lower interest expense on floating rate debt. Second, lower interest rates lead to higher asset, and thus collateral, values through a discount rate channel, assuming there is no inflationary offset through future nominal cash flows. Because of the persistently low level of inflation and lack of variation relative to interest rates over our sample period, this offset is not of concern. Nonetheless, in unreported analysis, we verify that controlling for inflation has little effect on our results and inferences.

Both of these effects lead to greater pledgeable income and lower external financing premia. While low interest rates have a similar effect on bank balance sheets, a more pressing concern arises on their income statements. Low interest rates reduce interest income and deposit markups, squeezing margins for lenders and reducing profitability (Alessandri and Nelson (2015), Borio, Gambacorta, and Hofman (2017), Drechsler, Savov, and Schnabl (2017)). Thus, in low interest rate environments, borrowers are well-positioned to absorb interest rate shocks, particularly further declines in rates, whereas lenders are at greater risk.

The contract design process explicitly recognizes this risk imbalance in two ways. First, loan spreads and fees increase in response to interest rate reductions. This inverse relation between interest rates and the price terms of loans leads to a temporal smoothing of income and expenses for lenders and borrowers, respectively. Second, interest rate floors are more likely to be incorporated into contracts, protecting lenders against the risk of negative interest rate shocks after the loan is issued.

Risk-sharing also helps explain why interest rate floors, as opposed to higher loan spreads, are used in the loan design. Arscott (2018) shows that the typical interest rate floor is value equivalent to an increase in loan spread of about 0.60%. However, the higher level of loan spreads when rates are low leaves both borrower and lender exposed to increases in interest rates. Specifically, borrowers would face higher interest expense, which exacerbates their incentive conflict with lenders, all else equal, and would cause lenders to face increased loss of principal from default. Interest rate floors avoid this problem by offering lenders protection against negative rate shocks without large increases in loan spreads.

There are several reasons why borrowers are the natural providers of interest rate insurance for lenders. First, if the bank were to purchase an interest rate floor in the over-the-counter market for interest rate derivatives, it would face an additional regulatory capital charge. Second, the ability of a borrower to prepay its loan would induce a basis risk between a lender's loan portfolio and its interest rate hedges. Including the floor in the loan contract incurs no additional capital charge and eliminates the basis risk induced by prepayment. Finally, the bank would have difficulty finding counterparties for a long-term floor contract because other financial institutions have the same hedging demand.

The cross-sectional heterogeneity in the relation between rates and price terms and the response of covenant design reinforce this risk-sharing interpretation. Banks with a high income gap are most sensitive to low rates, so they are most likely to respond by raising spreads and including floors, and to compensate borrowers by offering covenant-lite loans. Less creditworthy firms benefit the most from low interest rates, in terms of reductions in credit risk. Consequently, they are in a strong position to insure against further rate reductions.

As discussed earlier, the joint tightening of covenant thresholds and increase in covenant-lite treatment in low-rate environments is revealing about risk considerations. Tighter incurrence covenants limit the amount of debt that borrowers can issue, which mitigates the risk of excessive interest payments when interest rates rise. This covenant design recognizes that when interest rates are low, earnings shocks are less of a concern because borrowers have less trouble making interest payments. That said, this approach is not without risk. Borrowers can fall into deep distress following a series of negative earnings shocks without tripping a covenant, potentially eroding the value of creditors' claims.

4.4.2 Incentive Provision

A closer look at interest rate floors reveals that risk-sharing alone cannot explain their prevalence in loan contracts. Panel A of Figure 4 shows that interest rate floors are widely adopted in both pro rata and institutional loan types. For pro rata tranches mostly held by banks, the risk-sharing motivation discussed above is clear. For institutional tranches held mostly by CLOs, a risk-sharing motivation is less compelling, yet LIBOR floors are even more prevalent in this segment of the market.[16]

On a related note, Panel B of Figure 4 reports the distribution of floors in each year using box-and-whisker plots. Two features of the plot cast doubt on an explanation for LIBOR floors that is driven solely by risk-sharing. First, interest rate floors are not solely for the purpose of avoiding the zero lower bound. The typical floor is set strictly above zero throughout the low-rate period following the crisis. It is only over the last two years of our sample that a number of floors have been set at zero. Second, there is little cross-sectional dispersion in the level of floors, with almost every floor set at exactly 1% in 2014 and 2015. Clearly, heterogeneity in borrower characteristics, which is substantial in this market, has

[16]One possibility is that the risk of failing to syndicate the loan, or pipeline risk as termed by Bruche, Malherbe, and Meisenzahl (2017), drives arrangers to incorporate their preferences into the contract. While a potentially important consideration, it is unlikely a complete explanation because few syndications actually fail. Another possibility is that interest rate floors help CLO managers meet interest coverage tests, which require that coupon income exceeds payments to CLO tranche securities by a specified margin in order to allow payouts to CLO equity investors. The importance of this channel depends on the correlation between interest rate changes and loan delinquency and the amount of slack in interest coverage restrictions.

little effect on the decision to include this contract term, even if it does affect the overall design of the loan contract.

Recall from Figure 1 that the majority of funding for institutional tranches comes from non-bank entities. Hedge funds rely on prime brokerage financing of their investments and, as such, are subject to the lending rates offered by banks. Therefore, any effects of low interest rates on banks are passed through to hedge funds through the terms of prime brokerage financing. However, CLOs and mutual funds are pass-through entities, offering returns that vary one-for-one with the underlying assets.[17]

Rather, what unifies these vehicles in their preference for interest rate floors, and other contractual features, are the incentives of the principals and investors holding the equity tranches. CLOs are managed by alternative asset managers, a broad group including private equity and hedge funds (Creditflux (2018)). The incentive structure of the fund managers is such that compensation is sensitive to returns (Rajan (2005)). As noted by Gompers, Kaplan, and Mukharlyamov (2016), few private equity investors use the CAPM to determine their cost of capital, instead relying on sticky rate of return targets between 20% and 25%. In other words, return targets are independent of the interest rate environment, requiring low interest rates be compensated through other means.

To illustrate the appeal of LIBOR floors to CLO managers, we construct a simulation based on our sample of loans and data on CLO tranche structures and coupon rates from CLO-i. First, we compute the principal value-weighted loan spread, level of LIBOR floor, CLO leverage, and CLO tranche coupon rates in each year from 2003 to 2018, the period over which we have data on CLOs. Then we compute the initial equity yield, equal to the difference between the coupons on the loan pool and the coupons on the CLO tranches divided by the principal amount of the equity tranche, under three scenarios. The first uses the observed level of loan spreads and LIBOR floor terms (inclusion, floor). The second uses

[17]Banks provide a substantial share of the funding for the senior tranche securities issued by CLOs, but these securities have long maturities of 10 to 15 years, so fluctuations in bank health after the issuance of a CLO do not affect the CLO's ability to finance its loan portfolio.

the same loan spreads and assumes no loans have floors. The third also assumes no loans have floors, but adjusts the loan spread upwards by an amount that sets the market value of the loan without a floor equal to the market value of a loan with a floor. We compute the fair value of the floor using Black's (1976) model for pricing interest rate derivatives and data on the implied volatility of over-the-counter floor contracts from Bloomberg. The Internet Appendix provides additional detail on these calculations.

Figure 5 presents the results of this exercise. The pricing of loans and CLOs in our sample period is such that the equity investor in a typical CLO, usually the manager of the collateral pool, earns a current yield between 15% and 30%.[18] LIBOR floors serve to increase this equity yield because they increase the level of coupons received by the collateral pool relative to the coupons paid on purely floating-rate CLO tranche securities. The effect of LIBOR floors is to increase the CLO equity yield by between two and four percentage points from 2012 to 2015. The inclusion of LIBOR floors in the post-crisis period is central to the ability of CLO managers to offer similar equity payoffs to the pre-crisis period, allowing investors to meet their sticky rate-of-return targets. The direct impact of floor inclusion disappears in 2016, when the typical floor is set below the prevailing LIBOR rate, but the spread adjustment still has an effect due to the floor's option value.

4.4.3 Surplus Sharing and Market Clearing

The time-series and cross-sectional patterns discussed above suggest a tradeoff between cash flow and control rights in which lenders giving up some control in low-rate environments in exchange for an increase in cash flows from new loans. In this section, we provide further evidence consistent with that interpretation. However, it is important to recognize the limitations of this analysis. We do not have exogenous variation in contract terms, which are determined by a complex bargaining game involving material nonpublic information

[18] The high return to CLO equity is attributable to 10-to-1 leverage and the gap between the coupon rates of syndicated loans in the collateral pool and the tranche securities issued by the securitization vehicle. See Benmelech and Dlugosz (2009) for a primer on the economics of CLOs.

among participants. Thus, our results should be viewed as suggestive.

Table 5 reports estimates of conditional correlations between price and nonprice contract terms from regressions containing full interacted fixed effects for the type of loan, the month of origination, and the loan credit rating. In other words, we correlate terms only among loans of the same type that are originated in the same month and assigned the same credit rating. We perform this analysis on three separate subsamples of the data defined by the prevailing LIBOR rate.

