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Covenant Prices of U.S. Corporate Bonds

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In this paper, we analyze the key drivers of bond covenant prices by employing a novel measurement approach based on secondary market data. We find that covenant prices vary significantly over time and are associated with market-wide credit risk, volatility, and macroeconomic variables. Apart from the time-series dynamics, there is also significant variation across bond and firm characteristics. In particular, covenant prices increase with the riskiness of bonds and are higher for firms that have more growth options, more tangible assets, and are smaller. Furthermore, we document a positive correlation between the prices of covenants and their subsequent inclusion rates. (*JEL* G32, G34)

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Debt covenants primarily serve as a mechanism to mitigate agency conflicts between stockholders and bondholders. Different covenant types either restrict predefined corporate actions or grant state-dependent rights to bond investors. Their importance is highlighted not only by a rich theoretical literature but also by the stylized fact that basically all debt instruments include multiple covenants. Overall, covenants are an essential part of a firm's capital structure and significantly affect market prices. A crucial part of understanding the economic impact of covenants is quantifying and analyzing their price

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effects. However, despite their relevance, the question of which variables drive the impact of covenants on debt prices remains open.

In this paper, we provide new economic insights into the determinants of covenant prices. Specifically, we analyze the effects of bond-, market-, and firm-specific variables that are suggested to affect the severity of agency conflicts. Our contribution is based on a novel approach that provides a time series of price effects based on secondary market data of the U.S. corporate bond market. Thereby, we drastically increase the number, frequency, and quality of observations compared to existing evidence from issuance yields. This allows us to precisely quantify the dynamic relation between covenants' price impact and the riskiness of the bonds. In our regression analysis, we indeed show that covenant prices increase with bond-specific and market-wide risk. In addition, we find an increase in covenant prices associated with the severity of agency conflicts measured by firm characteristics. Furthermore, we document a positive relation between covenant prices and subsequent covenant inclusion decisions.

In general, covenant prices are measured as yield differentials between bonds with differing covenant structures but otherwise identical exposures to risk factors. So far, the literature has not identified an approach that overcomes all the challenges associated with the estimation of covenant prices. In particular, the existing approaches exclusively rely on issuance yields and, thereby, mask the underlying dynamics by reporting static averages (see, e.g., Reisel, 2014; Simpson and Grossmann, 2017). Moreover, severe endogeneity issues arise, as firms choosing different covenants at issuance most likely do not share the same exposure to risk factors, which might additionally vary over the business cycle, making bond issuances across different environments less comparable. In fact, a dynamic relation between yields and risk factors is not accounted for in prior empirical research. Due to these concerns, we move away from issuance information as changing firm fundamentals and financial market frictions allow for situations where bonds with different covenant structures but the same underlying characteristics exist simultaneously.[1]

We develop a new empirical approach to estimate covenant prices based on secondary market prices of individual bonds. We group the different covenants into four covenant types—that is, financial, investment, event, and dividend covenants—as is standard in the literature (see Chava, Kumar, and Warga, 2010).[2] Each covenant type of a bond is priced by employing a replication with a portfolio of simultaneously traded bonds that feature the same covenant structure, except for the particular covenant type being priced. We use a novel methodology for this replication, starting with a standard

1 Applying our methodology to issuance yields would only allow us to derive a covenant price for around 7% of our bonds. Furthermore, we would only obtain one observation per bond. In contrast, our approach based on secondary market data provides a time series of covenant prices for each bond.

2 While we follow the literature in defining covenant types, changing these definitions does not affect our main conclusions as shown in Internet Appendix X.

matching of interest, credit, and liquidity risk and combining it with the derivation of optimal weights within the matched sample. This approach leads to a precise, investable replication of the underlying risk factors alongside the covenant structure. Moreover, this procedure acknowledges the time variation of covenant prices, which is not accounted for when pooling issuance information over economic regimes. Thereby, we obtain more reliable results, which would not be attainable with simpler benchmarks commonly used in the literature.

Empirically, we analyze the U.S. corporate bond market from 2004 to 2018. The U.S. corporate bond market is an ideal laboratory, as all secondary bond market transactions are available in the Trade Reporting and Compliance Engine (TRACE) database. These detailed transaction data are necessary to implement our methodology. Furthermore, the considered period covers the years before the financial crisis, the crisis itself, and a longer postcrisis period, providing us with the opportunity to observe covenant prices across the business cycle. We consider 12,904 bonds and over one million covenant prices.

We make a first contribution by examining covenants' general effects on bond yields with our dynamic price data. Indeed, we confirm the literature's findings that covenants are an important feature of corporate bonds (see Reisel, 2014; Bradley and Roberts, 2015). We document that prior issuance-based findings hold over the bonds' whole lifetime; that is, we find that covenants significantly decrease the yields of corporate bonds in general. The average effect over our time series is between 13 and 20 basis points (bps), depending on the covenant type. As our main contribution and in line with theoretical predictions, we additionally show that covenant prices are dynamically driven by risk factors, with the yield reductions varying over the business cycle. In particular, covenant prices peaked during the financial crisis, when, for example, financial covenants led to yield reductions of around 80 bps. During this period, the magnitude of covenant prices amounts to roughly 5% relative to overall bond yields. These results indicate a strong dependence on the economic environment.

Our main focus is the identification of covenant price dynamics and the variables that determine covenants' price effects. To empirically determine the drivers of covenant prices, we set up panel regressions based on first differences of individual bonds' covenant prices. This setup has the additional advantage that the matched sample's potential static imperfections due to unobservable factors are filtered out. Starting with bond-specific risk variables, we find that an increase in interest rate, credit, or liquidity risk leads to higher covenant prices. Specifically, a lengthening of bond duration by 1 year increases the covenant price by 7 bps, a weaker credit rating by 1 notch increases the covenant price by 12.8 bps, and a one-standard-deviation higher illiquidity is associated with an increase in the covenant price of 3.3 bps. Overall, these results suggest that covenant prices increase with all three risk dimensions.

Focusing on the economic environment, we explore the impact of market-wide credit risk, volatility, and macroeconomic variables on covenant prices, addressing the hypothesis that covenants are more impactful during macroeconomic downturns. We find that aggregate credit risk and volatility have highly significant effects on determining the impact of covenants. A positive one-standard-deviation change in default spreads increases covenant prices by 1.9 bps, the VIX has an effect of 2.5 bps, and CDS spreads show the most substantial impact with 3.3 bps. Additionally, we find that all measures triple in the financial crisis preceding a similar spike in covenant prices. The macroeconomic variables show similar significant effects as well. To this end, we provide novel insights on market-wide measures as well as macroeconomic variables, indicating that economic downturns are linked to elevated covenant prices. Thus, covenants lead to higher yield reductions when the risk of capital outflow, risk-shifting, and claim dilution is exceptionally high.

In addition, we consider firm-specific variables that might reflect the severity of agency conflicts. The existing literature (see, e.g., Malitz, 1986; Nash, Netter, and Poulsen, 2003; Billet, King, and Mauer, 2007; Simpson and Grossmann, 2017) documents significant relations between covenant inclusion frequencies and growth options, leverage, firm size, and tangibility. This suggests that there might be effects on prices as well. Given our rich data, we can analyze these conjectures and find that investors pay higher prices for covenants included in bonds issued by growth firms. Similarly, smaller firms and firms with more tangible assets have higher covenant prices on average.

In the last part, we explore whether the level of covenant prices can be related to the inclusion of covenants in newly issued bonds. In general, our results indicate that the usage of certain covenant types shows cyclical behaviors and trends. In particular, all inclusion rates experience a pronounced drop before the crisis, which shows similarities to the developments of their respective prices. For example, the frequency of investment covenants decreases from 90% to around 60%. This drop is followed by a large spike in covenant prices preceding a subsequent increase in covenant inclusion rates. Similarly, at the end of our observation window, when covenant prices go down again, we also observe a downward trend in the usage of covenants. In our analysis, we find supportive evidence for an effect on inclusions for large, long-term changes in covenant prices.

To summarize, the contribution of this paper is to provide new economic insights into the determinants of covenant price dynamics by developing and employing a new methodology. This new approach allows us to observe a time series of covenant prices for each bond based on secondary market data. With this setup, we can identify the effects of the economic environment as well as bond- and firm-specific variables on covenant prices. In line with theoretical predictions, we find that market-wide variables measuring general default risk and volatility as well as macroeconomic variables affect covenant prices. In general, these results indicate that covenant prices show a strong, dynamic relation to the business cycle, with higher covenant prices in economic downturns. Moreover, the bond-specific measures for interest rate, credit, and liquidity risk have a significant, positive effect on covenant prices. In addition, prices are higher for growth firms, smaller firms, and firms with more tangible assets. Finally, we show that the covenant price is linked to the choice of covenants in subsequently issued bonds.

1. Literature

Jensen and Meckling (1976) and Smith and Warner (1979) are among the first to discuss covenants and their role in mitigating agency conflicts that arise from misaligned incentives of shareholders and bondholders. Covenants balance both parties' interests by restricting managerial actions or shifting control rights in poor economic situations. In both cases, covenants allow lenders to enforce their claims outside of bankruptcy (see, e.g., Gilson, 1990; Ayotte and Morrison, 2009) and thereby avoid the associated costs.

Restrictions on managerial actions aim to avoid financial distress and ensure that the firm retains a sufficient amount of equity (Christensen and Nikolaev, 2012). This is achieved by limiting payouts to equity holders, ruling out the issuance of additional (senior) debt claims, and limiting certain type of projects.[3] On the other hand, ex post shifts in control rights can be triggered either by a signal about firm fundamentals (see, e.g., Aghion and Bolton, 1992) or by missed payments (see, e.g., Hart and Moore, 1998). In effect, these covenants act as an early signal for bondholders that allows them to shorten their maturity, see Dichev and Skinner (2002). The academic literature has further divided these two general groups by focusing on the type of firm decision affected. Specifically, we consider the grouping used by Chava, Kumar, and Warga (2010)—that is, dividend, event, financial, and investment covenants—and discuss these covenant types in more detail in Section 2.

