The Hidden Cost of Financial Derivatives: Options Trading and the Cost of Debt*

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ABSTRACT

We investigate the extent to which firms' cost of debt may be affected by the presence of an active options market for the stock. Our baseline results reveal a detrimental effect of options trading volume on bond yield spreads and bond credit ratings. Specifically, a one-standard-deviation increase in options trading volume from its mean is associated with a 10-basis-point increase in the bond at-issue yield spread. We discuss the potential underlying mechanisms and provide suggestive evidence of this effect via the exacerbation of shareholder-bondholder conflicts. Finally, using several econometric specifications and instrumental variables analysis, we argue that the nature of the effect is causal.

KEYWORDS: cost of debt, options trading, expropriation risk,firm default, takeover vulnerability.

JEL Classification: G12, G23, G24, G31, G33

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1. Introduction

Despite the exponential growth of total equity option volume traded in the U.S., from 676 million contracts in 2000 to over 3,727 million contracts in 2015 [1], there is still considerable disagreement about the real effects of these instruments on the underlying firms. On the one hand, options can act as a managerial discipline mechanism that increases stock price informativeness, thus better reflecting fundamentals. In a seminal paper, Holmström and Tirole (1993) explore the active role of price informativeness in disciplining managers and incentivizing them to engage in value-increasing activities that ultimately benefit shareholders and debtholders. On the other hand, we argue that an active options market exacerbates the classic conflict of interest between shareholders and debtholders by providing the former with a powerful instrument to expropriate the latter. A more liquid options market for the stock allows shareholders to extract high trading gains from certain situations, altering shareholders risk-taking incentives in a way that should consequently be priced by debtholders. Take, for instance, the case of Jana Partners LLC, a multi-billion-dollar hedge fund, and CNet, the telecommunications company. By late December 2007, Jana had accumulated a large economic interest in CNet via an 8% voting interest (through common shares of the company) and an additional 8% of non-voting rights through derivative markets. In January 2008, Jana partnered with Sandell Asset Management (who had 5% economic interest in CNet through derivatives) to takeover CNet's board and gain majority control. The telecommunications company fought back this takeover attempt, leading to a controversial lawsuit between the parties that some voices interpreted as Jana pulling a public relations stunt to put pressure on the board so that a third party came in with a takeover [2]. These concerns were proven right when in May of the same year CBS Corporation bought CNet for $1.8 billion. The bid price was $11.50 a share (Jana valued it at $11 short before), a premium of 44% relative to the last market price ($7.95). Jana and its partners tendered their shares to the bidder, earning a huge profit in both stock and derivative markets.

These conflicting channels of influence raise an interesting empirical question regarding how bondholders, an important group of claimholders in the capital structure, view an active option market. In this paper, we address this open empirical question. Specifically, we study whether the volume of equity options written on the underlying asset increases

[1] Data from Options Clearing Corporation: http://www.optionsclearing.com/webapps/historical-volume-query.

[2] See, for example, 'What is Jana doing?' by Andrew Ross Sorkin, The New York Times, February 7th, 2008.

or reduces firms' cost of debt. We find that a one-standard-deviation increase in options trading volume from its mean is associated with a 10-basis-point increase in the bond at-issue yield spread.

We examine in detail the reasons for and mechanisms driving these results. Our starting point is the recognition that active options markets alter the incentives for market participants to gather private information and that trading on such information makes stock prices more efficient (e.g., Cao, 1999; Chakravarty, Gulen, and Mayhew, 2004; Pan and Poteshman, 2006). However, the benefit to informed traders from options markets should depend on the volume of option trading activity because illiquid markets hamper not only informed but also uniformed traders. Accordingly, the informational benefit goes beyond the effect of the mere existence of an options market on the firm's stock and should be related to whether the market for the listed options has sufficient volume, as informed traders' incentives to trade are higher in high-volume markets (Pagano, 1989; Admati and Pfleiderer, 1988). Taken together, these works provide strong support for the conjecture that informational efficiency may be greater in highly liquid options markets. Because prices play an active role (i.e., managers learn from prices) when managerial decisions are made (Dow and Gorton, 1997; Faure-Grimaud and Gromb, 2004; Chen, Goldstein, and Jiang, 2007), greater price efficiency should serve as a more effective disciplining mechanism, mitigating the classic moral hazard problem between management and shareholders. Under this argument, stock prices reflecting more information about firms' fundamentals not only mitigate the agency problem between management and shareholders but also reduce the information asymmetry between shareholders and debtholders, which should ultimately facilitate firm financing.