Panel A of Table 5 shows that in the set of loans issued when LIBOR is below 1%, loans with LIBOR floors have longer maturities by six months, are 6% more likely to be covenant-lite, and have spreads that are 103 basis points higher than comparable loans without LIBOR floors. The first two effects are natural in light of the fact that the floor is valuable for lenders and costly for borrowers to provide, but the large positive relation with spread suggests that selection on unobservable risk plays a substantial role here. The relations between floor inclusion and other contract terms are qualitatively similar in the medium-rate environment. The relation between floors and covenant-lite status is significantly stronger in this subsample, due to the increased use of both contract features during the last few years of the sample period. Finally, when LIBOR is above 3% at issuance, the relations attenuate and even change sign, highlighting the importance of the interest rate environment for the nature of these tradeoffs.

The second row of each panel shows that loans with higher spreads have longer maturities, consistent with an upward-sloping term structure of credit spreads. This relation is similar in all rate environments. Covenant-lite status is insignificantly related to spread, again indicating that unobserved selection of borrowers into contract terms plays a role, because covenant-lite loans are riskier than loans with maintenance covenants, all else equal. Finally, covenant-lite loans are associated with maturities of about six months longer in all rate environments, which suggests that these control rights are complements rather than substitutes in the contract design.

Although the results in Table 5 must be interpreted cautiously, they shed some light on the tradeoffs between cash flow and control rights that are necessary for borrowers and lenders to agree on the terms of credit provision. Market clearing in credit markets is multidimensional, depending on more than just price and quantity.

5 Implications

5.1 The Cost of Borrowing

Conventional wisdom is that loans are floating-rate instruments and therefore any interest rate changes translate one-for-one into changes in loan coupon rates. Our results thus far suggest that the sensitivity of coupon rates to short-term interest rates is less than one-for one. We examine this issue in three ways. First, we compute the sensitivity of the cost of new loans to interest rates using the regression estimates presented earlier in this paper. Second, we compute the realized amount of incremental interest paid over our sample period attributable to interest rate floors. Third, we discuss the effect of interest rate floors on the sensitivity of existing loans to changes in short-term interest rates.

Consider a 1% reduction in the short-term nominal interest rate. How much of this reduction is reflected in the cost of borrowing? Table 2 shows that the spreads of new loans increase by 0.16% in response to a 1% reduction in LIBOR. Focusing solely on the spread component of the loan pricing mechanism implies that a 1% reduction in LIBOR is met with only a 0.84% reduction in the cost of borrowing.

However, this calculation ignores the other components of the pricing mechanism, specifically, fees and interest rate floors. To account for these other components, we characterize the effective annual cost of a new loan above the prevailing short-term interest rate, which we call the "loan spread equivalent," as:

$$LSE = Spread + \frac{Fee}{E\left(T\right)} + Pr\left(F\right) Pr\left(B|F\right) E\left(x|F,B\right), \tag{7}$$

where the first term is the loan spread, the second term is the up-front fee amortized over the loan's expected life, and the last term is the effect of an interest rate floor, with F referring to the presence of a floor, B referring to a binding floor (i.e., the floor exceeds the base rate), and x representing the extra interest arising from the floor.

We are interested in the sensitivity of the loan spread equivalent to changes in short-term interest rates. Because each of the terms in equation (7) is a function of the interest rate, the chain rule implies:

$$\begin{aligned}\frac{\partial LSE}{\partial r} &= \frac{\partial Spread}{\partial r} + \frac{1}{E\left(T\right)}\frac{\partial Fee}{\partial r} - \frac{Fee}{E\left(T\right)^2}\frac{\partial E\left(T\right)}{\partial r} \\ &\quad + \frac{\partial Pr\left(F\right)}{\partial r} Pr\left(B|F\right) E\left(x|F,B\right) \\ &\quad + Pr\left(F\right)\frac{\partial Pr\left(B|F\right)}{\partial r} E\left(x|F,B\right) \\ &\quad + Pr\left(F\right) P\left(B|F\right)\frac{\partial E\left(x|F,B\right)}{\partial r}.\end{aligned} \tag{8}$$

We estimate the partial derivatives from the regression coefficients in Table 2 and analogous regressions for the expected life of the loan, the probability of a binding floor and the amount by which the floor binds. To proxy for the expected maturity, we use data on loan outcomes to determine each loan's realized life, assuming the loan survives to maturity if it does not default and is not paid down early or refinanced.

Table 6 reports our estimates of the sensitivity of borrowing costs to changes in short-term interest rates. We consider both value-weighting and equal-weighting when forming the quarterly series for the regression estimates and estimating the conditional moments related to interest rate floors. We also report conditional elasticities based on the level of LIBOR, which allows for non-linearity in the effects of rate changes on borrowing costs. For these calculations, we use the regression coefficients from the full sample to estimate the partial derivatives because the subsample coefficients are imprecisely estimated. The Internet Appendix reports qualitatively similar elasticities based on subsample regression coefficients, as well as estimates based on panel regressions with firm and bank fixed effects, which demonstrate robustness to compositional shifts over the sample period.

The main finding in Table 6 is that the annual cost of a new loan issuance moves less than one-for-one with changes in short-term interest rates. We find that a 1% reduction in rates is associated with a decrease in borrowing costs of between 76 and 79 basis points. When the level of LIBOR is already below one percent, which is the case for about one third of the quarterly periods in our sample, the elasticity to a one percent rate change is between 69 and 77 basis points. These estimates show that the contractual response to interest rate variation, which involves lenders receiving stronger cash flow rights when rates decline, has important effects on the cost of capital for firms.

As an alternative lens on this issue, we consider the realized effect of interest rate floors. Figure 6 presents the realized effect of LIBOR floors on dollar corporate borrowing costs by computing the aggregate monthly interest arising from interest rate floors (blue line) and the fraction of total monthly interest expense attributable to interest rate floors (red line). These series are computed by first estimating two paths of interest expense for each loan: the actual interest payable according to the pricing terms of the contract, and the hypothetical interest in which we assume that there is no interest rate floor.

For each loan in the Markit sample, we calculate the coupon payments over the loan's realized life, as defined above. We assume that the entire amount is drawn over the realized life for term loans. For revolving credits, we assume a 57% draw rate as suggested by Mian and Santos (2018). Interest is computed as the product of the drawn funds and the start of quarter interest rate divided by four, which is determined by the prevailing LIBOR, loan spread, and interest rate floor. We then aggregate over loans in a quarter for each of the two series to obtain a measure of aggregate interest expense.

The blue line shows the aggregate amount of incremental interest attributable to interest rate floors. This number peaked at over $1.8 billion in the first quarter of 2015. Over the entire sample period, interest rate floors are responsible for an additional $35.8 billion of interest. In relative terms, this amounts to 7.3% of total interest from 2010 to 2015 and

2.6% of total interest over the full sample period.

The calculations above show that the coupon rates of new loans move less than one-for-one with changes in short-term interest rates, but the inclusion of interest rate floors also mutes the effect of rate changes on the coupon rates of outstanding loans. For instance, on December 16, 2015, the date of the first increase in the target Fed Funds rate since the financial crisis, there were \$1.29 trillion in loans outstanding in our sample. Of this amount, \$903 billion had a LIBOR floor and \$803 had a binding floor. Therefore, the Fed's rate hike affected the interest expense of less than 40% of the debt in a large segment of the corporate loan market. This could explain Ippolito, Ozdagli, and Perez-Olive's (2018) finding that the sensitivity of corporate interest expense to monetary policy shocks weakened after the Federal Reserve approached the zero lower bound. The introduction of LIBOR floors, which insure lenders against further reductions in rates, reduces the sensitivity of corporate interest costs to changes in short-term rates and thus weakens the balance sheet channel of monetary policy transmission.[19]

5.2 Commitment to the Contract

We use data on loan amendments from Markit to study the effects of rate changes and contract terms on the propensity to renegotiate. For each loan, Markit categorizes the eventual outcome into broad groups: maturity, prepayment, refinancing, amendment, restructuring, and other less common events. Amendments refer to material changes in the contract (spread, maturity, size) and do not include changes that do not directly affect cash flows (e.g., changes to covenants). Each loan has at most one event before it exits the sample or is rolled over into a new loan identifier in the data. We classify amendment, refinancing, restructuring, and prepayment as renegotiations and treat other events as adherence to the original contract.[20] Our analysis accounts for censored events in which loans that have

[19]We do not take a stand on the net effect of interest rate floors on monetary policy transmission because it is difficult to disentangle the offsetting effects on the cash flows of borrowers and lenders.

[20]There are 6,067 renegotiation events in our data, of which 50% are classified as refinancing, 46% prepayment, and 4% amendment or restructuring. These events are economically similar for our purposes,

yet to mature reach the end of our sample horizon. We are unable to distinguish among borrower- and lender-initiated renegotiations in the data, but we can draw inference about their relative importance using secondary market loan quotes included in the Markit data.

Figure 7 presents kernel-smoothed estimates of the renegotiation hazard function for the subsamples of loans with and without LIBOR floors. The curves provide the estimated probability of renegotiation at each point in time conditional on having not yet renegotiated. Both hazard functions are increasing, consistent with an increasing likelihood of renegotiation as time passes. However, loans with a LIBOR floor exhibit a dramatically higher likelihood of renegotiation up to 36 months after origination (or the preceding renegotiation). The probability of renegotiation in a given month is about twice as high when the loan includes a floor during this timeframe.