Among the first ideas on the pricing of covenants, Black and Cox (1976) apply an option pricing framework to derive the price of covenants. Thereafter, subsequent studies extend their approach using similar models (see, e.g., Stulz and Johnson, 1985; Titman and Torous, 1989; Childs, Ott, and Riddiough, 1996, among others), while other authors incorporate the effects of covenants on leverage decisions (see, e.g., Leland, 1994, 1998; Mauer and Triantis, 1994). All these models guide our empirical analysis. In particular, Black and Cox (1976) model covenants that allow bondholders to force the firm into bankruptcy or reorganization if the firm value falls below a specified threshold. When a standard two-factor model is considered for this asset

[3] There is an extensive literature that studies the effects that covenants have on various firm decisions (see, e.g., Baird and Rasmussen, 2006; Chava and Roberts, 2008; Nini, Smith, and Sufi, 2009, 2012; Roberts and Sufi, 2009; Sufi, 2009; Bradley and Roberts, 2015, among others).

value, covenant prices are dynamically driven by a combination of idiosyncratic and market risk factors. However, in all theoretical models, only abstract and stylized covenants are used. Thus, the model parameters cannot be directly related to existing covenants that are often linked to specific events or accounting ratios.

Therefore, the empirical literature has not focused on such model calibrations but has analyzed bond prices/yields directly. Reisel (2014) is the first paper to investigate if the presence of covenants has an impact on bond prices. She studies issuance yields for bonds with covenants, assuming that firms include covenants when their benefits outweigh their costs.[4] To address the endogeneity problem, she employs a treatment effects model and finds that covenants are relevant for bond pricing. Specifically, she finds significant reductions in the cost of debt by around 35 to 75 bps at issuance. After the financial crisis, this methodology is applied by Simpson and Grossmann (2017), showing that covenants remain an important consideration when issuing corporate bonds after the crisis.

Focusing on the inclusion of covenants, Nash, Netter, and Poulsen (2003) find that firms with growth opportunities are more inclined to preserve financial flexibility by not including dividend and debt-issuance restrictions. Billet, King, and Mauer (2007) and Bradley and Roberts (2015) find that the use of covenants increases with debt maturity, leverage, and growth opportunities. Moreover, they point out that loans include covenants more often during recessionary periods. A similar selection effect is documented in Mansi, Qi, and Wald (2021), who show that some covenants are associated with higher bankruptcy risk due to faulty contract design, inability to shift to safer investments, or inefficient liquidation. Lou and Otto (2020) show that firms with heterogeneous debt sources subsequently include new and stricter covenants. In the loan market, Prilmeier (2017) finds that covenant tightness is relaxed over the duration of a relation. On a country level, Miller and Reisel (2012) find that bonds are more likely to include covenants when creditor protection laws are weaker.

The literature on covenants also addresses differences between bond indentures and loan agreements (see, e.g., Diamond, 1984; Ramakrishnan and Thakor, 1984; Asquith, Gertner, and Scharfstein, 1994; Sweeney, 1994; Bolton and Scharfstein, 1996; Gilson, 1997; Denis and Mihov, 2003; Becker and Ivashina, 2016; Lou and Otto, 2020). In a recent paper, Li, Lou, and Vasvari (2015) analyze the usage of default clauses in loan and bond contracts, discussing the impact of various firm-specific variables, in particular, asset tangibility. Overall, this literature provides us with additional firm characteristics that could impact the price of covenants.

4 This cost-benefit consideration was already pointed out by, for example, Smith and Warner (1979).

2. Covenant Types

The recent literature uses the framework by Smith and Warner (1979) and Chava, Kumar, and Warga (2010) to group covenants into four types: dividend, event, financial, and investment covenants. Thus, we discuss important aspects of these types and the economic channel through which covenants affect firms.

Dividends reduce liquidity held within the firm, increasing default risk, which in turn reduces bond prices. Thus, it is advantageous for bondholders to limit this possibility. Dividend covenants vary in their stringency and typically do not prohibit dividend-like payments outright. Instead, limitations on such payments are tied to the development of specific accounting figures.

Individual covenants that are grouped in the event type trigger if certain special situations occur. For example, if the firm defaults on or accelerates other debt, event covenants allow the bondholders to accelerate their debt as well. Alternatively, this could also occur if the firm's net worth falls below a prespecified threshold. Moreover, control put provisions, also referred to as poison puts, take effect if the firm is taken over.

Financial covenants prevent or limit stockholders from diluting existing bondholders by creating claims that effectively have a higher priority or jeopardize their ability to honor the outstanding debt. The most direct way for stockholders to achieve that would be to issue additional senior debt. Financial covenants either prohibit this outright or automatically elevate existing debt to the same seniority level. Additionally, covenants of this type may also restrict rentals, leases, and sale-leaseback arrangements.

Generally, investment covenants restrict investment policy to prevent risky investments that decrease the value of debt, thereby preventing risk shifting. However, they can also mandate certain investments or require the maintenance of a firm's working capital, which also includes retaining earnings to cover fixed charges. For example, these covenants restrict M&As. Similarly, these covenants restrict interactions between a parent company and its affiliates. Some investment covenants also mandate that proceeds from asset sales are used to repay bondholders.

3. Data

For our empirical analysis, we combine bond data from Mergent Fixed Income Securities Database (FISD) with transaction data from TRACE. We follow the relevant literature on corporate bonds and consider senior, unsecured corporate bonds denoted in USD with a fixed coupon that are straight, callable, or puttable, excluding all others with complex structures, such as asset-backed and convertible securities.[5] In addition, we require that the

[5] Given the potential connection between a bond's riskiness and the use of call options, we assess the robustness of our results with respect to call features. In alternative specifications, we consider bonds with or without such

bonds are rated by at least one rating agency. We consider ratings from S&P, Moody, and Fitch and convert them to numeric values (i.e., one corresponds to AAA/Aaa, two to AA+/Aa1, etc.). In total, we observe 37,863 bonds.

For these bonds, we consider transaction data from 2004, when TRACE reporting became mandatory for all bonds, up to the second quarter of 2018. We delete noninstitutional trades (i.e., transaction volume below USD 100,000), clean the transaction data following Dick-Nielsen (2009) as implemented in Scheuch, Voigt, and Weiss (2023), and apply median as well as reversal filters.[6] This leaves us with a sample of 13,289 traded bonds.

Next, we add bond covenant information from Mergent FISD. This information is available for most bonds with trading data, and our final sample consists of 12,904 bonds, representing approximately 80% of the overall market trading activity.[7] As discussed in Section 2, we follow the framework by Smith and Warner (1979) and Chava, Kumar, and Warga (2010) to group the individual covenant dummies from Mergent FISD into four covenant types, namely, dividend, event, financial, and investment covenants.[8] We provide a complete list of how to map covenant dummies to covenant types in the Appendix. Note that we have no data available that cover the details of the individual covenants (e.g., trigger values or others). Furthermore, information concerning covenant violations is not available. Table 1 shows summary statistics of our bonds in panel A and covenant inclusion frequencies in panel B (with additional insights on covenant frequencies in Internet Appendix I).

Our empirical setup focuses on a weekly observation frequency since some variables require multiple observations for their calculation. In addition, given the general illiquidity of the U.S. corporate bond market, weekly observations reduce the volatility of variables and the missing value problem; see, for example, Bessembinder et al. (2009). Specifically, we require more than three transactions per week. Overall, we observe 1,498,420 bond-weeks. We discuss the main bond-specific variables below and provide their exact definitions in the Appendix.

options separately. In further tests, we use callability as an additional matching criterion, and we rerun all our analyses using the yield-to-worst. All our main conclusions remain unchanged.

6 Median filters address excessive intraday price variation; that is, if a trade deviates from the daily median or the 2-week median centered at the trading day by more than 10%, it is considered erroneous. The price-reversal filter deletes transactions that deviate from the previous price, the next price, and the average of both prices by more than 10%.

7 As the majority of bonds trade very infrequently in the U.S. corporate bond market, it appears at first glance that restricting to issuance information would provide an advantage in sample size. However, when Reisel (2014) is taken as a benchmark, it turns out that much more data—in particular, equity data—are needed to calibrate issuance-based models. Thus, such models cannot be calibrated for more bonds.

8 Changing the literature-based definition of covenant types arguably does not affect our main conclusions, as they hold across covenant types (see Section 5). However, we also consider alternative covenant-grouping algorithms. First, we employ a grouping focused on accounting-based covenants. Second, we group based on a cluster analysis. We present these results in Internet Appendix X.

Table 1
Summary statistics: Traded bonds

A. Bond characteristics

	Mean	SD	Median	IQR
Amount issued	0.58	0.59	0.40	0.50
Coupon	5.74	2.20	5.75	3.08
Time-to-maturity	12.29	10.11	10.00	3.51
Rating	9.19	3.78	9.00	4.00

B. Covenant inclusion frequency

	Dividend	Event	Financial	Investment
Overall	18.23	79.89	95.67	89.34
Precrisis	18.01	63.21	98.69	94.34
Crisis	20.18	86.30	89.30	75.28
Postcrisis	18.05	97.26	93.69	86.85

This table shows summary statistics for the 12,904 traded bonds in our sample. In panel A, we show the amount issued in billion USD, the coupon in percent, time-to-maturity at issuance in years, and the rating as a numeric variable between 1 (best) and 24 (worst). We present the mean, the standard deviation (SD), the median, and the interquartile range (IQR). In panel B, we show how often a covenant type (dividend, event, financial, and investment) is included in bond indentures. First, the overall number is shown, followed by subsets including bonds issued before, during, and after the crisis.

We calculate a volume-weighted price for each week (see Bessembinder et al., 2009) and use these to compute yield to maturity and duration.[9] We incorporate all aspects of liquidity risk by considering the Roll measure as a transaction cost measure (see Roll, 1984), the Amihud measure as a price impact measure (see Amihud, 2002), and the price dispersion measure that is particularly well suited for dealer markets (see Jankowitsch, Nashikkar, and Subrahmanyam, 2011). We then aggregate these three variables into one liquidity measure by performing a principal component analysis.[10] Table 2 shows summary statistics for the weekly variables alongside the number of trades per bond and the trading volume.