Opposite to the beneficial effect stated above, there is also a more pessimistic view of the effect of options from a bondholder perspective. Active options markets can exacerbate the expropriation of bondholder wealth from shareholders. Specifically, options allow investors, including current shareholders [3], to extract high trading gains from certain events, with especially detrimental effects on bondholders' welfare.

A particular concern arises when a shift in control from shareholders to creditors is

[3]Although several restrictions on free trading in derivative markets apply to a firm's shareholders, strict requirements and prohibitions primarily affect corporate insiders, defined by the SEC as a company's officers and directors and any beneficial owners of more than ten percent of a class of the company's equity securities registered under Section 12 of the Securities Exchange Act of 1934. Any shareholder not falling into these categories faces no constraints whatsoever on engaging in, for example, options trading. The literature has documented widespread use of financial derivatives such as options by large institutional investors, including mutual funds (Koski and Pontiff, 1999) and hedge funds (Aragon and Martin, 2012).

imminent as, for instance, in the event of financial distress (Borisova, Fotak, Holland, and Megginson, 2015). In the event of default, creditors become the new owners through the distribution of stock in restructuring, thereby increasing the likelihood of bondholders being expropiated by shareholders. An additional concern arises in the case of acquisitions and disciplinary takeovers. Takeovers can benefit target shareholders but also harm the target bondholders by adding more debt to the firm, thereby reducing the value of the outstanding bonds not only by increasing the probability and deadweight costs of a possible future bankruptcy but also by reordering the priority of claims in bankruptcy (Cremers, Nair, and Wei, 2007). The literature provides extensive theoretical and empirical evidence supporting the use of options by shareholders in advance of banrupcy fillings and takeovers, to the detriment of bondholders. Back (1993) argues that informed traders may prefer to trade options rather than stocks because of increased opportunities for leverage. Cao (1999) concludes that agents with information about future contingencies should be able to trade more effectively on their information in the presence of options, and Easley, O'Hara, and Srinivas (1998) provide theoretical evidence that informed traders may choose the options market to capitalize on their private information, benefiting from the higher leverage and liquidity in the options market; therefore, informed traders also may trade in the options market before extreme corporate events to benefit from option features. More recently, Ge, Hu, Humphery-Jenner, and Lin (2016a) empirically show how informed traders also exploit options markets before the event of bankruptcy filing. They find that the volume of options to stock ratio (O/S) measured from Roll, Schwartz, and Subrahmanyam (2010), computed over the interval from two days to four days before the bankruptcy filing, is significantly and negatively related to bankruptcy filing returns. In particular, they show how a one-standard-deviation increase in O/S is associated with a 10.84-percentage-point decrease in bankruptcy announcement returns. The last empirical result indicates a direct channel for shareholders to improve their payoff in the extreme case of bankruptcy. These works conclude that shareholders can significantly improve their expected payoff in the event of default by directly leveraging options' features, which could even favor strategic default decisions. Shareholders may default for solvency reasons, as well for strategic reasons (Favara, Schroth, and Valta, 2012). Thus, as a firm becomes seriously distressed, increasing shareholder control can affect managerial decisions in a way that not only augments the shareholders' expected payoff in the event of default but also contributes to the ability to anticipate the timing of default (Feldhütter, Hotchkiss, and Karakaş, 2016). The other important corporate event from a bondholder perspective is when a merger or acquisition take place.