To analyze the factors driving loan renegotiation, we estimate a Cox regression model for the hazard function,

$$h_{it}\left(t|X_{it}\right) = h_0(t)\exp\left(X_{it}\beta\right). \tag{9}$$

We report hazard ratios, $\exp(\hat{\beta})$, that provide a multiplicative effect of each covariate X_{it} on the baseline hazard $h_0(t)$ to ease the interpretation of our results.

Table 7 reports estimates of the Cox regression model. Our analysis focuses on how renegotiation depends on changes in LIBOR and the interest rate environment at the time the loan was issued. We also consider the effect of specific contract terms on renegotiation. We include the loan's price at the time of renegotiation as a signal of the borrower's health, with loan prices above (below) par corresponding to better (worse) credit quality relative to the time of issuance. Finally, the unreported controls include the remaining time to maturity, log issue size, and indicators for the initial rating and loan type.

The first column shows that renegotiation is insignificantly related to changes in LIBOR when the initial contracting conditions are excluded from the regression, consistent with loans

consisting of changes to the payment terms of the loan, so we group them for this analysis. Our findings are unaffected by excluding prepayment as a renegotiation event.

being floating-rate instruments whose value is insensitive to short-term rates. However, the second column shows that after controlling for the level of LIBOR at issuance, reductions in LIBOR are associated with heightened renegotiation intensity. There is a strong negative relation between the level of LIBOR at issuance and the propensity to renegotiate, with loans originated in a low-rate environment significantly more likely to require ex post renegotiation. The effect is robust to controlling for price, which is positively associated with renegotiation, consistent with borrowers controlling the initiation of an amendment under normal circumstances (i.e., absent a covenant violation).

The rightmost columns show that loans with higher spreads and LIBOR floors are more likely to be amended, while covenant-lite loans are significantly less likely to be amended. These estimates suggest that the responses of cash flow and control rights have opposing effects on commitment. The evidence is consistent with borrowers demanding renegotiation to remove stronger cash flow rights but not being subject to lender-initiated renegotiation in response to covenant violations, which are less likely under covenant-lite contracts. Overall, the results in Table 7 highlight the importance of the contracting environment in driving ex post renegotiation and imply that low interest rates reduce the commitment of borrowers and lenders to initial contract terms.

To better understand the effects of initial contract terms on renegotiation outcomes, we examine the changes in loan terms occurring around each amendment. Table 8 reports regressions of changes in spread, floor inclusion, the level of the floor, maturity date, and issue size on the same covariates from the hazard regressions. In addition to affecting the likelihood of renegotiation, the initial contract terms also dictate the nature of renegotiation. For example, loans originated in a low-rate environment are more likely to see reductions in spread, the removal of LIBOR floors, and increases in loan capacity during a renegotiation. As discussed earlier, these patterns are consistent with borrowers requesting concessions ex post in response to the ex ante concessions they granted to lenders.

The results in Table 8 also offer a useful robustness check on the results described in earlier sections. The coefficients on the change in LIBOR are consistent with the aggregate patterns, with reductions in rate corresponding to higher spreads and the addition of floors. These within-loan estimates imply that our main results are not driven by changes in borrower composition over the sample period. Although not the focus of our analysis, the coefficients on the loan price at the time of renegotiation are intuitive, with firms that are healthier than they were at issuance (i.e., the secondary market loan price is above par) receiving more attractive loan terms after the amendment.

6 Conclusion

Interest rates play an important role in shaping financial contracts and commitment to those contracts. We argue that the contractual response to interest rate variation serves to share risk and align incentives for borrowers and lenders. The specific contract changes reflect tradeoffs between cash flow and control rights that are necessary to clear loan markets.

An important consequence of this endogenous relation between financial contracts and interest rates is a smoothing of the relation between interest rates and the cost of corporate borrowing. Though floating rate instruments, loan interest rates vary less than one-for-one with the benchmark interest rate due to the response of new contract terms and the inclusion of LIBOR floors when interest rates are low. Moreover, we find that renegotiation is significantly more likely for loans originated when interest rates are low, which implies a decline in commitment that feeds back into the initial contract design.

While we have made progress in understanding the relation between the macroeconomic environment and financial contract design, many questions remain. For example, does the endogenous response of contracts to interest rate variation help explain the lack of compelling evidence relating corporate investment to the cost of capital? How should one measure the cost of capital when its determination is state-contingent and a complex function of the pricing mechanism? In other words, are credit spreads really sufficient statistics for the cost of credit? What are the implications of monetary policy on credit provision and real outcomes when loan contracts endogenously respond to changes in interest rates? We look forward to future research that addresses these questions.

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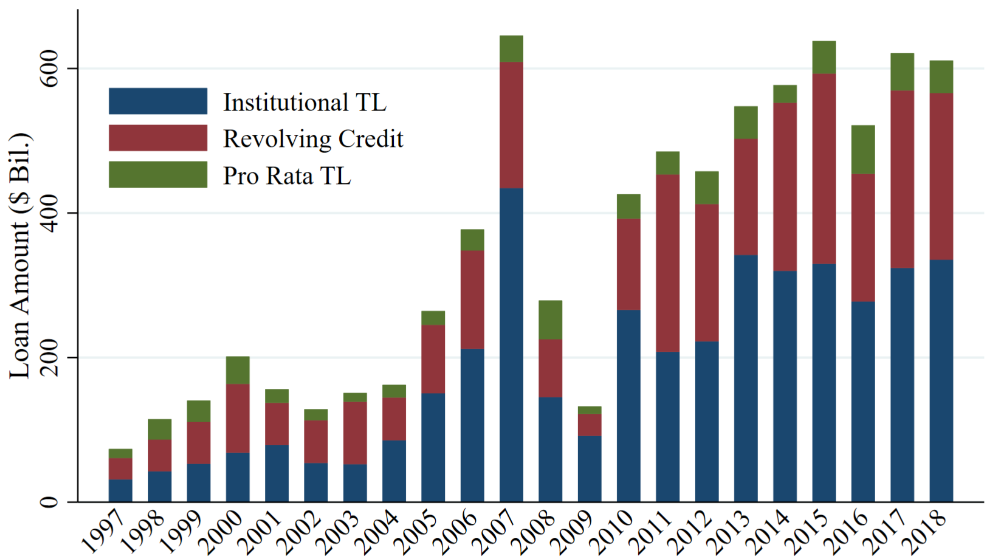
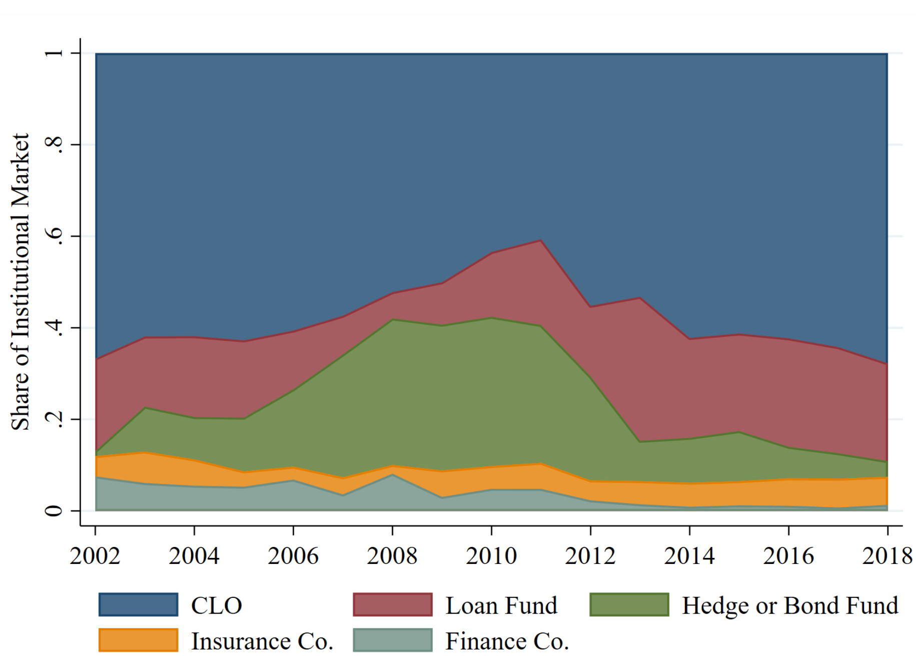
Figure 1: Syndicated Loan Market Originations

This figure reports aggregate volumes in the syndicated loan market by segment and the breakdown of investor types in the institutional segment. Panel A reports the total amount of U.S. dollar issuance for the main loan types in the Markit data. The sample is restricted to originations between 1997 and 2018, inclusive, with nonmissing data for the loan spread, maturity, and size of the loan. Panel B reports the market shares in the institutional segment of various types of nonbank investor. Data on investor shares are from S&P Leveraged Commentary & Data from 2002 to 2018. Panel C is based on the same sample as Panel A and reports annual issuance by loan-level rating category.