In addition to the bond-specific information, we also consider various explanatory variables. We obtain the following macroeconomic variables from Federal Reserve Economic Data (FRED): GDP growth, the CPI, term spread, T-bill rate, the volatility index (VIX), and default spread. Furthermore, we match firm-specific information to the bond data using the Wharton Research Data Services (WRDS) CUSIP-PERMNO link and access equity and accounting variables from the matched CRSP-Compustat database. These include market-to-book, firm size, leverage, tangibility, equity beta, abnormal earnings, asset maturity, Altman Z scores, interest coverage ratio,

[9] In order to avoid potential outliers when calculating yields, we truncate the yield to maturity at the 0.5% level in both tails.

[10] We smooth the liquidity variables by considering a 3-month rolling average and winsorize the variables and principal component at the 1% level.

Table 2
Summary statistics: Bond-weeks

	Mean	SD	Median	IQR
Yield	5.11	4.31	4.51	3.21
Duration	5.61	3.92	4.70	4.22
Rating	9.19	3.87	9.00	5.00
Price dispersion	0.37	0.30	0.31	0.27
Roll	0.56	0.53	0.46	0.38
Amihud	0.01	0.02	0.01	0.01
Number of trades	11.55	14.86	7.00	9.00
Volume	19.62	61.08	8.00	17.65

This table shows summary statistics for the 1,498,420 bond-weeks included in our sample. We show Yield in percent, Duration in years, Rating as a numeric variable between 1 (best) and 24 (worst), Price dispersion in percent, Roll measure in percent, Amihud measure in million USD, Number of trades per week, and the weekly trading Volume in million USD. We present the mean, standard deviation (SD), median, and interquartile range (IQR) for each metric.

retained earnings, and cash balance. A full list and exact definitions are shown in the Appendix.[11]

4. Methodology

In this section, we present our approach to analyzing covenant prices. First, we focus on the measurement of covenant prices by employing a novel estimation procedure. Second, we explain how we explore the resulting price variation using bond-, market-, and firm-specific variables in a regression setup.

4.1 Covenant prices

When quantifying the price effect of a covenant, we would ideally compare two identical bonds issued by the same firm that differ only in the specific covenant type. However, firms generally do not simultaneously issue bonds with differing covenant structures. Furthermore, since most firms only have a small number of bonds outstanding, there are also only a few cases where firms issue bonds with different covenant structures over time. Thus, a within-firm analysis is not feasible. So far, the literature has tackled this problem by analyzing issuance yields across firms while considering covenant-type dummy variables as bond characteristics.[12] Such an approach has several disadvantages. First, using issuance yields implies that price

[11] To ensure that outliers do not drive our results, we winsorize the accounting variables at the 1% level on both sides.

[12] In general, considering bonds only at issuance leads to small samples. For example, if we considered pairing bonds at issuance with other bonds issued within a 6-month window, required a loose match in risk characteristics (± one standard deviation), and only considered a pair given a fit in the covenant structure, we can only obtain covenant prices for 7% of our bonds across covenant types. With such a minuscule sample, we could not derive our insights, as a reasonable time-series analysis is not possible. Furthermore, issuance yields themselves might be biased (see Nagler and Ottonello, 2022).

information from completely different time periods has to be compared, running the risk of omitting variables that capture the economic differences over time. Even more critically, firms choosing different covenants at issuance most likely do not share the same exposure to risk factors, and hence, endogeneity issues arise that have to be addressed in the analysis. In addition, issuance-based approaches often use simple individual estimations for each covenant type and, thus, cannot disentangle their individual effects as many bonds have multiple covenants.[13]

Thus, we base our approach on secondary market data. This allows us to compare bonds across firms with different covenant structures at the same point in time. Furthermore, since the contractual details of bonds are fixed at issuance, changing firm fundamentals and financial market frictions allow situations where bonds with different covenant structures and the same underlying characteristics exist at the same time. To estimate the covenant prices of a particular treatment bond, we use a set of simultaneously traded control bonds that share the same exposure to risk factors and have the same covenant structure, except for the specific covenant type that is being priced. Within our approach, we then precisely match the typical bond risk factors by employing a novel weighting of the control bonds, allowing a direct estimation of the covenant price.[14]

In particular, we identify the covenant price p of a particular covenant type $c \in \{\text{dividend}, \text{event}, \text{financial}, \text{investment}\}$ for an individual treatment bond i in week t based on its yield y as the following yield differential:

$$p_{i,t}^{c} = \sum_{j \in J_{i,t}^{c}} w_{j,t}\, y_{j,t} - y_{i,t}, \tag{1}$$

where $J_{i,t}^{c}$ denotes the control sample of bonds that do not feature the covenant type c but that match the remaining covenant structure. Thus, the covenant price is represented by the difference between the weighted yields of the replicating portfolio and the yield of the treatment bond. In general, this difference is expected to be positive as the additional covenant type will lower the yield of the treatment bond compared to the other bonds.

The specification of the control group is a critical step in our estimation procedure. So far, in the context of measuring bond price effects, many papers define risk characteristics—for example, duration, credit rating, or liquidity—and restrict the allowed deviation for the control bonds (e.g., ± 1 year in duration). These bonds are then typically equal- or volume-weighted, which

[13] For example, Reisel (2014) calibrates one treatment effects model for each covenant type. Thus, in this analysis, bonds with only this covenant type and bonds with multiple types (including the considered covenant type) are treated the same.

[14] This comparison of contemporaneous bond prices is essential to estimate stable covenant prices. We applied OLS regressions and treatment effects models as alternatives. Although the general results are similar for the overall sample, all these alternative approaches have severe stability issues once subsamples for different time periods or across firms/bonds are estimated.

is sufficient for most applications. However, this approach is too crude for estimating covenant price effects.[15] In particular, limiting the control bonds to a certain covenant structure often results in risk characteristics that are not symmetrically distributed (e.g., most bonds in the control group have a lower duration and only a few have a higher duration and vice versa). Consequently, significant deviations arise, causing potential biases. Narrower boundaries could alleviate this issue but result in too-small control samples.

Therefore, we introduce a replicating portfolio that assigns weights $w_{j,t}$ to the control bonds such that the deviation to the risk characteristics of the treatment bond is eliminated. In the first step, we follow the literature taking the perspective of a bond investor by considering three relevant risk characteristics—that is, duration, rating, and liquidity—with a one-standard-deviation boundary in all three risk dimensions. As a second step, we derive the optimal weights of the replicating portfolios.

Formally, we consider a standardized, three-dimensional characteristics space spanning interest rate, credit, and liquidity risk. In this space, we have a characteristics vector $x_{i,t}$ for the treatment bond and a characteristics matrix $X_{J^c_{i,t}}$ for the bonds in the control sample $J^c_{i,t}$. The optimal weights $w^{\star}_{J^c_{i,t}}$ minimize the squared Euclidean distance between the treatment and control bond without allowing for short selling:[16]

$$\min_{w_{J^c_{i,t}}} ||x_{i,t} - w'_{J^c_{i,t}} X_{J^c_{i,t}}||_2, \tag{2}$$
$$\text{s.t.} \quad w_j \geq 0, \ \forall j \qquad \text{and} \qquad \sum_{j \in J^c_{i,t}} w_j = 1.$$

Note that we only consider observations where the minimum identified in Equation (2) is sufficiently close to zero, that is, the maximum allowed deviation is 0.01, implying that the risk characteristics are perfectly matched in economic terms.[17] Overall, this weighting approach offsets even small differences in the characteristics between the considered bond and the control sample. This is essential as it avoids a mechanical correlation between the characteristics and covenant prices.[18]

[15] Indeed, we tested the typically applied equal- or volume-weighting, and the resulting covenant prices were very noisy.

[16] The optimization is performed by the R package of Theussl, Schwendinger, and Hornik (2020). We compute the initial weights by employing a local fitting approach similar to Cleveland and Devlin (1988), Meese and Wallace (1991), Spiegel and Starks (2016), and Jankowitsch, Ottonello, and Subrahmanyam (2022). For computational efficiency, we only include the 100 bonds with the highest initial weights, covering more than 99.5% of the initial weights.

[17] In alternative specifications, we allow for negative weights (i.e., short positions in the control sample), and we change the optimization from L2 to L1 norm. Neither change affects our results.

[18] Indeed, we find that covenant prices estimated without the weighting procedure have a positive correlation with the differences in risk characteristics between the considered bond and its control sample. After applying our procedure, this correlation is basically zero. Using even a strict maximum deviation in the weighting does not change the results, but significantly reduces the observations.

This novel methodology produces a large sample of weekly covenant prices. We conduct four tests to ensure that the resulting prices are unbiased. First, we check whether the methodology is able to reliably replicate bond yields if we match the entire covenant structure, that is, the treatment bond and the benchmark bonds have identical covenants. Indeed, we show that these pricing errors are basically zero on average without any significant time trends (see Internet Appendix II). Additionally, we show that the three risk characteristics are unaffected by the covenant structure (see Internet Appendix III).[19] Note that any such bias would plausibly only reduce covenant prices. Furthermore, we test whether non-Markov effects could affect our results; that is, we consider lags of our characteristics as additional matching criteria. In particular, bonds with negative (positive) rating changes in the past year are only matched with bonds that also had a negative (positive) change; see Internet Appendix V. We conduct a similar exercise based on past liquidity changes; see Internet Appendix VI. Again, we find the same results.