In this vein, Chan, Ge, and Lin (2015) find that the implied volatility spread and implied volatility skew have significant predictability for acquirer announcement returns in mergers and acquisitions, and Cao, Chen, and Griffin (2005) show that the call option volume imbalance has a positive relationship with target firm announcement returns in takeovers. Both empirical studies suggest that options are also used to take advantage before takeovers, providing shareholders with an effective instrument to profit from these corporate events. Although we have focused thus far on the direct use of options as potential expropiation instruments, the mere fact of the existence of a liquid option market constitutes a clear threat of being expropiated by shareholders that should be priced, accordingly, by bondholders.

Combining all of these considerations, it is apparent that the net impact of options markets on the cost of debt is theoretically unclear and ultimately an empirical issue. To resolve this ambiguity, we assemble a rich and original data set containing information on bond issues, firm-specific characteristics and options trading data. To approximate the total quarterly dollar options volume, we use the approach proposed by Roll, Schwartz, and Subrahmanyam (2009). We run panel data regressions on a sample of 4,330 bond issues by 808 different publicly traded U.S. firms during the period from 1996 to 2014.

Our baseline test reveals a detrimental effect of options trading volume on a firm's cost of debt. In particular, a more liquid option market is related to higher yield spreads over treasuries and lower bond credit ratings. These results are robust to using alternative subsamples and alternative measures of the cost of debt, the inclusion of a wide range of control variables and several econometric models.

While these findings are consistent with options markets having a net detrimental effect on bond yields and credit ratings, by augmenting the conflict of interest between shareholders and bondholders, we are concerned that our results could be explained by an alternative interpretation. This is the case if our results are totally driven by options investors trading in advance of bond issues to profit from companies with a more uncertain short-term future and, hence, costlier debt financing. Although the last argument implicitly assumes weak expected company, or stock market price, short-term behavior, options traders could benefit from options even if short-term expectations are not negative. For instance, options are a mechanism for trading on information about future equity volatility, which allows investors with information about short-term stock price volatility to benefit from options (Ni et al., 2008). Both stories support the interpretation of options traders anticipating a company's short-term market behavior after bond issues, thus, challenging our main argument suggesting an exacerbation of the classical

conflict of interest between shareholders and bondholders.

To account for such selection issues, we extend our baseline specification in several ways. First, we estimate two-stage least squares (2SLS) models using moneyness and open interest as instrumental variables (Roll, Schwartz, and Subrahmanyam, 2009; Blanco and Wehrheim, 2017). Our identification strategies suggest that the detrimental association between options trading and the cost of debt is not simply driven by self-selection. Second, to avoid the possibility that our results are driven by investors more heavily trading options on highly distressed firms, we include specific proxies for firm distress in our regression specification, and we run our baseline regressions by firm distress quartiles and perform quantile regressions. Overall, we show that the negative impact of options trading on a firm's cost of debt is not totally explained by traders anticipating future firm distress, nor is neither concentrated in highly distressed firms. Moreover, we explore the effect of option trading volume on short-term firm value and stock price behavior after bond issues. We show that the detrimental impact of options on the firm's cost of debt is not caused by traders anticipating short-term negative firm or stock price evolution. Finally, we show how the inimical effect of options trading over the cost of debt remains economically and statistically significant after considering time-series yield spreads instead of bond issues. The results are also robust to the inclusion of bond fixed effects.

To address additional potential concerns about our findings, we revisit these results to provide a better understanding of the mechanisms driving them. Specifically, we investigate the intensity of the effect in different scenarios in which our hypothesis predicts option markets have a stronger detrimental effect on firms' cost of debt. First, we focus on the two previously mentioned corporate events, takeovers and firm defaults, that the literature identifies as detrimental to bondholders' welfare (Cremers, Nair, and Wei, 2007; Qiu and Yu, 2009) but are potentially profitable for option traders (Cao, Chen, and Griffin, 2005; Chan, Ge, and Lin, 2015; Ge, Hu, Humphery-Jenner, and Lin, 2016a). The effect of options volume on firm cost of debt is more pronounced when the firm is more financially distressed, or closer to experiencing default, and more open to the market for corporate control (more likely to experience a takeover). Second, we assess how the type of shareholder influences our results. Consistent with our main story, we find that the effect is amplified when the proportion of dedicated owners (Bushee, 1998), which have greater incentives to be informed about firm fundamentals and to influence managerial decisions, is higher. Finally, we explore the case of debt renegotiation. When shareholders have advantages over debtholders in renegotiation, bondholders' expropriation risk increases as