Panel A: Annual Amount of Loan Originations



Panel B: Annual Investor Shares in the Institutional Segment



Panel C: Annual Loan Issuance by Rating Category

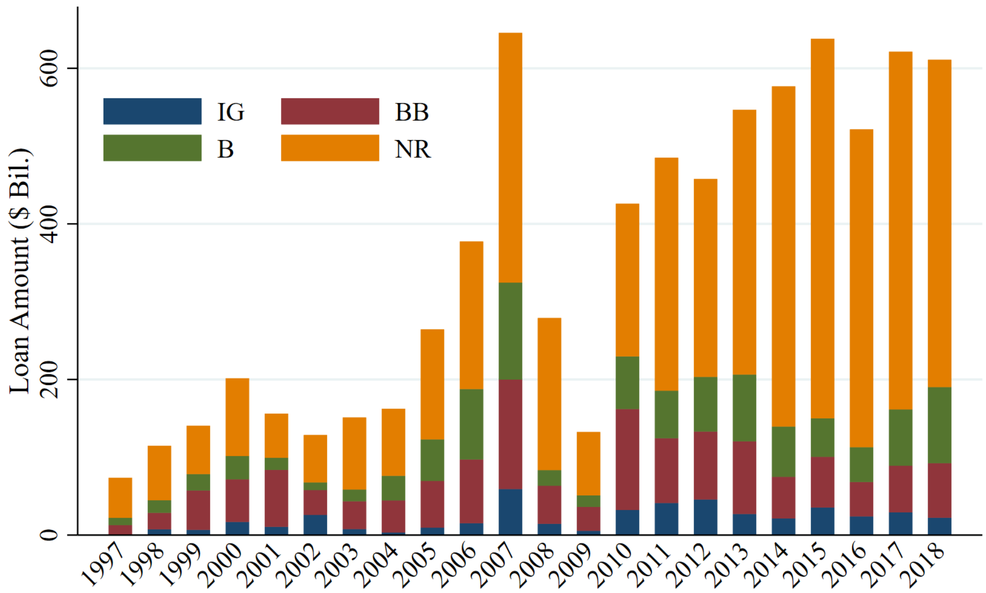
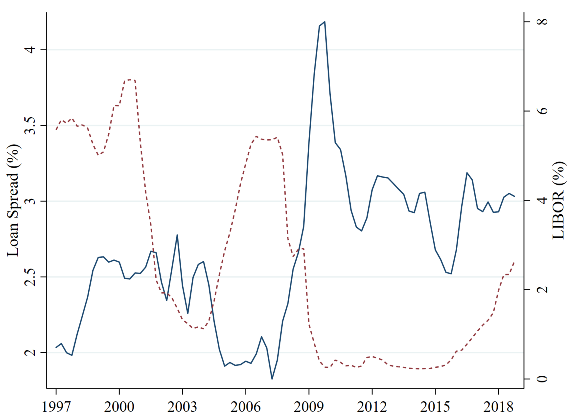


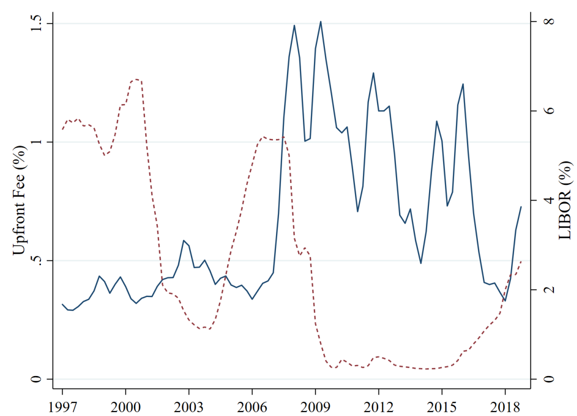
Figure 2: Interest Rates and Cash Flow Rights

This figure presents time-series plots of contract terms against short-term interest rates. Each panel presents two quarterly time series. The dashed red line presents the average three-month LIBOR rate for the quarter. The solid blue line corresponds to a component of the contract pricing mechanism, expressed as an average weighted by loan size. For ease of presentation, each quarterly series is presented as a moving average with one-half weight on the current quarter and one-quarter weight on each of the neighboring quarters. Spread and interest rate floor information is from Markit; fee information is from Dealscan.

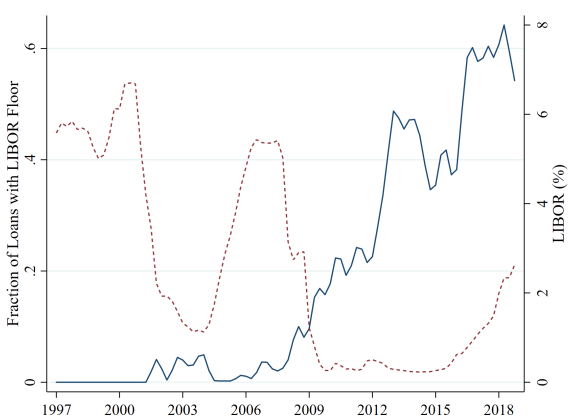
Panel A: Loan Spread



Panel B: Upfront Fee



Panel C: Inclusion of LIBOR Floor



Panel D: Level of LIBOR Floor

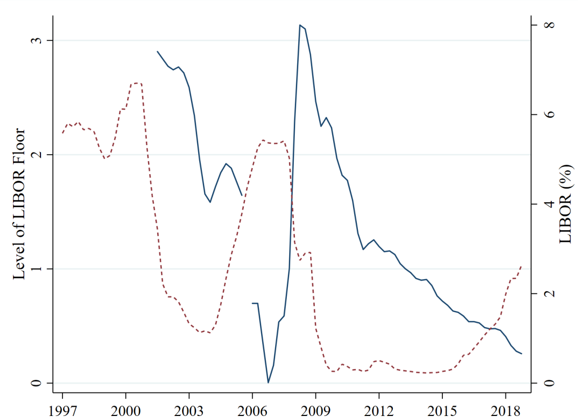
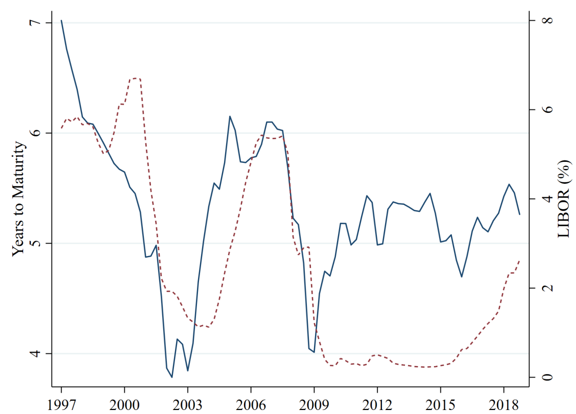


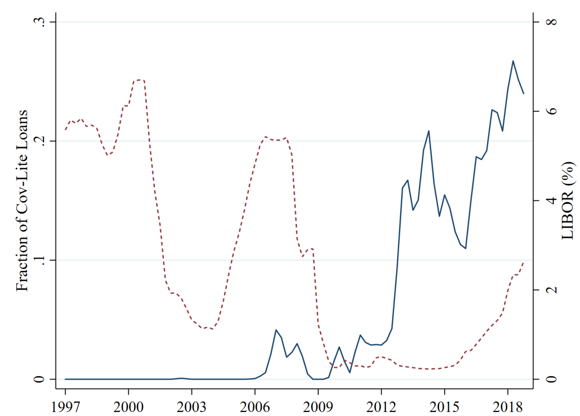
Figure 3: Interest Rates and Control Rights

This figure presents time-series plots of contract terms against short-term interest rates. Each panel presents two quarterly time series. The dashed red line presents the average three-month LIBOR rate for the quarter. The solid blue line corresponds to a component of the control rights assigned by the loan contract, expressed as an average weighted by loan size. For ease of presentation, each quarterly series is presented as a moving average with one-half weight on the current quarter and one-quarter weight on each of the neighboring quarters. Maturity and covenant-lite status are from Markit; covenant thresholds are from Dealscan.

Panel A: Maturity



Panel B: Covenant-Lite Status



Panel C: Debt-to-EBITDA Covenant

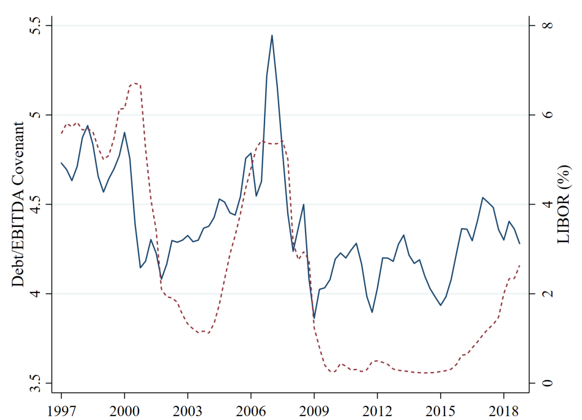
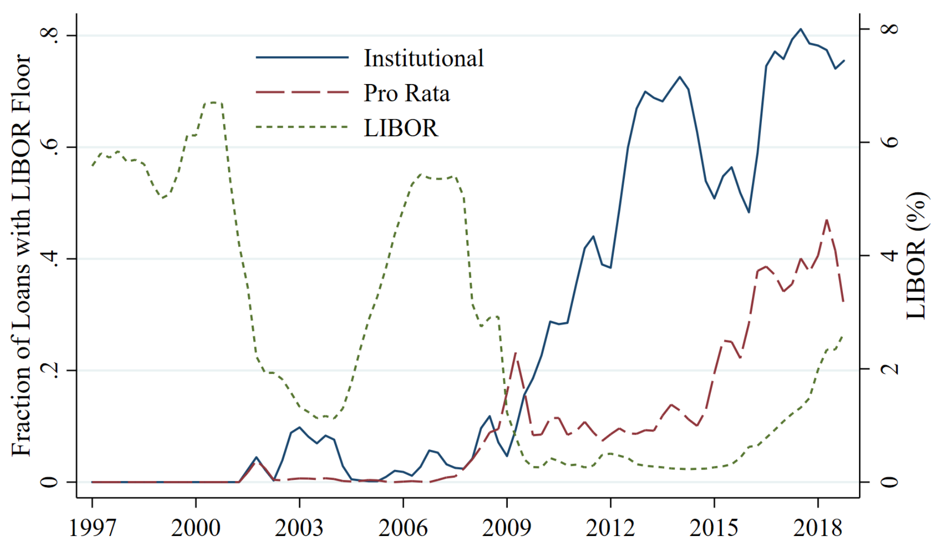