Even though the covenant prices are unbiased, we consider several additional measures to address potential economic concerns. Our results are robust across specifications not imposing these restrictions. First, we exclude bonds with extreme characteristics, that is, durations less than 3 months or more than 15 years, liquidity measures greater than 1.5, and bonds with default-like ratings.[20] Second, we ensure that idiosyncratic effects beyond duration, rating, and liquidity do not influence the covenant prices. To this end, we only consider bond-week observations if the bond's pricing error (i.e., from the aforementioned analysis where the entire covenant structure is matched) is less than 0.5%.[21] Thus, we eliminate cases where bond yields might be affected by, for example, fire sales, earnings announcements, or M&A activity, among others.[22] Last, we require 12 bond-covenant-week observations and truncate the resulting covenant prices at the 1% level.[23]

Ultimately, our sample consists of 1,022,974 covenant prices. Each observation represents a bond-covenant-week observation. In total, we report covenant prices for 8,069 unique bonds, with an average of 127 observations per bond. These observations correspond to 1,391 unique firms, with an average

[19] While we do not find any evidence that rating is affected by the covenant structure, one could assume that covenants positively affect bond ratings. In a robustness check, we replace bond ratings with firm ratings, which are arguably unaffected by the covenant structure of one particular instrument. We show the effectively unchanged results in Internet Appendix IV.

[20] Since the linearity assumption is especially critical if ratings transition from investment- to speculative-grade, we show that the results remain practically unchanged if we only consider investment-grade bonds; see Internet Appendix VII.

[21] Note that treatment effects models or similar regression-based approaches cannot integrate such outlier filters.

[22] Note that the pricing error restriction does not impact our main results as shown in Internet Appendix II.

[23] Note that all these measures reduce the sample size to 8,069 bonds: 52 bonds do not have any covenants; for 2,378 bonds, a traded control sample with matching criteria cannot be found; 1,164 bonds cannot fulfill the maximum deviation; 425 bonds are eliminated because of the pricing error restriction; 784 bonds provide covenant prices too infrequently; and 32 bonds have covenant prices in the 1% tails.

Table 3
Observation frequency

Weeks	Bonds
<10	3,605
10-20	1,617
20-30	1,095
30-40	873
>40	879

This table shows the distribution of bonds by data availability. For each bond, we calculate the number of weeks with observable covenant prices and scale it to the total weeks the bond could potentially be observed. We transform this ratio into the number of observed weeks in an average year. Then, the table reports the number of bonds falling into each of the five frequency buckets. In total, the sample includes 8,069 bonds.

of 735 covenant prices per firm. This sample covers bonds with various trading frequencies. Table 3 shows the available trading weeks in an average year. As expected, many bonds are not traded every week. However, more than 10% of the bonds show a very high trading frequency, allowing us to analyze bonds across all liquidity levels.

4.2 Regression analysis

Given our large sample, we can exploit within-bond variation to identify the key drivers of covenant prices. To this end, we mainly use pooled time-series regressions to explain covenant prices based on first differences. Note that first differences provide the additional advantage of filtering out any potential bond-specific biases due to matching, omitted variables, or the idiosyncratic effects of contractual details. We aggregate all variables on a monthly basis, which allows us to directly use certain measures, for example, macroeconomic variables, that are not available on a weekly basis.[24] Furthermore, we cluster the standard errors on a firm and quarter level:

$$\begin{aligned}\Delta p^c_{i,t} = \alpha + \beta\Delta(\text{Duration})_{i,t} + \gamma\Delta(\text{Rating})_{i,t} + \delta\Delta(\text{Liquidity})_{i,t} \\ + \zeta\Delta(\text{Macroeconomic Variables})_t + \varepsilon_{i,t}\end{aligned}. \quad (3)$$

In our regression analysis, we include the bond-specific variables duration, rating, and liquidity, which we also employ in the matching procedure. This allows us to analyze whether covenant prices are related to bond pricing factors (e.g., whether lower-rated bonds have higher covenant values). We use GDP growth, inflation, term spread, T-Bill rate, default spread, VIX, and credit default swap (CDS) spread to study the effect of market-specific variables.

In general, this setup allows us to analyze covenant prices based on all covenant types together (combined analysis) and separately for the individual covenant types. We exclude the dividend covenant type from this discussion,

[24] Note that we also present results based on weekly data as a robustness test (see Internet Appendix VIII).

as it represents less than 1% of our sample, which makes a thorough discussion of dividend-specific results impossible.

We consider a series of robustness tests shown in Section VIII of the Internet Appendix. First, we analyze a weekly time horizon within the first-difference model as our bond-specific variables move on this frequency. Furthermore, we consider differences in all variables with respect to the bond's issuance. Thus, changes in the covenant prices since issuance are explained by changes in the other variables relative to the same reference point. Finally, we add a model explaining covenant prices using bond-fixed effects instead of first differences. Overall, we find the same results in all three of these additional models.

5. Results

Our results are structured in the following way. We first present general summary statistics on the covenant prices of the various types and their variation over time. Next, we analyze various bond-, market-, and firm-specific variables and their effects on covenant prices based on our regression setup. Finally, we investigate whether the covenant price affects subsequent covenant inclusions in newly issued bonds.

In general, we find that covenants reduce bond yields; that is, bond investors are willing to pay higher prices for bonds with covenant protection due to mitigated agency conflicts. On average, the inclusion of a covenant reduces yields by 18 bps, as shown in Table 4. This effect's economic implications are highly relevant. The yield reduction translates to a price effect exceeding 1% for a bond with an average duration. Additionally, there is some variation across covenant types, with covenant prices ranging from 13 bps for financial to 16 bps for investment and 20 bps for event covenants. Moreover, all these effects are highly statistically significant.

Overall, positive covenant prices are in line with the results of prior studies. Our findings for the three covenant types coincide with the conclusion of Reisel (2014) and Simpson and Grossmann (2017) that covenants are important contractual features. Regarding the magnitude of yield reductions, we find smaller effects than other authors on average. Such differences in effect size might be related to time periods, covenant types, or the fact that these papers only consider issuance information.[25]

Exploring the covenant price dynamics over time, Figure 1 shows average covenant prices. Generally, we find significant variation, especially before and after the crisis. Covenant prices start below average, around 10 bps at the beginning of our sample period in 2004. In the crisis and the subsequent

[25] We generally consider bonds over their whole lifetime. However, we also assess bonds at different stages of their life cycles (e.g., shortly after issuance, three years after issuance, etc.), and our unreported results hold for all considered intervals. Although the results are very similar, they indicate that moving away from the issuance leads to higher explanatory power, suggesting additional noise in issuance yields.

Table 4
Summary statistics: Covenant prices

	Observations	Mean	SD	Median	IQR
Combined	1,022,974	0.18	0.33	0.15	0.39
Event	481,070	0.20	0.34	0.18	0.40
Financial	78,356	0.13	0.30	0.12	0.37
Investment	463,548	0.16	0.33	0.14	0.39

This table shows summary statistics for the covenant prices, measured as a yield reduction in percent, over the entire sample period from 2004 to 2018Q2. In the first row, we show how many covenant prices were identified overall, followed by their means, standard deviations (SD), medians, and interquartile ranges (IQR). Afterward, we present the same information for each covenant type individually.

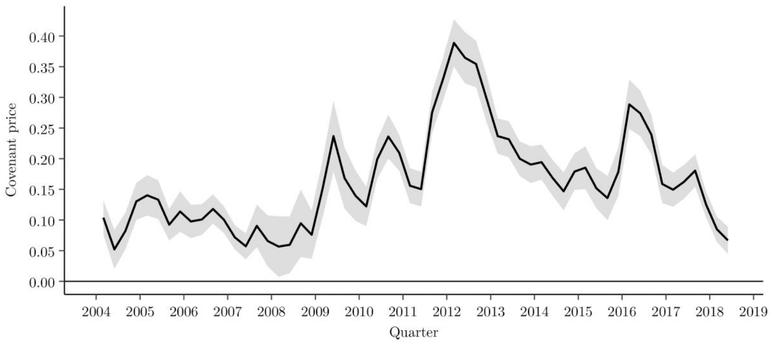

Figure 1
Covenant prices over time
This graph shows the evolution of covenant prices, measured as a yield reduction in percent, from 2004 until 2018Q2. We aggregate the weekly observations to quarters. Alongside the mean, we plot the 99% confidence region (shaded area) based on heteroskedasticity-robust standard errors clustered at the firm level.

period, covenant prices increase significantly, spiking to around 40 bps. During this period, the magnitude of covenant prices amounts to roughly 5% relative to overall bond yields. Thereafter, covenant prices slowly revert to their precrisis average. These results indicate a strong relation between covenant prices and the overall economic environment. We further explore this relation in Section 5.2.

Next, we analyze the individual covenant types and their price dynamics. Figure 2 shows that, in general, all three types show a similar pattern over time. However, there are differences in the magnitudes. Specifically, financial covenants experience the most pronounced spike of up to 80 bps during the crisis. On the other hand, event and investment covenants peak at 40 bps.

Interestingly, Figure 2 also reveals that event covenant prices dip into negative territory for a brief period of time at the onset of the crisis. This can be explained by the fact that cross-acceleration and cross-default clauses dominate this covenant type. During financial distress, multiple of these

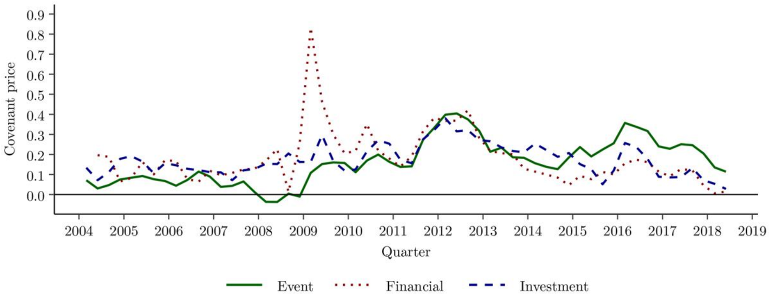

Figure 2
Individual covenant type prices over time
This graph shows the evolution of the individual covenant prices for event (solid, green line), financial (dotted, red line), and investment (dashed, blue line) covenants from 2004 until 2018Q2. The covenant prices are measured as yield reductions in percent. We aggregate the weekly observations to quarters.

covenants might trigger simultaneously within one firm, allowing multiple lenders to demand early repayment. While this is optimal from the perspective of each lender individually, their joint actions might exhaust the firm's liquidity buffer. This coordination failure among the dispersed bondholders could cause a cascading default (see also Beatty, Liao, and Weber, 2012). This risk of coordination failure might result in negative covenant prices (see Mansi, Qi, and Wald, 2021, for a discussion) with such effects most likely occurring during times of heightened default risk and uncertainty.