the threat of strategic default intensifies (Garlappi, Shu, and Yan, 2008; Favara, Schroth, and Valta, 2012). Options are particularly damaging for bondholders when shareholders' incentives for default and bargaining power are higher. In summary, these results provide compelling evidence regarding the role of option markets inducing shareholders to act to the detriment of bondholders' interests.

Our paper makes several contributions to the literature. First, to the best of our knowledge, it is the first study to specifically examine the real effect of financial derivatives on the firm's cost of debt. In this vein, there is a growing literature that empirically explores the effects of financial derivatives on the real economy. Roll, Schwartz, and Subrahmanyam (2009) show that options trading is positively associated with firm value and price informativeness, Blanco and Wehrheim (2017) find a positive association between options trading volume and firm innovation, and Naiker, Navissi, and Truong (2013) show how high-volume options markets reduce the cost of equity.

Second, we contribute to the understanding of the determinants of the cost of debt. While there is a vast literature studying the determinants of corporate bond spreads, such an analysis of the relationship between options trading and the firm's cost of debt has not previously been undertaken. Empirical studies have examined, for instance, the effect of liquidity (Odders-White and Ready, 2006), competition (Valta, 2012), government ownership (Borisova, Fotak, Holland, and Megginson, 2015), an open market for corporate control (Qiu and Yu, 2009), political rights (Qi, Roth, and Wald, 2010) or strategic ownership (Aslan and Kumar, 2012).

Third, our paper builds on a recent empirical literature showing that options trading contains information on several important upcoming corporate events, such as earnings announcements (Easley, O'Hara, and Srinivas, 1998; Roll, Schwartz, and Subrahmanyam, 2010; Johnson and So, 2012), takeovers (Cao, Chen, and Griffin, 2005; Chan, Ge, and Lin, 2015; Augustin, Brenner, and Subrahmanyam, 2015) and bankruptcy fillings (Ge, Lin, and Pearson, 2016b). In addition, Poteshman (2006) investigates unusual put option buying before the terrorist attack of September 11, 2001, finding informed trading in the options market for two airline companies prior to the attack. This study empirically explores the direct economic consequencies of the potential use of options by shareholders at the expense of bondholder interests.

Finally, we also enrich the debate on the regulation of financial derivatives. Unlike stock market listings, where firms apply, options listings are exogenous to firm decisions; they are made within exchanges. These exchanges are self-regulating institutions that are members of the Options Clearing Corporation (OCC), which operates under the juris-

diction of the Securities and Exchange Commission (SEC) (for exchange-listed options). Because the SEC plays an important role in determining the eligibility criteria for securities in options trading (Mayhew and Mihov, 2004), this topic is of particular interest to policy makers.

The remainder of the paper is organized as follows. Section 2. describes the sample, the measurement of variables and descriptive statistics. Section 3. presents our main results. We perform a rich set of robustness tests in Section 4.. In Section 5., we discuss the underlying mechanism through which options trading may affect the cost of debt. Section 6. concludes the paper.