Figure 4: Distribution of LIBOR Floors and Floor Levels

Panel A presents the percentage of loan originations of each broad loan type that contain a floor. Panel B presents box and whisker plots of the cross-sectional distribution of LIBOR floor levels over time. The horizontal lines of the box denote the quartiles of the distribution. Boxes with fewer than three lines correspond to a concentration of observations. The whiskers extend 1.5 quartiles away from the median of the distribution. Observations beyond 1.5 quartiles from the median are displayed individually as diamonds.

Panel A: Inclusion of LIBOR Floors by Loan Type



Panel B: Distribution of LIBOR Floor Levels

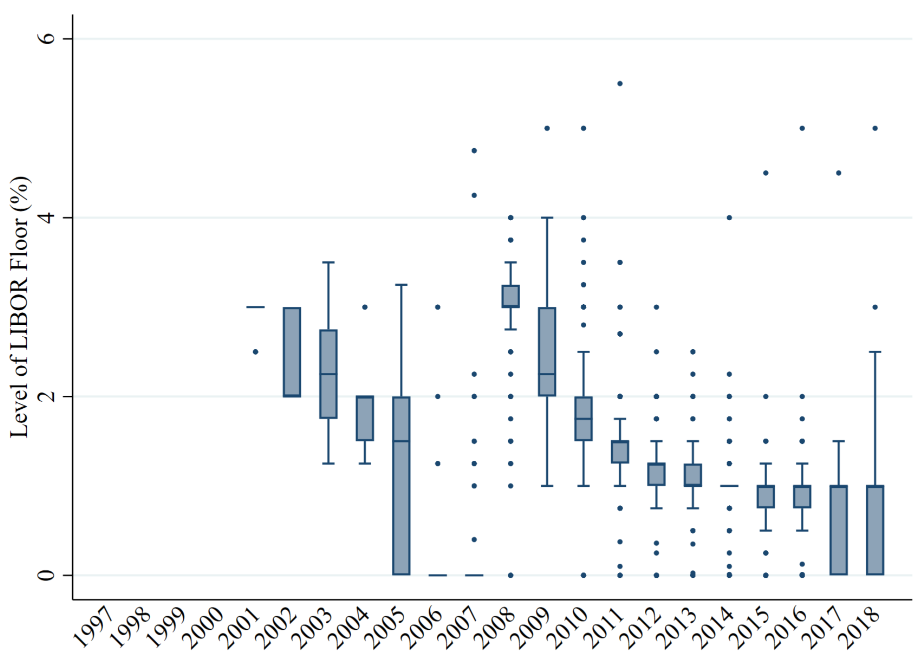


Figure 5: Effect of LIBOR Floors on CLO Equity Distributions

This figure illustrates the effect of LIBOR floors on the equity yields of collateralized loan obligations (CLOs). The calculation uses the principal value-weighted terms of loans and CLOs in each year from 2003 to 2018, including loan spreads, the inclusion of floors and their levels, the capital structure of CLOs, and the coupon rates paid on CLO tranche securities. The equity yield paid on the typical CLO in each year is calculated as the difference between coupons paid to the collateral pool and coupons paid on CLO tranche securities divided by the principal amount of the CLO equity tranche. The solid blue line reports the equity yield using the average loan spread, the fraction of loans with a LIBOR floor, and the average level of the LIBOR floor. The dashed red line is based on the alternative assumption that no loans have a floor. The dashed green line also assumes no loans have a floor but adjusts the loan spread upwards in an amount that offsets the theoretical value of the average LIBOR floor and fraction of loans with a floor each year. The period 2008 to 2011 is excluded due to a dearth of new CLO issuance during and after the financial crisis.

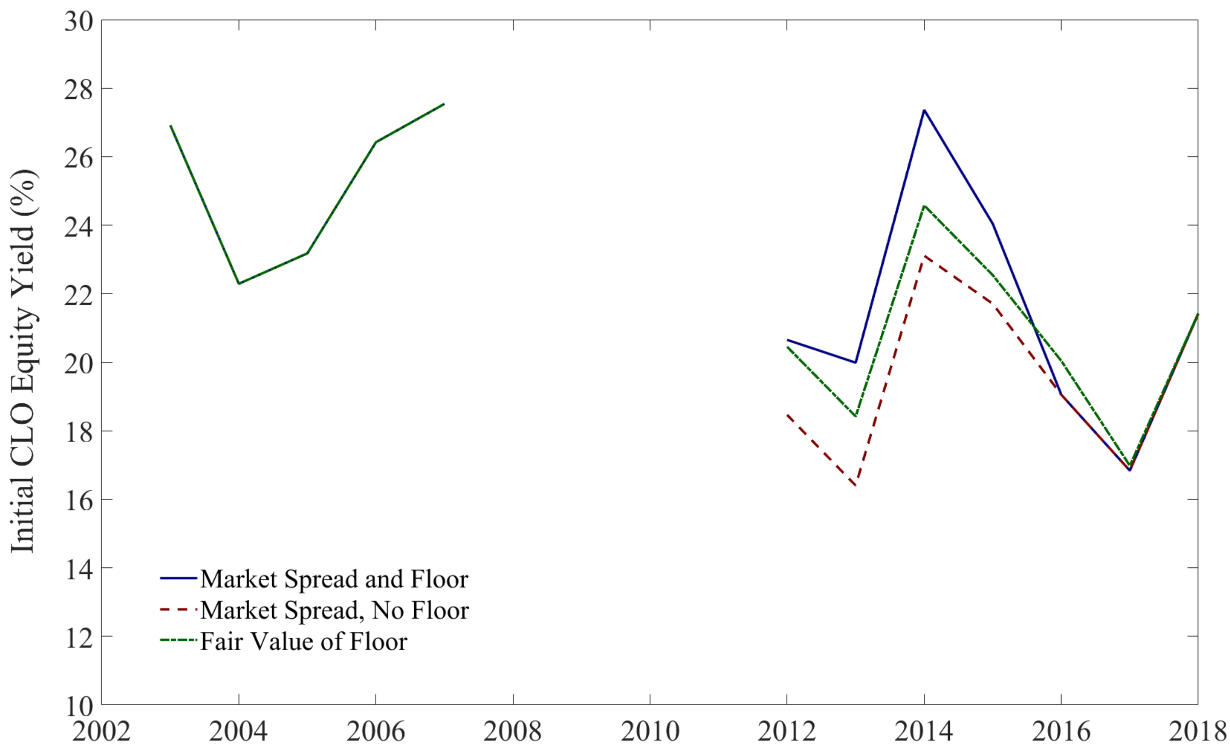


Figure 6: Extra Interest from LIBOR Floors

The figure presents quarterly time series of the extra interest paid by borrowers as a result of LIBOR floors. For each loan in the Markit sample, we compute two estimates of the quarterly interest expense. The first ignores the presence of a LIBOR floor, if any, and is equal to the sum of LIBOR and the loan spread at the start of the quarter times the loan principal. The second recognizes the presence of a LIBOR floor, if any, and is equal to the maximum of the floor rate and LIBOR plus the loan spread at the start of the quarter times the loan principal. For both estimates, the interest for revolving lines of credit is computed assuming that 57% of the loan commitment is drawn (Mian and Santos (2018)). We plot the dollar difference between the two estimates, which represents the additional realized interest expense attributable to LIBOR floors, as a solid blue line referencing the left axis. The percentage of total realized interest expense attributable to floors is plotted as a dash red line referencing the right axis.