5.1 Covenant prices and bond-specific risk factors

In this section, we investigate whether covenant prices vary with the three main bond-specific risk factors, that is, duration, rating, and liquidity. Specifically, we are interested if covenants have stronger effects on riskier bonds, which would be reflected in a higher yield reduction. This intuition reflects that the effects of agency conflicts might be more severe when a bond has a longer duration, is more likely to default, and is harder to sell. The empirical literature is so far silent on this particularly important question.

Table 5 shows that covenant prices are indeed increasing in all three bond-risk characteristics for the individual and combined analyses. The effects are economically sizeable and statistically significant. Additionally, recall that these are first-difference regressions on a bond- and covenant-level that remove the impact of unobservable bond- and firm-specific factors.

We find that the yield reduction caused by covenants increases with higher duration. To put the coefficient of the combined sample into context, a reduction in duration of 1 year implies a drop in the covenant price by 7 bps. Economically, this change in covenant prices most likely reflects the reduction of uncertainty associated with lower bond duration. The effect itself is of similar magnitude for all covenant types, with event covenants featuring a slightly elevated coefficient.

Table 5
Covenant price determinants: Bond risk variables

	Covenant type			
	Event	Financial	Investment	Combined
Duration	0.088^{***}	0.051^{**}	0.057^{***}	0.070^{***}
	(0.009)	(0.026)	(0.012)	(0.009)
Rating	0.126^{***}	0.086^{***}	0.135^{***}	0.128^{***}
	(0.007)	(0.012)	(0.007)	(0.006)
Liquidity	0.181^{***}	0.204^{***}	0.307^{***}	0.236^{***}
	(0.018)	(0.044)	(0.020)	(0.013)
Observations	182,537	30,464	178,860	391,861
Adjusted R^2	0.038	0.032	0.047	0.041

This table shows the results of monthly first-difference regressions of covenant prices (in percent) on the bond risk variables Duration, Rating, and Liquidity. First, the results of the individual covenant types are shown, followed by the combined model. The standard errors shown in parentheses are corrected for heteroscedasticity and clustered at the firm and quarter level. We indicate statistical significance at the 10%, 5%, and 1% level by *, **, and ***, respectively.

A rating change also has a significant impact on covenant prices for all three types individually as well as in the combined test. In particular, we find that if the rating worsens by one notch, covenant prices increase. While coefficient estimates for event and investment covenants are similar, with a magnitude of roughly 13 bps, the covenant price increase due to a rating change for financial covenants is lower, at 8.6 bps. Thus, covenants are more important for firms issuing bonds with higher credit risk. Apart from bond-specific ratings, we also consider covenant price sensitivities to changes in firm ratings in Internet Appendix IV and find similar effects.

Similar to the other variables, we observe a positive relation between the covenant price and liquidity risk. That is, a worsening of a bond's liquidity—that is, an increase in transaction costs, price impact, or price dispersion—is accompanied by an increase in the covenant price. To give some reference point, the standard deviation of changes in liquidity is equal to 0.14, which results in a covenant price change of around 3.3 bps. This impact is comparable in economic terms to the other two variables, that is, a one-standard-deviation move in rating leads to a move of 4.0 bps in covenant prices compared to a move of 1.5 bps for duration.

Overall, we find that bond-specific risk factors have a significant effect on the covenant's price impact. As theory suggests, investors value covenants more in riskier bonds. In comparison with the impact of a one-standard-deviation change in the bond-specific risk variables, credit risk is the most important driver, followed by liquidity and interest rate risk. However, in economic terms, we can conclude that all three risk factors are relevant in pricing the impact of covenants. To summarize, increases in a bond's riskiness are associated with higher yield reductions from covenant protection.

5.2 Covenant prices and market-wide risk factors

In our next analysis, we add variables measuring market-wide risk to the analysis conducted above and, thus, explore whether changes in covenant price are related to the business cycle. For example, Figure 1 shows that covenant prices experience an upward trend starting with the financial crisis, which coincides with changes in market-wide risk factors. We focus on the default spread, VIX, and CDS spread as variables that capture market-wide credit risk and uncertainty; see Section 3. However, we also control for other macroeconomic indicators like GDP growth, inflation, term spread, and T-Bill rate. We illustrate the relation of these variables over time in Figure 3, where we plot the covenant price against the market-related risk variables. All three, generally, show similar patterns throughout the entire sample period and, in particular, feature a pronounced spike during the financial crisis. Interestingly, all three market-wide variables spike before the covenant prices. Overall, this comparison suggests a positive correlation between the aforementioned measures and covenant prices.

To formally investigate the potential relation between market-wide variables and covenant prices, we conduct a series of regression analyses. Specifically, the analyses presented in Table 6 add the market-wide variables to the previous first-difference regression setup. We present four different regressions based on the combined covenant price sample.[26] In the first three specifications, we use the bond-specific and macroeconomic variables and add the market-wide credit and uncertainty measures individually. In the fourth regression, we add all three variables together.

First, these results confirm the robustness of the statistical analyses concerning the three main bond variables presented in Table 5. Their coefficients are quantitatively similar when adding additional explanatory variables. Second, regarding the three market-related risk measures, we find that covenant prices are higher in times of increased aggregate risk and volatility. Indeed, we find that all three of these variables have a strong explanatory power individually. A one-standard-deviation change in the default spread leads to an increase in the covenant price by 1.9 bps, while the effects are 2.5 bps for the VIX and 3.3 bps for the CDS spread. In the combined model, only the VIX retains its statistical significance, which is unsurprising since Figure 3 suggests that these variables capture similar economic forces.

Finally, analyzing the macroeconomic variables, we find that the term spread and inflation show significant parameters. Increases in inflation are accompanied by higher covenant prices in our sample. On the other hand, the coefficient estimated for the term spread indicates a negative relation. Thus, we find that covenant prices are related to inflation and changes in the interest rate curve. In detail, an increase in inflation by 1% is related to an increase in covenant prices by 1.3 bps, and a reduction of the term spread by

[26] We show results for individual covenant types in Internet Appendix IX.

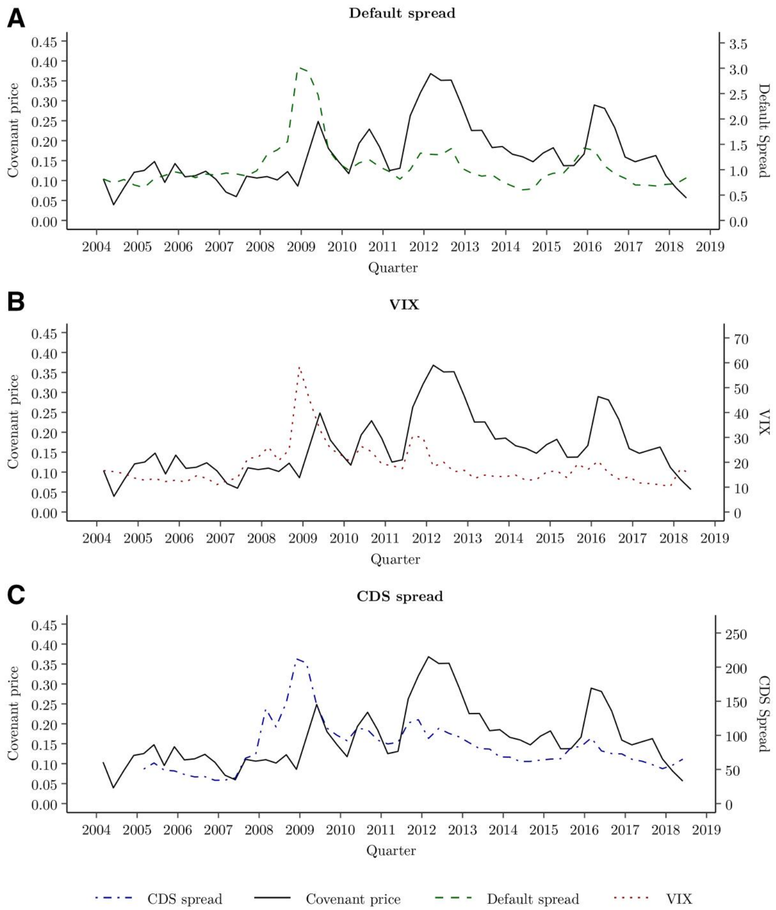

Figure 3
Market risk measures and covenant prices over time
This graph shows the evolution of covenant prices (in percent on the left axes) from 2004 until 2018Q2, plotted alongside different market risk measures (on the right axes). Panel A includes the default spread; panel B, the VIX; and panel C, the CDS spread. We aggregate the weekly price observations to quarters.

one standard deviation leads to 7.9 bps higher prices. Neither the GDP growth nor the T-Bill rate shows a significant relation to covenant prices.