2. Data and methodology

We compile information on bond issues, firm-specific characteristics and options trading data from a variety of sources. Detailed definitions of all variables and their sources are provided in Appendix A. We begin by extracting bond-level data from the Thomson Reuters SDC Platinum Global New Issues Database. Our main focus is on new issues, rather than secondary market quotes, as they provide direct and more accurate measures of the cost of debt (e.g., Datta, Iskandar-Datta, and Patel, 1999; Elton, Gruber, Agrawal, and Mann, 2001; Maxwell and Stephens, 2003; Qi, Roth, and Wald, 2010; Francis, Hasan, John, and Waisman, 2010). We limit our sample to U.S. companies and issues of fixed-rate [4] corporate bonds defined in U.S. dollars over the period 1996-2014 [5]. In addition to our measures of the cost of debt (bond rating and yield spread), we retrieve from the SDC Global New Issues data on bond *maturity* and *principal* amount, and we construct two dummy variables that indicate whether the bond is *callable*[6] and *public*. These variables have previously been successfully used as determinants of the cost of debt [7].

We measure a firm's cost of debt using the bond yield spread and bond rating. Both metrics are standard in the literature and provide direct values of the real cost incurred

[4]We retrieve bond issues for fixed and floating rate bonds from SDC Global New Issues. After applying all filters, floating bond issues represent less than 6.5% of all bonds. Given this small amount, the greater difficulty of properly assessing yields to maturity on floating bonds with different complex benchmarks, and for the sake of homogeneity in our main sample, we decide to drop issues of floating rate bonds. In any case, when we add this small sample, the results remain qualitatively intact. These results are available from the authors upon request.

[5]Options Metrics data coverage starts in 1996.

[6]There are no putable bonds in the sample once we apply all filters.

[7]See, among others, Qiu and Yu (2009),Qi, Roth, and Wald (2010), Francis, Hasan, John, and Waisman (2010) or Borisova, Fotak, Holland, and Megginson (2015).

by firms to access debt financing via bond markets. Our first measure of the cost of debt is the bond yield spread at the time of bond issue. Following Cremers, Nair, and Wei (2007) and Qiu and Yu (2009), we calculate the yield spread as the difference between the bond's yield to maturity and the Treasury bond yield with the same maturity. We collect constant maturity Treasury yields from the Federal Reserve H-15 Release for the six-month, one-year, three-year, five-year, seven-year, 10-year, 20-year and 30-year maturities. In the few cases in which there is not a maturity-equivalent Treasury bond, we use linear interpolation between the two closest maturities to calculate the yield of the risk-free bond [8].

Alternatively, we use bond ratings to capture the perceived risk of a bond. To measure these ratings, we rely on the Standard and Poor's rating reported by SDC [9]. We convert the traditional bond rating by S&P into a numerical scale, where lower values correspond to poorer ratings [10] and vice versa.

For data on options trading activity, we use Option Metrics. This database contains information on daily put and call contracts traded for each individual stock along with bid and ask closing prices from 1996 onward. To define our measure of options volume, we follow Roll, Schwartz, and Subrahmanyam (2009). We first multiply the total trade in each option by the end-of-day quote midpoint for that option. Next, we aggregate this number quarterly across all trading days and all options on the listed stock. We construct this variable, which we call *Options Volume*, for the quarter prior to that of bond issuance [11].

Existing empirical research on structural credit risk modeling and market microstructure finds a significant role of firm-specific characteristics in determining the cost of debt (Collin-Dufresne, Goldstein, and Martin, 2001; Campbell and Taksler, 2003; Odders-White and Ready, 2006; Avramov, Jostova, and Philipov, 2007; Ericsson, Jacobs, Oviedo, et al., 2009; Qiu and Yu, 2009). To control for these effects, we gather firm-specific data

[8] There are more complex methods for interpolating a piece-wise term structure. However, there is no reason to believe that our approach poses a problem. Most of our bonds either match a maturity-equivalent treasury or have maturities within one year of an existing Treasury.

[9] Whereas other agencies such Moody's also provide with individual bond ratings, Standard and Poor's is the standard in recent literature (Qiu and Yu, 2009; Qi, Roth, and Wald, 2010; Borisova, Fotak, Holland, and Megginson, 2015).