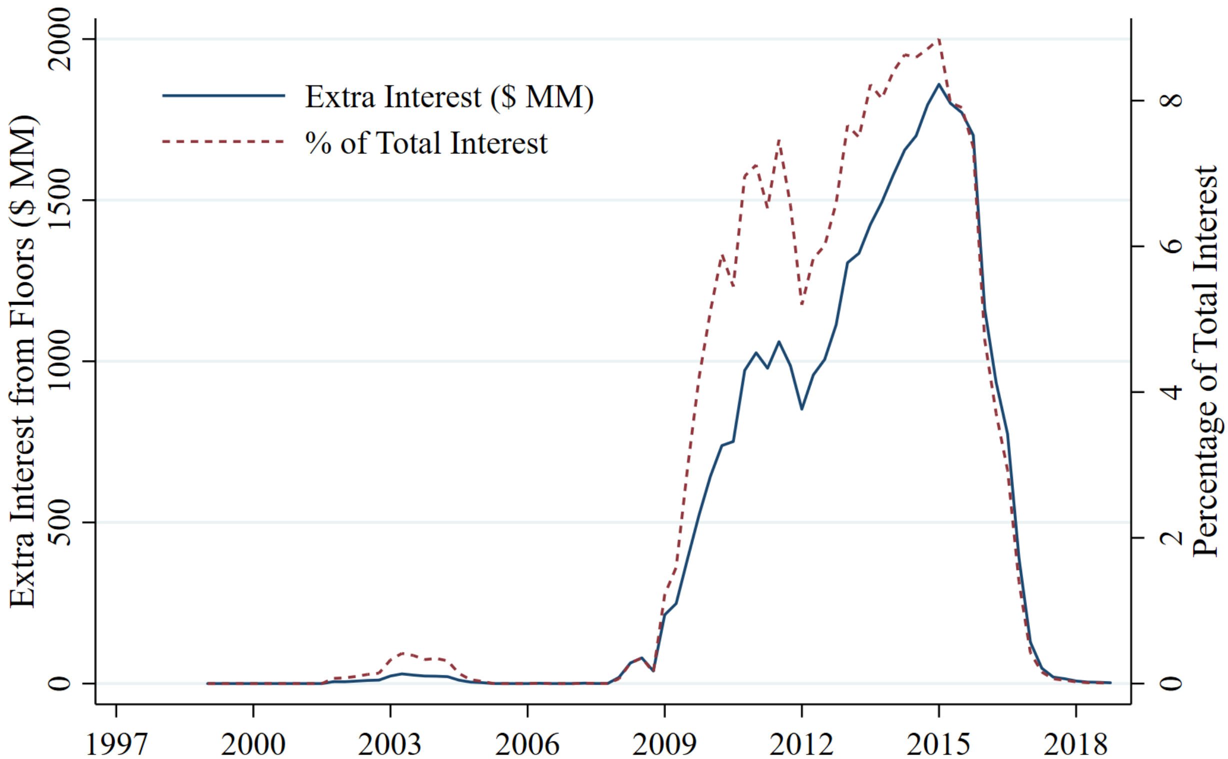


Figure 7: Renegotiation Hazard Functions

This figure reports kernel-smoothed hazard functions with 95% confidence bands. Observations are at the loan-month level. Failure events are defined as amendment, refinancing, or prepayment. The sample is split into loans with and without a LIBOR floor.

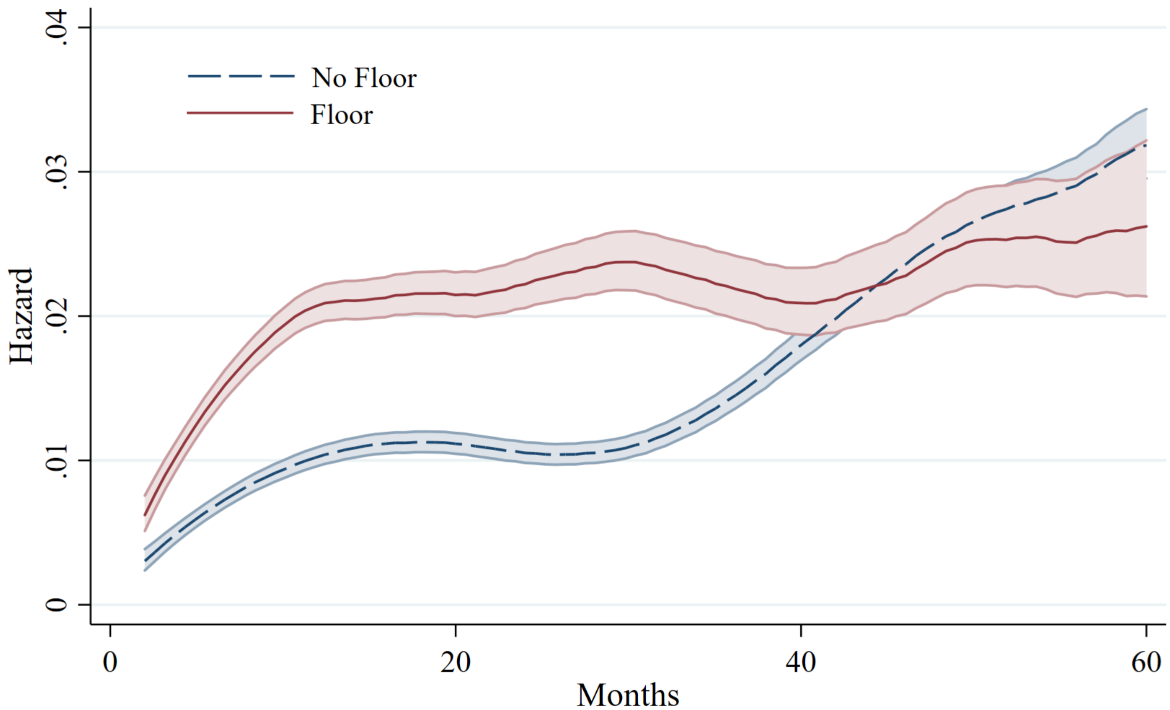


Table 1: Summary Statistics

This table presents loan counts and contract term summary statistics for the Markit sample of originations (Panel A) and amendments (Panel B), the Dealscan sample (Panel C), and the merged Markit-Dealscan sample (Panel D). Both samples are restricted to U.S. dollar-denominated loans with nonmissing information on loan spread, maturity, issue size, and loan type. Variables denoted 1(·) correspond to indicator variables. Maturity is measured in years.

Panel A: Markit – Originations

	Mean	Std.Dev.	Min.	p10	p50	p90	Max.	Obs.
Spread (%)	3.75	2.10	0.05	1.75	3.25	6.25	33.4	28,469
1(Floor)	0.30	0.46	0	0	0	1	1	28,469
LIBOR Floor (%)	0.93	0.62	0	0	1.00	1.50	5.00	8,488
Loan Amount ($MM)	270.9	645.7	0.10	15.0	100	630	35,520	28,469
Maturity	5.30	1.72	0.09	3.00	5.00	7.00	39.8	28,469
1(Cov-Lite)	0.06	0.23	0	0	0	0	1	28,469

Panel B: Markit – Amendments

	Mean	Std.Dev.	Min.	p10	p50	p90	Max.	Obs.
Spread (%)	3.39	1.60	0.13	1.75	3.00	5.25	20.0	12,876
1(Floor)	0.42	0.49	0	0	0	1	1	12,876
LIBOR Floor (%)	0.96	0.68	0	0	1.00	1.75	5.50	5,442
Loan Amount ($MM)	467.2	716.4	1.82	35.0	240	1,138	10,700	12,876
Maturity	5.55	1.35	0.08	4.00	5.33	7.00	12.6	12,876
1(Cov-Lite)	0.17	0.37	0	0	0	1	1	12,876

Panel C: Dealscan

	Mean	Std.Dev.	Min.	p10	p50	p90	Max.	Obs.
Spread (%)	2.60	1.70	-0.95	0.75	2.25	4.75	22.5	117,747
Commitment Fee (%)	0.33	0.26	0	0.10	0.25	0.50	7.50	42,601
Upfront Fee (%)	0.79	6.21	-2.50	0.10	0.50	1.50	10.0	26,494
Loan Amount ($ MM)	292.0	644.6	0	12.5	100	700	30,000	117,747
Maturity	4.30	2.18	0.01	1.00	5.00	7.00	36.0	117,747
1(LBO Deal)	0.09	0.29	0	0	0	0	1	105,204
1(Perf. Price)	0.20	0.40	0	0	0	1	1	117,747
Debt/EBITDA Cov.	4.41	8.27	0.15	2.50	4.00	6.25	800	20,000
Dist. to Cov.	1.54	1.12	0	0.35	1.35	2.85	9.68	9,429