The results of this section provide novel insights showing that covenant prices change over the business cycle and that the results provide a positive link between adverse economic conditions and covenant prices. That is, covenants appear to be more important in times when the risks of capital outflow, risk shifting, and claim dilution are exceptionally high. These results on covenants' price impacts are in line with the findings on covenant inclusion frequencies provided by previous studies (see, e.g., Bradley and Roberts, 2015). Overall, our findings confirm the theoretical predictions that covenant

Table 6
Covenant price determinants: Bond risk and market variables

	Model specification			
	(1)	(2)	(3)	(4)
Duration	0.095***	0.096***	0.090***	0.094***
	(0.012)	(0.012)	(0.011)	(0.012)
Rating	0.129***	0.129***	0.132***	0.133***
	(0.006)	(0.005)	(0.005)	(0.005)
Liquidity	0.250***	0.250***	0.250***	0.250***
	(0.014)	(0.014)	(0.015)	(0.015)
GDP	0.002	0.002	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
CPI	0.006***	0.006***	0.006***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Term spread	−0.095***	−0.098***	−0.095***	−0.094***
	(0.012)	(0.013)	(0.011)	(0.012)
T-Bill rate	−0.017*	−0.017	−0.010	−0.009
	(0.009)	(0.010)	(0.011)	(0.010)
Default spread	0.042***			0.004
	(0.015)			(0.021)
VIX		0.003***		0.002**
		(0.001)		(0.001)
CDS spread			0.001***	0.001
			(0.000)	(0.000)
Observations	391,861	391,861	373,989	373,989
Adjusted R^2	0.047	0.048	0.048	0.048

This table shows the results of monthly first-difference regressions of combined covenant prices (in percent) on the bond risk variables Duration, Rating, and Liquidity as well as market-wide indicators. Models (1) to (3) add market risk measures (i.e., Default spread, VIX, and CDS spread) individually, followed by a combined model. All specifications include the macroeconomic variables GDP growth, Inflation, Term spread, and T-Bill rate. The standard errors shown in parentheses are corrected for heteroscedasticity and clustered at the firm and quarter level. We indicate statistical significance at the 10%, 5%, and 1% level by *, **, and ***, respectively.

prices are dynamically driven by a combination of idiosyncratic and market risk factors.

5.3 Covenant prices and firm-specific factors

In this section, we investigate the relation between covenant prices and firm characteristics, which might reflect the severity of agency conflicts. We focus on variables that were suggested to drive the likelihood of covenant inclusions by previous studies. In particular, Nash, Netter, and Poulsen (2003) and Billet, King, and Mauer (2007) show higher covenant inclusion rates for firms with more growth opportunities, higher leverage, and smaller size. Similarly, the literature (see, e.g., Malitz, 1986; Simpson and Grossmann, 2017) also discusses that firms with more tangible assets include covenant restrictions more frequently. While the aforementioned studies show firm characteristics' effects on covenant inclusions, we investigate whether these firm-specific variables result in differences in covenants' price effects.

We analyze the importance of these firm characteristics by comparing covenant prices between portfolios in an asset-pricing framework. In particular, we split the sample of firms in each quarter into terciles (low, medium, and high) based on the respective characteristic, as in classical portfolio sorts. We employ market-to-book as a measure for growth opportunities and use leverage, firm size, and tangibility. We expect that firms with more growth opportunities, higher leverage, smaller size, and more tangible assets show higher covenant prices. The advantage of this procedure is that it controls for time variation in the covenant price levels themselves. This allows us to directly expose differences in covenant prices across firm characteristics. First, we plot the time series of the average covenant price for the high and low portfolios in Figure 4 for each of the four firm variables. In addition, we provide statistical tests for the significance of the graphically observable differences and present these results in Table 7.

We find that growth firms (i.e., firms with higher market-to-book ratios) have significantly higher covenant prices for all covenant types. The difference in the covenant price between high and low market-to-book firms is 7.9 bps on average. This result is stable over time as panel A in Figure 4 shows a positive price difference for the whole sample. While the theoretical literature also suggests a positive link between leverage and covenant inclusions, we do not find a similar price relation. This hints at the fact that not all differences in inclusion probabilities are mirrored in price differences in the years after a bond is issued. We find that smaller firms have higher yield discounts for the inclusion of covenants. Smaller firms are considered less transparent and riskier than larger firms (consider, e.g., the size premium in equity markets), making state-dependent right transfers included in bond indentures more valuable for investors. However, this result is not necessarily equally important for all covenant types, and the magnitude of the difference is lower than that observed for growth options. Finally, we observe higher covenant prices for bonds issued by firms with more tangible assets, in line with the literature's predictions for the inclusion frequency. Interestingly, this difference narrowed over the more recent years.

Using this cross-sectional analysis, we find a difference in the impact of these firm characteristics on covenant prices based on bond portfolios sorted on the characteristics. We also included these firm characteristics in our regression setup based on first differences. However, we find no statistically robust results for the firm characteristics. Most likely, the higher frequency of bond-specific and market-wide risk variables can explain the variation of covenant prices better than balance-sheet variables, which can only be measured on low frequencies and are typically more stable over time. In first-difference regressions, the vast majority of accounting observations are equal to zero or have to be interpolated, which results in identical changes between two observations. Thus, we find no additional explanatory power based on the firm characteristics in our regression setup.[27]

[27] To save space, we only show the regression results including firm characteristics in Internet Appendix XI.

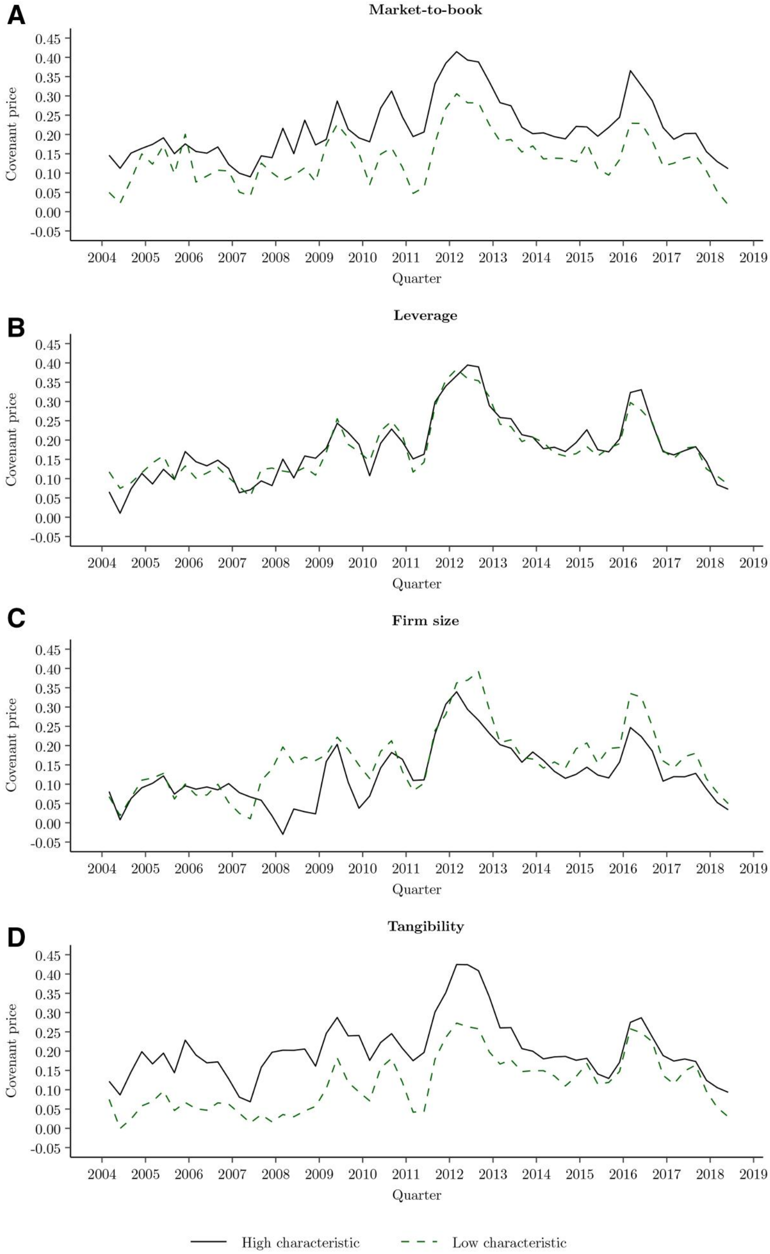

Figure 4
Covenant prices by firm characteristics over time
This graph shows the evolution of the overall covenant prices (in percent) between treatment bonds belonging to the upper versus the lower third of a firm characteristic's distribution in a given quarter from 2004 to 2018Q2. The solid (dashed) lines represent the average covenant price of the upper (lower) third. Regarding characteristics, panel A considers market-to-book; panel B, leverage; panel C, firm size; and panel D, tangibility. We aggregate the weekly observations to quarters.

Table 7
Covenant price differences by firm characteristics

	Covenant type			
	Event	Financial	Investment	Combined
A. Market-to-book				
Market-to-book	0.076***	0.191***	0.072***	0.079***
	(0.015)	(0.024)	(0.015)	(0.014)
Observations	93,648	17,867	93,169	204,684
B. Leverage				
Leverage	0.001	0.014	0.002	0.004
	(0.015)	(0.034)	(0.016)	(0.014)
Observations	94,206	17,976	92,501	204,683
C. Firm size				
Firm size	−0.041**	0.049	−0.065***	−0.046***
	(0.017)	(0.036)	(0.018)	(0.017)
Observations	107,475	19,298	107,811	234,584
D. Tangibility				
Tangibility	0.071***	0.065**	0.059***	0.066***
	(0.016)	(0.033)	(0.017)	(0.015)
Observations	100,814	16,580	101,330	218,724

This table shows the results of monthly regressions testing the difference in covenant prices (in percent) between treatment bonds belonging to the upper versus the lower third of a firm characteristic's distribution in a given quarter. First, the results of the individual covenant types are shown, followed by the combined model. We present the results for Market-to-book in panel A, Leverage in panel B, Firm size in panel C, and Tangibility in panel D. The models include quarter-fixed effects, and the standard errors shown in parentheses are corrected for heteroscedasticity and clustered at the firm level. We indicate statistical significance at the 10%, 5%, and 1% level by *, **, and ***, respectively.

5.4 Covenant frequency analysis

Our final set of results addresses whether covenant prices are related to subsequently issued bonds' covenant structures. Figure 5 shows the relative frequency of the individual covenant types in newly issued bonds. Generally, the use of covenants changes significantly over time, and additionally, there are covenant-type-specific developments and common trends across all covenants. We find a reduction in covenant usage just before and during the onset of the financial crisis. Thereafter, inclusion rates increase significantly with different patterns for the three covenant types. In line with covenant prices, we observe a reduction in covenant inclusion at the end of our time series. Overall, we find trends related to changes in covenant prices. However, these changes appear as long-term trends and not as short-term reactions.