[10] The complete numerical scale is as follows: 1-CCC-, 2-CCC, 3-CCC+, 4-B-, 5-B, 6-B+, 7-BB-, 8-BB, 9-BB+, 10-BBB-, 11-BBB, 12-BBB+, 13-A-, 14-A, 15-A+, 16-AA-, 17-AA, 18-AA+, 19-AAA-, 20-AAA, 21-AAA+.

[11] We set the value of *Options Volume* equal to zero when the firm is not quoted in the options market. Although firms not listed in options markets could be idiosyncratic and should be treated with caution (Mayhew and Mihov, 2004), only two observations in our final sample have options volume equal to zero. The results remain completely unchanged when excluding these observations.

from CRSP-Compustat Merged (CCM) on the quarter prior to bond issuance. Specifically, we collect data to construct the following variables: *Size* (as the log of total assets), return on assets or *ROA* (net income over total assets), *Leverage* (total debt divided by total assets), growth opportunities as proxied by *Tobin's Q* (sum of the market capitalization of a firm's common equity, liquidation value of its preferred shares and the book value of debt, divided by book value of assets), relative *Bid-ask spread*, and *Firm risk* (as proxied by the standard deviation of a firm's quarterly cash-flow during previous year [12]). We drop firms that have missing observations for the quarter of interest in any of these variables and require them to be reporting to the CRSP database for at least two years, to mitigate back-filling bias. We remove from our sample firms that are not quoted in the three major American markets (Amex, NYSE, or Nasdaq). Finally, we exclude financial firms (Standard Industry Classification (SIC) code 6000-6999)[13], as their leverage may be influenced by their idiosyncrasy, and their debt-like liabilities are not strictly comparable to those of non-financial firms (Rajan and Zingales, 1995). In line with existing literature, all variables are winsorized at the 1st and 99th percentiles to ensure that our results are not driven by outliers.

Because, after applying all filters, our data sets do not perfectly overlap, we lose some observations when merging data from these three sources. Our final sample comprises 4,330 bond issues in the period 1996-2014 for 808 different firms [14]. Table 1 provides information on the number of issues per year and the number of issuers.

[Insert Table 1 around here]

2.1. Summary statistics

Table 2 reports the summary statistics for the main variables used in this study. The average issue in our sample has a spread over treasuries of approximately 215 basis points (bps) with a median of 157 bps, which is consistent with similar recent studies

[12] For robustness, we also use stock return volatility instead of that of the cash-flows, which does not change the results.

[13] We drop 222 financial firms. The results remain economically and statistically significant when we include these firms.

[14] We aggregate bond issues at the 6-digit-CUSIP level, which is the identifier provided by SDC Platinum.

[15] in the literature (e.g., Borisova, Fotak, Holland, and Megginson, 2015). With respect to bond ratings, the average (median) according to our numerical scale is 11.54 (12.00), which corresponds to a Standard and Poor's rating between BBB and BBB+ (BBB+). The average firm has a quarterly options trading volume of $165 million (median $ 22.46 million). This substantial number reflects the dramatic, exponential growth in the use of derivatives in recent years [16]. For other variables, firms in our sample have a mean (median) size of $33.48 ($13.58) billion with an average Tobin's Q of 1.80 (median 1.57). The average bond in our sample has a principal equal to $558 million and maturity of approximately 12 years. Finally, 99.5% of our bonds are public, and almost 5% include a callable option [17]. All these statistics fall within the standards in the literature. Due to high skewness that may jeopardize our results, we use the natural logarithm of some of the variables for the analysis. Specifically, we calculate the natural logarithm of the yield spread, options volume, total assets, firm risk, bid-ask spread and (one plus) maturity.

[Insert Table 2 around here]

2.2. Specification

In our baseline specification, we analyze the effect of options trading volume on a firm's cost of debt by estimating the following ordinary least squares (OLS) regressions, where i indexes bond issues and t indexes time:

$$Y_i = \alpha + \beta Ln(OptionVolume) + \gamma Z_i + \delta_t + \lambda_i + \epsilon \tag{1}$$

The dependent variable, Y_i, measures a firm's cost of debt under the two metrics previously discussed. Thus, one type of econometric model in our analysis will take the natural

[15] Obviously, in existing studies with a sample ending before 2007, the average yield spread is much lower (approximately 120 bps.). The average yield spread in our sample pre-2007 is 130 bps.