Panel D: Markit-Dealscan Merge

	Mean	Std.Dev.	Min.	p10	p50	p90	Max.	Obs.
Spread (%)	3.10	1.51	0.09	1.50	2.75	5.00	22.0	10,525
1(Floor)	0.31	0.46	0	0	0	1	1	10,525
LIBOR Floor	0.97	0.66	0	0	1.00	1.75	3.50	3,261
Upfront Fee (%)	0.94	1.07	0	0.13	0.63	2.00	10.0	3,006
1(Perf. Price)	0.31	0.46	0	0	0	1	1	10,525
Loan Amount ($MM)	433	705	1.00	30.0	200	1,030	10,700	10,525
Maturity	5.29	1.29	0.09	3.80	5.00	7.00	19.9	10,525
1(Cov-Lite)	0.09	0.29	0	0	0	0	1	10,525
Debt/EBITDA Cov.	4.60	1.45	1.00	3.00	4.50	6.50	10.0	3,622
Dist. to Cov.	1.33	0.97	0	0.25	1.16	2.58	8.83	1,744
1(LBO Deal)	0.16	0.37	0	0	0	1	1	10,313
Number of Arrangers	2.61	2.28	1	1	2	5	30	10,525
Log(Bank Assets)	13.6	1.01	9.22	12.1	13.8	14.7	15.2	10,301
Bank Capital (%)	9.24	4.62	0.37	3.37	8.70	15.2	32.5	9,537
Bank Deposits/Liab.	0.60	0.15	0.17	0.39	0.61	0.79	0.97	6,954
Bank Income Gap	0.28	0.11	0	0.11	0.30	0.41	0.79	6,054
Bank Margin (%)	2.70	0.86	0.71	1.56	2.73	3.84	4.89	6,388
1(Rated Firm)	0.47	0.50	0	0	0	1	1	10,525
Log(Firm Assets)	7.70	1.61	-1.20	5.83	7.53	9.77	14.8	5,401
Firm Leverage	0.39	0.22	0	0.11	0.37	0.70	1.00	3,972
Firm Dist.-to-Def.	6.92	5.35	-3.21	1.45	6.10	12.8	94.9	3,957
Firm FCF/Assets	0.15	0.10	-0.07	0.06	0.13	0.25	0.59	5,744

Table 2: Aggregate Determinants of Cash Flow and Control Rights

This table reports regressions of loan contract terms on macroeconomic variables. The regression residual is specified to follow an AR(1) process as described in equation (2). Panels A and B examine cash flow and control rights, respectively. Each column has a different contract term as the dependent variable. Contract terms are aggregated by taking quarterly averages weighted by loan amount. S&P 500 Return is computed over the trailing 12 months. t-statistics are based on heteroskedasticity-autocorrelation-consistent standard errors. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.

Panel A: Cash Flow Rights

Dependent Variable	Spread	Upfront Fee	1(Floor)	Floor Level
LIBOR	-0.156***	-0.081***	-0.010	-0.223***
	(-3.87)	(-2.68)	(-0.81)	(-7.23)
1(Recession)	-0.082	0.108	0.018	0.889
	(-0.32)	(0.60)	(0.78)	(1.33)
GDP Growth	-2.019	-0.938	-0.020	0.545
	(-0.99)	(-0.72)	(-0.10)	(0.18)
S&P 500 Return	0.283	-0.320	0.031	-0.873
	(0.75)	(-1.64)	(0.59)	(-1.05)
Constant	3.136***	0.936***	0.237*	1.470***
	(15.35)	(6.68)	(1.91)	(6.72)
AR(1) Coefficient	0.629	0.662	0.954	0.273
R^2	0.636	0.627	0.899	0.564
Observations	88	88	88	88

Panel B: Control Rights

Dependent Variable	Maturity	1(Cov-Lite)	Debt/EBITDA Cov.
LIBOR	0.156***	-0.003	0.088***
	(4.82)	(-0.50)	(4.00)
1(Recession)	-0.021	0.003	-0.013
	(-0.09)	(0.34)	(-0.07)
GDP Growth	0.379	-0.087	2.125
	(0.19)	(-0.72)	(1.10)
S&P 500 Return	1.786**	0.017	0.321
	(2.21)	(0.77)	(1.59)
Constant	4.710***	0.080*	4.042***
	(34.26)	(1.84)	(52.42)
AR(1) Coefficient	0.205	0.891	0.161
R^2	0.614	0.819	0.446
Observations	88	88	88

Table 3: Sensitivity of Cash Flow and Control Rights to Interest Rates

This table reports regressions of loan contract terms on bank and borrower characteristics interacted with the level of interest rates. Panels A and B examine cash flow and control rights, respectively, using data from the Markit-Dealscan merged sample. Each column has a different contract term as the dependent variable. Observations are at the loan level, with bank characteristics equal-weighted across lead arrangers. Controls include an indicator for revolving credit facilities, indicators for deal purpose (general, working capital, capital expenditure, M&A and LBO, recapitalization, debt repayment, exit financing), log issue size, the number of co-lead arrangers, the number of participant lenders, a U.S. recession indicator, lagged GDP growth, and the trailing 12-month S&P 500 return. Covariates other than indicators are standardized for ease of interpretation. Bank fixed effects correspond to the lead arrangers credited in Dealscan. t-statistics are based on standard errors clustered by borrower and year-month. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.

Panel A: Cash Flow Rights

Dependent Variable	Spread	Upfront Fee	1(Floor)	Floor Level
LIBOR	-0.147***	-0.172***	-0.008	-0.171*
	(-5.23)	(-3.35)	(-1.24)	(-1.75)
Bank Income Gap	0.106***	-0.072*	0.108***	-0.149***
	(3.03)	(-1.85)	(8.83)	(-5.43)
Bank Income Gap X LIBOR	-0.025**	-0.054***	-0.012***	-0.062***
	(-2.38)	(-3.31)	(-3.78)	(-2.66)
1(BB-Rated)	0.734***	0.047	0.209***	0.382***
	(9.86)	(0.50)	(7.66)	(3.29)
1(BB-Rated) X LIBOR	-0.050*	0.088	-0.051***	-0.197**
	(-1.74)	(1.56)	(-7.49)	(-2.00)
1(B-Rated)	1.641***	0.408***	0.326***	0.440***
	(15.67)	(3.68)	(10.03)	(3.83)
1(B-Rated) X LIBOR	-0.183***	-0.014	-0.084***	-0.150
	(-6.16)	(-0.27)	(-11.44)	(-1.45)
1(Non-Rated)	0.724***	0.166	0.088***	0.140
	(8.64)	(1.61)	(3.00)	(1.14)
1(Non-Rated) X LIBOR	-0.050*	0.022	-0.031***	0.014
	(-1.86)	(0.43)	(-4.46)	(0.13)
Controls	X	X	X	X
Outcome Mean	2.832	0.857	0.266	0.897
Outcome SD	1.441	1.032	0.442	0.662
Adj. R^2	0.380	0.184	0.350	0.483
Observations	6,032	1,465	6,032	1,607
LIBOR Coefficient by Sub-Group				
High Income Gap Banks	-0.197	-0.280	-0.032	-0.295
Low Income Gap Banks	-0.097	-0.064	0.016	-0.047
BB-Rated Firms	-0.197	-0.084	-0.059	-0.368
B-Rated Firms	-0.330	-0.186	-0.092	-0.321
Non-Rated Firms	-0.197	-0.150	-0.039	-0.157

Panel B: Control Rights

Dependent Variable	Maturity	1(Cov-Lite)	Debt/EBITDA Cov.
LIBOR	0.083***	0.004	0.043
	(2.63)	(1.03)	(0.99)
Bank Income Gap	0.125***	0.073***	-0.100
	(4.19)	(8.42)	(-1.34)
Bank Income Gap X LIBOR	-0.030***	-0.009***	0.013
	(-2.75)	(-3.74)	(0.58)
1(BB-Rated)	0.567***	0.080***	0.743***
	(6.55)	(4.45)	(5.55)
1(BB-Rated) X LIBOR	-0.016	-0.015***	0.049
	(-0.47)	(-3.33)	(1.01)
1(B-Rated)	0.631***	0.188***	1.469***
	(7.03)	(7.31)	(6.72)
1(B-Rated) X LIBOR	0.022	-0.028***	0.078
	(0.69)	(-4.13)	(1.30)
1(Non-Rated)	0.228***	0.029**	-0.058
	(2.83)	(2.24)	(-0.47)
1(Non-Rated) X LIBOR	-0.010	-0.003	0.107**
	(-0.34)	(-0.82)	(2.13)
Controls	X	X	X
Outcome Mean	5.163	0.075	4.493
Outcome SD	1.294	0.264	1.459
Adj. R^2	0.245	0.127	0.280
Observations	6,032	6,032	2,406
LIBOR Coefficient by Sub-Group			
High Income Gap Banks	0.023	-0.014	0.069
Low Income Gap Banks	0.143	0.022	0.017
BB-Rated Firms	0.067	-0.011	0.092
B-Rated Firms	0.105	-0.024	0.121
Non-Rated Firms	0.073	0.001	0.150

Table 4: Covenant-Lite Status and the Details of Contractual Protections for Lenders

This table reports regressions of Moody's loan covenant quality (LCQ) scores on the cov-lite indicator from the Markit loan-level data. LCQ scores range from one to five, with lower scores corresponding to stronger protections for lenders, and are split out into seven categories along with an overall score. These scores are constructed by Moody's analysts for a nonrandom sample of institutional term loans of $500 million or more from 2007 to 2018. Moody's (2014) provides a detailed overview of the covenant quality scoring criteria. Panel A contains estimates of a simple regression of the LCQ category scores on the cov-lite indicator. Panel B adds calendar quarter and broad rating category (BBB, BB, B, CCC, or NR) fixed effects to the regression. t-statistics are clustered by issuer and quarter of issuance. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.