When analyzing the inclusion frequency of individual covenant types, event covenants experience a steady increase from roughly 60% at the beginning of our sample, with reduced inclusion during the onset of the crisis and usage in nearly every bond issued from 2011 onward, which drops to 80% at the end of the sample. On the other hand, we see that nearly all bonds include financial and investment covenants initially, but this ratio decreases steadily to 65%. Then, the inclusion rates increase to 95% and fall again from 2015 onward. Overall, these patterns share certain similarities with the covenant price developments depicted in Figure 1.

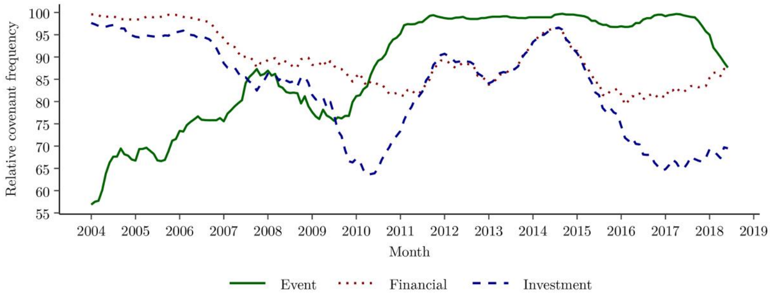

Figure 5
Covenant frequencies over time
This graph shows the relative inclusion frequencies of the different covenant types in newly issued bonds over the last year on a monthly frequency from 2004 until 2018Q2. The proportions of the event covenants are depicted in solid green; financial, in dotted red; and investment, in dashed blue.

Nevertheless, finding an identification strategy for the inclusion frequencies is challenging as bond issuance decisions are not frequent events for the average firm. The typical firm will roll over debt and, thus, will consider the market conditions at that time. In addition, issuing a new bond is a time-consuming process. Thus, managers will not react to short-term covenant price changes but will instead observe the general price levels when deciding on a new bond's covenant structure. Thus, a contemporaneous comparison of covenant prices and inclusion rates will not provide any significant relation.

To investigate the relation between the prices of covenants and their relative inclusion frequencies, we compare the prices of a quarter with the inclusion rates within the next year and the next two years. To analyze the observed long-term changes, we split the time series into smaller windows. In Table 8, we show the average covenant price for each covenant type and time period. This numerical exercise reveals a positive correlation between covenant prices and the inclusion of the respective covenant type in newly issued bonds over the following years. Especially, analyzing a 2-year lag shows a difference before and after the onset of the crisis. For each covenant type, we find an increase in covenant prices and significantly higher inclusion rates. Thus, firms consider the reduction in bond yields more beneficial than the restrictions imposed by the covenants in this time period, indicating that not only risk factors changed, but also the price of risk increased. This is also in line with the results of Bradley and Roberts (2015), who find that loans include covenants more often during recessionary periods. In the subsequent period (2011 to 2014), covenant prices and inclusion rates are both high. For investment and financial covenants, we find a drop in both variables for the last period. Overall, there seems to be a relation between covenant prices and inclusion frequencies when considering long-term trends. Nevertheless, there is no contemporaneous, short-term relation between covenants' price effects and their usage.

Table 8
Relative covenant frequencies and covenant prices

A. Event covenants

	2006 - 2008	2009 - 2010	2011 - 2014	2015 - 2016
Price	0.059	0.178	0.238	0.281
Frequency +1y	0.81	0.97	0.98	0.98
Frequency +2y	0.84	0.99	0.99	0.91

B. Financial covenants

	2006 - 2008	2009 - 2010	2011 - 2014	2015 - 2016
Price	0.137	0.380	0.229	0.105
Frequency +1y	0.88	0.85	0.88	0.82
Frequency +2y	0.85	0.87	0.87	0.84

C. Investment covenants

	2006 - 2008	2009 - 2010	2011 - 2014	2015 - 2016
Price	0.157	0.233	0.255	0.162
Frequency +1y	0.78	0.81	0.87	0.66
Frequency +2y	0.74	0.88	0.82	0.68

This table shows the average covenant price (in percent) and the relative frequency of covenants in new bond issues for different time periods. In each panel, we consider the covenant price in the first row (column names indicate the respective periods) and 1- and 2-year forward-looking relative covenant frequencies in the subsequent rows. We present averages for event covenants in panel A, financial covenants in panel B, and investment covenants in panel C.

6. Conclusion

In this paper, we show that covenant provisions are important contractual features and have significant relevance for the prices of U.S. corporate bonds. We develop a novel empirical methodology to analyze the price impact of covenants and derive a large sample of covenant prices. Our price estimates are based on detailed transaction data and, when compared to the existing literature, are not restricted to issuance prices.

We find that the inclusion of an additional covenant type reduces bond yields by 18 bps on average. Covenant prices increase significantly during the financial crisis and the subsequent period, spiking to around 40 to 80 bps depending on the covenant type. In this time period, covenant prices amount to roughly 5% of the overall average bond yields. Our analysis contributes to the literature by analyzing the effects of bond-, market, and firm-specific drivers of covenant prices. We find higher covenant prices for riskier bonds; that is, covenant prices increase with interest rate, credit, and liquidity risk. Furthermore, we demonstrate that market-wide measures as well as macroeconomic variables indicating economic downturns are linked to increasing covenant prices. Thus, covenants are more important in times when the risk of capital outflow, risk-shifting, and claim dilution is exceptionally high.

Considering firm-specific variables, we find that investors pay higher prices for covenants included in bonds issued by growth firms, smaller firms, and firms with more tangible assets. Finally, we find supportive evidence for a link between long-term changes in covenant prices and subsequent covenant inclusion frequencies in newly issued bonds. Overall, we confirm the theoretical predictions that covenant prices are dynamically driven by a combination of idiosyncratic and market factors. These new aspects are relevant for future research on capital structure choices as well as fixed-income pricing.

Author notes

Authors have furnished an Internet Appendix, which is available on the Oxford University Press Web site next to the link to the final published paper online.

Appendix. Variable Definitions

In this part, we define the main variables used in this paper. We first specify the price and liquidity variables before we move to the equity and accounting metrics. Finally, we discuss the constituents of the four covenant types.

A.1 Price and liquidity variables

The weekly *volume-weighted price* $\bar{p}$ for bond i in week t is given by

$$\bar{p}_{i,t} = \frac{\sum_{k=1}^{K_{i,t}} p_{i,t,k} v_{i,t,k}}{\sum_{k=1}^{K_{i,t}} v_{i,t,k}}, \tag{A1}$$

where $K_{i,t}$ denotes the number of trades for bond i in the given week; $p_{i,t,k}$, the prices of these trades; and $v_{i,t,k}$, the respective volumes.

The *Roll measure* for bond i in week t is defined as

$$\text{Roll}_{i,t} = 2 \cdot \sqrt{-Cov(\Delta p_{i,t,k}; \Delta p_{i,t,k-1})}, \tag{A2}$$

where $\Delta p_{i,t,k}$ denotes the price change between the consecutive observations k and $k-1$. Note that the measure is only defined if the autocorrelation is negative.

The *Amihud measure* for bond i in week t is defined as

$$\text{Amihud}_{i,t} = \frac{1}{K_{i,t}} \cdot \sum_{k=1}^{K_{i,t}} \frac{|r_{i,t,k}|}{v_{i,t,k}}, \tag{A3}$$

where $r_{i,t,k}$ is the return with respect to to the last price implied by trade k.

The *Price dispersion measure* for bond i in week t is defined as

$$\text{Price Dispersion}_{i,t} = \sqrt{\frac{1}{\sum_{k=1}^{K_{i,t}} v_{i,t,k}} \sum_{k=1}^{K_{i,t}} (p_{i,t,k} - m_{i,t})^2 \cdot v_{i,t,k}}, \tag{A4}$$

where the fundamental price $m_{i,t}$ is approximated by the volume-weighted price $\bar{p}_{i,t}$.

A.2 Equity and accounting variables

A set of accounting and equity market variables are used in our analysis. We define them in this section by showing their formulas in terms of CRSP and Compustat variables, which we detail in Table A1. Due to space considerations, we show all of the aforementioned variables in the following list:

Table A1
Compustat variables

Abbreviation	Description
at	Assets - total
csho	Common shares outstanding
dlc	Debt in current liabilities
dltt	Long-term debt
ppent	Property plant and equipment–total (net)
prcc_f	Price Close
pstk	Preferred/preference stock (capital)
pstkl	Preferred stock liquidating value (only annual)
pstkrv	Preferred stock redemption value (only annual)
seq	Stockholders' equity
txditc	Deferred taxes and investment credit
be	= seq - pstkl (Use pstkrv or pstk alternatively.) + txditc
me	= prcc_f × csho

The abbreviations from Compustat are matched with the description of the respective item. At the bottom, we list two variables that are computed from Compustat variables.

- *Market-to-book* (=(at-be+me)/at),
- *Firm size* (=log(at)),
- *Leverage* (= (dltt + dlc)/(be)),
- *Tangibility* (=ppent/at),
- *Beta* from rolling CAPM regressions using a sample of daily returns over one year,
- *Abnormal earnings* (=(epspx$_{t+1}$-epspx$_t$)/prcc_f),
- *Asset maturity* (=(1-act/at)*(ppegt/dp) + (act/at)*(act/cogs)),
- *Altman Z* as an indicator equal to one if the Z score is below 1.81 (Z score = 3.3*(ebit/at) + 1.0*(sale/at) + 1.4*(re/at) + 1.2*(wcap/at) + 0.6*(me/(dlc+dltt))),
- *Interest coverage* (=(oiadp+xint)/xint),
- *Retained earnings* (=re/at)), and
- *Cash balance* (=che/at).