Panel A: Pooled Regression without Fixed Effects

LCQ Score Component	Overall	Fin. Cov.	Security	Leveraging	Payouts	Investments	Asset Sales	Voting
1(Cov-Lite)	0.561***	0.921***	0.618***	0.468***	0.556***	0.451***	0.250**	0.359**
	(5.58)	(6.29)	(3.64)	(3.91)	(4.41)	(4.32)	(2.45)	(2.44)
Constant	3.380***	3.892***	2.873***	3.677***	3.640***	3.566***	2.829***	3.148***
	(39.68)	(28.93)	(22.20)	(36.10)	(33.93)	(34.54)	(37.90)	(22.69)
Adj. R^2	0.155	0.239	0.072	0.062	0.069	0.057	0.026	0.025
Observations	329	329	329	329	329	329	329	329

Panel B: Panel Regression with Fixed Effects

LCQ Score Component	Overall	Fin. Cov.	Security	Leveraging	Payouts	Investments	Asset Sales	Voting
1(Cov-Lite)	0.347***	0.745***	0.494**	0.204*	0.238*	0.231**	0.000	0.209
	(3.66)	(5.49)	(2.54)	(1.78)	(1.98)	(2.11)	(0.00)	(1.19)
Constant	3.513***	4.010***	2.956***	3.833***	3.831***	3.701***	2.975***	3.251***
	(66.26)	(50.28)	(28.24)	(58.37)	(52.90)	(53.36)	(46.60)	(31.81)
Year-Quarter FE	X	X	X	X	X	X	X	X
Rating Category FE	X	X	X	X	X	X	X	X
Adj. R^2	0.300	0.311	0.194	0.216	0.175	0.138	0.066	0.098
Observations	323	323	323	323	323	323	323	323

Table 5: Tradeoffs among Contract Terms

This table reports estimates from pairwise regressions of contract terms. Each cell reports the coefficient from a regression of the contract term in the column on the contract term in the row, controlling for year-month by initial rating by loan type fixed effects. Observations are at the loan level using data from the Markit-Dealscan merged sample. The sample is split into low (LIBOR $<$ 1%), medium (LIBOR between 1% and 3%), and high (LIBOR $>$ 3%) interest rate environments. t-statistics are based on standard errors clustered by borrower and year-month. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.

Panel A: Low-Rate Environment (LIBOR $<$ 1%)

Contract Term:	Maturity	1(Cov-Lite)	Spread
1(Floor)	0.47***	0.06***	1.03***
	(8.97)	(5.35)	(13.6)
Spread	0.08***	-0.004*	
	(4.88)	(-1.71)	
1(Cov-Lite)	0.42***		
	(5.42)		
Observations	5,021		

Panel B: Medium-Rate Environment (LIBOR $\in$ [1%, 3%])

Contract Term:	Maturity	1(Cov-Lite)	Spread
1(Floor)	0.33**	0.23***	1.18***
	(2.44)	(5.76)	(9.36)
Spread	0.05	-0.002	
	(1.27)	(-0.26)	
1(Cov-Lite)	0.51***		
	(4.66)		
Observations	2,472		

Panel C: High-Rate Environment (LIBOR $>$ 3%)

Contract Term:	Maturity	1(Cov-Lite)	Spread
1(Floor)	0.18	-0.08**	-0.13
	(1.36)	(-2.45)	(-0.83)
Spread	0.03	-0.007*	
	(0.91)	(-1.79)	
1(Cov-Lite)	0.54***		
	(3.99)		
Observations	3,033		

Table 6: Elasticity of Borrowing Costs to Changes in Short-Term Interest Rates

This table reports back-of-the-envelope calculations of the elasticity of the annual cost of new loans to changes in short-term interest rates. The calculation is based on the decomposition in equation (8). The table reports estimates of each component as well as the estimated elasticity in the rightmost column. We compute the inputs using both principal value-weighted and equal-weighted averages of contract terms in our sample. We also estimate the elasticities separately for low (LIBOR < 1%), medium (LIBOR ∈ [1%, 3%]), and high (LIBOR > 3%) rate environments.

	$\frac{\partial Spread}{\partial r}$	$\frac{\partial Fee}{\partial r}$	$\frac{\partial E(T)}{\partial r}$	$\frac{\partial Pr(F)}{\partial r}$	$\frac{\partial Pr(B\|F)}{\partial r}$	$\frac{\partial E(x\|F,B)}{\partial r}$	Fee	$E(T)$	$Pr(F)$	$P(B\|F)$	$E(x\|F,B)$	$\frac{\partial LSE}{\partial r}$
Value-Weighted Estimates												
Full Sample	-0.16	-0.081	0.26	-0.010	-0.15	-0.15	0.62	3.56	0.28	0.15	0.11	-0.21
LIBOR < 1%							0.83	3.24	0.36	0.29	0.22	-0.23
LIBOR ∈ [1%, 3%]							0.49	3.82	0.38	0.014	0.01	-0.19
LIBOR > 3%							0.48	3.90	0.015	0.001	0.001	-0.19
Equal-Weighted Estimates												
Full Sample	-0.13	-0.083	0.14	-0.015	-0.20	-0.18	0.74	3.75	0.30	0.53	0.77	-0.24
LIBOR < 1%							1.05	3.55	0.43	0.88	0.77	-0.31
LIBOR ∈ [1%, 3%]							0.67	3.99	0.46	0.04	0.68	-0.22
LIBOR > 3%							0.53	4.44	0.007	0.13	0.33	-0.15

Table 7: Determinants of Loan Renegotiation

This table reports hazard ratios from a Cox proportional hazard model. Observations are at the loan-month level from 2002 to 2018 in the Markit sample. Failure events are defined as amendment, refinancing, restructuring, or prepayment. Δ LIBOR is the change in three-month LIBOR since the loan's start month. LIBOR at Issuance is the three-month LIBOR rate on the loan's start date. Price (minus 100) is the difference between the secondary market loan price and par at the time of each observation. Controls include the remaining time to maturity, log issue size, initial rating dummies, and indicators for loan type. z-statistics based on standard errors clustered by year-month are reported in parentheses. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.

	(1)	(2)	(3)	(4)	(5)
Δ LIBOR	0.978	0.769***	0.743***	0.937***	0.891***
	(-0.86)	(-5.24)	(-6.31)	(-2.61)	(-4.79)
LIBOR at Issuance		0.737***	0.753***		
		(-6.33)	(-6.11)		
Spread				1.056***	1.077***
				(4.42)	(6.10)
1(Floor)				1.668***	1.561***
				(6.46)	(5.71)
1(Cov-Lite)				0.750***	0.784***
				(-3.81)	(-3.24)
Price (minus 100)			1.042***		1.042***
			(9.96)		(11.08)
Number of Loans	11,370	11,370	11,370	11,370	11,370
Number of Renegotiations	6,056	6,056	6,056	6,056	6,056
Loan-Month Observations	332,902	332,902	332,902	332,902	332,902

Table 8: Changes in Loan Terms around Renegotiation

This table reports regressions of changes in loan contract terms around renegotiation events on changes in interest rates since issuance and initial contract terms. Observations are at the loan level using data from the Markit sample, with the sample restricted to loans that are eventually renegotiated. Each column contains the change in a different contract term as the dependent variable. Panel A uses the level of interest rates at issuance as a proxy for the initial contracting environment and Panel B examines the effect of the initial contract terms directly. Controls include the remaining time to maturity, log issue size, initial rating dummies, and indicators for loan type. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.

Panel A: LIBOR at Issuance

Change in	Spread	1(Floor)	Floor Level	Maturity	Log(Size)
Δ LIBOR	-0.167***	-0.057***	-0.008	0.011	-0.006
	(-7.15)	(-6.87)	(-0.20)	(0.57)	(-0.53)
LIBOR at Issuance	0.145***	0.030***	0.072	0.038*	-0.056***
	(5.72)	(3.85)	(1.50)	(1.73)	(-4.99)
Price (minus 100)	-0.044***	0.004*	-0.017***	0.017***	0.021***
	(-3.04)	(1.84)	(-2.79)	(2.69)	(7.77)
Controls	X	X	X	X	X
Outcome Mean	-0.078	0.120	-0.331	2.138	0.282
Outcome SD	1.458	0.463	0.521	1.798	0.741
Adj. R^2	0.317	0.205	0.087	0.612	0.236
Observations	2,776	2,913	1,110	2,853	2,901

Panel B: Initial Loan Terms

Change in	Spread	1(Floor)	Floor Level	Maturity	Log(Size)
Δ LIBOR	-0.191***	-0.058***	-0.048	-0.002	0.029***
	(-12.40)	(-7.39)	(-0.97)	(-0.17)	(3.29)
Spread	-0.522***	0.026***	-0.091***	-0.108***	-0.033***
	(-18.09)	(3.50)	(-5.64)	(-3.96)	(-2.64)
1(Floor)	0.298***	-0.478***	0.000	0.110	0.127***
	(3.99)	(-15.75)	(0.00)	(1.40)	(2.91)
1(Cov-Lite)	-0.040	0.155***	0.040	0.018	0.146***
	(-0.70)	(6.59)	(0.93)	(0.23)	(3.39)
Price (minus 100)	-0.047***	0.005**	-0.018***	0.017**	0.021***
	(-3.35)	(2.41)	(-3.06)	(2.51)	(7.63)
Controls	X	X	X	X	X
Outcome Mean	-0.078	0.120	-0.331	2.138	0.282
Outcome SD	1.458	0.463	0.521	1.798	0.741
Adj. R^2	0.474	0.367	0.125	0.616	0.237
Observations	2,776	2,913	1,110	2,853	2,901