A.3 Covenant type definitions

We provide the exact definitions for the covenant types in Table A2 using the respective variable name from the Mergent FISD database. We specify the individual covenants that are grouped into each covenant type by following Chava, Kumar, and Warga (2010).

Table A2
Covenant type constituents

Type	Covenant	Type	Covenant
Dividend		**Investment**	
	dividends_related_payments_is		after_acquired_property_clause
	dividends_related_payments_sub		asset_sale_clause
	restricted_payments		consolidation_merger
Event			fixed_charge_coverage_is
	change_control_put_provisions		fixed_charge_coverage_sub
	cross_default		investments
	cross_acceleration		investments_unrestricted_subs
	declining_net_worth		maintenance_net_worth
	rating_decline_trigger_put		sale_xfer_assets_unrestricted
Financial			security_pledge
	borrowing_restricted		stock_transfer_sale_disp
	funded_debt_is		subsidiary_redesignation
	funded_debt_sub		transaction_affiliates
	indebtedness_is		
	indebtedness_sub		
	leverage_test_is		
	leverage_test_sub		
	liens_is		
	liens_sub		
	negative_pledge_covenant		
	net_earnings_test_issuance		
	preferred_stock_issuance		
	refund_protection		
	sale_assets		
	sales_leaseback_is		
	sales_leaseback_sub		
	senior_debt_issuance		
	stock_issuance		
	stock_issuance_issuer		
	subordinated_debt_issuance		
	subsidiary_guarantee		

This table shows which covenants are included in the four covenant types: dividend, event, financial, and investment in terms of their related Mergent FISD code.

The replication code is available in the Harvard Dataverse at https://doi.org/10.7910/DVN/IP6CY4.

References

Aghion, P., and P. Bolton. 1992. An incomplete contracts approach to financial contracting. *Review of Economic Studies* 59:473–94.

Amihud, Y. 2002. Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets* 5:31–56.

Asquith, P., R. Gertner, and D. Scharfstein. 1994. Anatomy of financial distress: An examination of junk-bond issuers. *Quarterly Journal of Economics* 109:625–58.

Ayotte, K. M., and E. R. Morrison. 2009. Creditor control and conflict in Chapter 11. *Journal of Legal Analysis* 1:511–51.

Baird, D. G., and R. K. Rasmussen. 2006. Private debt and the missing lever of corporate governance. *University of Pennsylvania Law Review* 154:1209–51.

Beatty, A., S. Liao, and J. Weber. 2012. Evidence on the determinants and economic consequences of delegated monitoring. *Journal of Accounting and Economics* 53:555 – 576.

Becker, B., and V. Ivashina. 2016. Covenant-light contracts and creditor coordination. *Working Paper: Riksbank Research Paper Series* .

Bessembinder, H., K. M. Kahle, W. F. Maxwell, and D. Xu. 2009. Measuring abnormal bond performance. *Review of Financial Studies* 22:4219–58.

Billet, M. T., T.-H. D. King, and D. C. Mauer. 2007. Growth opportunities and the choice of leverage, debt maturity, and covenants. *Journal of Finance* 62:697–730.

Black, F., and J. C. Cox. 1976. Valuing corporate securities: Some effects of bond indenture provisions. *Journal of Finance* 31:351–67.

Bolton, P., and D. S. Scharfstein. 1996. Optimal debt structure and the number of creditors. *Journal of Political Economy* 104:1–25.

Bradley, M., and M. R. Roberts. 2015. The structure and pricing of corporate debt covenants. *Quarterly Journal of Finance* 5:1550001–137.

Chava, S., P. Kumar, and A. Warga. 2010. Managerial agency and bond covenants. *Review of Financial Studies* 23:1120–48.

Chava, S., and M. R. Roberts. 2008. How does financing impact investment? The role of debt covenants. *Journal of Finance* 63:2085–121.

Childs, P. D., S. H. Ott, and T. J. Riddiough. 1996. The value of recourse and cross-default clauses in commercial mortgage contracting. *Journal of Banking & Finance* 20:511 – 536.

Christensen, H. B., and V. V. Nikolaev. 2012. Capital versus performance covenants in debt contracts. *Journal of Accounting Research* 50:75–116.

Cleveland, W. S., and S. J. Devlin. 1988. Locally weighted regression: An approach to regression analysis by local fitting. *Journal of the American Statistical Association* 83:596–610.

Denis, D. J., and V. T. Mihov. 2003. The choice among bank debt, non-bank private debt, and public debt: Evidence from new corporate borrowings. *Journal of Financial Economics* 70:3 – 28.

Diamond, D. W. 1984. Financial intermediation and delegated monitoring. *Review of Economic Studies* 51:393–414.

Dichev, I. D., and D. J. Skinner. 2002. Large-sample evidence on the debt covenant hypothesis. *Journal of Accounting Research* 40:1091–123.

Dick-Nielsen, J. 2009. Liquidity biases in TRACE. *Journal of Fixed Income* 19:43–55.

Gilson, S. C. 1990. Bankruptcy, boards, banks, and blockholders: Evidence on changes in corporate ownership and control when firms default. *Journal of Financial Economics* 27:355–87.

———. 1997. Transactions costs and capital structure choice: Evidence from financially distressed firms. *Journal of Finance* 52:161–96.

Hart, O., and J. Moore. 1998. Default and renegotiation: A dynamic model of debt. *Quarterly Journal of Economics* 113:1–41.

Jankowitsch, R., A. Nashikkar, and M. G. Subrahmanyam. 2011. Price dispersion in otc markets: A new measure of liquidity. *Journal of Banking & Finance* 35:343 – 357.

Jankowitsch, R., G. Ottonello, and M. G. Subrahmanyam. 2022. Regulation, asset complexity and the informativeness of credit ratings. *Review of Corporate Finance Studies* .

Jensen, M. C., and W. H. Meckling. 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3:305–60.

Leland, H. E. 1994. Corporate debt value, bond covenants, and optimal capital structure. *Journal of Finance* 49:1213–52.

——— 1998. Agency costs, risk management, and capital structure. *Journal of Finance* 53:1213–43.

Li, N., Y. Lou, and F. P. Vasvari. 2015. Default clauses in debt contracts. *Review of Accounting Studies* 20:1596–637.

Lou, Y., and C. A. Otto. 2020. Debt heterogeneity and covenants. *Management Science* 66:70–92.

Malitz, I. 1986. On financial contracting: The determinants of bond covenants. *Financial Management* 18–25.

Mansi, S. A., Y. Qi, and J. K. Wald. 2021. Bond covenants, bankruptcy risk, and the cost of debt. *Journal of Corporate Finance* 66:101799–.

Mauer, D. C., and A. J. Triantis. 1994. Interactions of corporate financing and investment decisions: A dynamic framework. *Journal of Finance* 49:1253–77.

Meese, R., and N. Wallace. 1991. Nonparametric estimation of dynamic hedonic price models and the construction of residential housing price indices. *Real Estate Economics* 19:308–32.

Miller, D. P., and N. Reisel. 2012. Do country-level investor protections affect security-level contract design? Evidence from foreign bond covenants. *Review of Financial Studies* 25:408–38.

Nagler, F., and G. Ottonello. 2022. Inventory-constrained underwriters and corporate bond offerings. *Review of Asset Pricing Studies* 12:639–66.

Nash, R. C., J. M. Netter, and A. B. Poulsen. 2003. Determinants of contractual relations between shareholders and bondholders: Investment opportunities and restrictive covenants. *Journal of Corporate Finance* 9:201–32.

Nini, G., D. C. Smith, and A. Sufi. 2009. Creditor control rights and firm investment policy. *Journal of Financial Economics* 92:400–20.

———. 2012. Creditor control rights, corporate governance, and firm value. *Review of Financial Studies* 25:1713–61.

Prilmeier, R. 2017. Why do loans contain covenants? Evidence from lending relationships. *Journal of Financial Economics* 123:558–79.

Ramakrishnan, R. T., and A. V. Thakor. 1984. Information reliability and a theory of financial intermediation. *Review of Economic Studies* 51:415–32.

Reisel, N. 2014. On the value of restrictive covenants: Empirical investigation of public bond issues. *Journal of Corporate Finance* 27:251–68.

Roberts, M. R., and A. Sufi. 2009. Control rights and capital structure: An empirical investigation. *Journal of Finance* 64:1657–95.

Roll, R. 1984. A simple implicit measure of the effective bid-ask spread in an efficient market. *Journal of Finance* 39:1127–39.

Scheuch, C., S. Voigt, and P. Weiss. 2023. *Tidy finance with R*. Boca Raton, FL: CRC Press.

Scheuch, C., S. Voigt, P. Weiss, and C. Frey. 2024. *Tidy Finance with Python*. NY: Chapman and Hall/CRC.

Simpson, M. W., and A. Grossmann. 2017. The value of restrictive covenants in the changing bond market dynamics before and after the financial crisis. *Journal of Corporate Finance* 46:307–19.

Smith, J. C. W., and J. B. Warner. 1979. On financial contracting: An analysis of bond covenants. *Journal of Financial Economics* 7:117–61.

Spiegel, M., and L. Starks. 2016. Institutional rigidities and bond returns around rating changes. *Working Paper* .

Stulz, R. M., and H. Johnson. 1985. An analysis of secured debt. *Journal of Financial Economics* 14:501 – 521.

Sufi, A. 2009. Bank lines of credit in corporate finance: An empirical analysis. *Review of Financial Studies* 22:1057–88.

Sweeney, A. P. 1994. Debt-covenant violations and managers' accounting responses. *Journal of Accounting and Economics* 17:281 – 308.

Theussl, S., F. Schwendinger, and K. Hornik. 2020. ROI: An extensible R optimization infrastructure. *Journal of Statistical Software, Articles* 94:1–64.

Titman, S., and W. Torous. 1989. Valuing commercial mortgages: An empirical investigation of the contingent-claims approach to pricing risky debt. *Journal of Finance* 44:345–73.

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