[16] Our number is considerably larger than those reported by previous articles using this variable. Nonetheless, these studies (e.g., Roll, Schwartz, and Subrahmanyam, 2009; Blanco and Wehrheim, 2017) focus on a period ending before 2005. The sample statistics prior to that date fall within those of the literature.

[17] This number may seem low compared to other recent studies (e.g., Qi et al., 2010), that report an average of 15% of bonds in their sample that include a callable option. However, these studies include bonds from firms in different countries and a larger proportion of floating-rate bonds, typically more subject to include a callable option.

logarithm of the at-issue bond yield spread, *Ln(Yield Spread)*, as the dependent variable; another will use the bond's *S&P Rating* [18]. *Ln(Option Volume)* is the natural logarithm of the previously discussed options trading volume variable. The vector Z_i contains a set of bond- and firm-level controls [19]. We control for firm size (log total assets), growth opportunities (Tobin's Q), profitability (ROA), leverage, firm risk, illiquidity (bid-ask spread), bond maturity and callable option[20] and include a dummy for public bonds. A complete definition of these variables is presented in Appendix A. In line with existing research, we expect that a firm's size, growth potential and profitability have positive impacts on (by reducing) the cost of debt. Conversely, leverage and firm risk (cash-flow volatility) will increase the return demanded by bondholders, which is contrary to the firm's interest. Similarly, bonds including a callable option or having longer maturities reflect, in principle, higher perceived risk. The control variable on stock market liquidity (or illiquidity) is of special relevance for this analysis. First, this is because exchanges are more prone to quote options from firms with high stock trading volume (Mayhew and Mihov, 2004), but second and more important, this is due to the asymmetric information embedded in stock market liquidity measures [21]. In particular, Odders-White and Ready (2006) find a negative relationship between a firm's credit rating and equity market liquidity. Moreover, common microstructure measures of adverse selection such as the relative bid-ask spread can be used to predict future changes in ratings. Following this rationale, we expect the relationship between stock liquidity and debt cost to be negative. We treat stock liquidity with caution by first using the relative bid-ask spread (used more prominently in the recent literature) as a proxy and then repeating the analysis with the Amihud (2002) measure [22].

[18] We are aware of the potential problems of using OLS regression with a count variable such as S&P Rating. To mitigate concerns regarding this issue, we fit a Poisson model for S&P Rating, and we repeat the analysis with a Negative Binomial and an Ordered Logit model. Moreover, we transform the rating variable to the natural log of one plus the rating in a traditional OLS regression. All these tests are reported in Table B5 in Appendix B and confirm our initial results.

[19] In subsequent analyses in the robustness section, we add various additional controls in both of these dimensions that leave our initial results unchanged.

[20] The callable dummy is typically not used in the literature as a control for Standard and Poor's bond rating. For this reason, we leave the callable variable as a control only in the case with the bond yield spread as a dependent variable. The results (unreported) when including the callable dummy as a control for bond rating remain substantially unchanged.

[21] See, among others, Roll (1984), Glosten and Harris (1988), Stoll (1989), Hasbrouck (1991), Easley, Kiefer, O'hara, and Paperman (1996) or Huang and Stoll (1997) for seminal work on the issue.

[22] In fact, using the Amihud (2002) measure yields a higher economic significance of the effect related to options volume. As it is most commonly used to capture the adverse selection component, we adopt a conservative approach and retain the traditional relative bid-ask spread in the main procedure. The results when using the Amihud (2002) measure are reported in Table B8 in Appendix B.

Although our focus is on bond issues (and hence a pooled OLS model) rather than time-series (panel) data, there exist some time-varying features not related to bond or firm characteristics that could undesirably influence our analysis. For example, the economic conditions surrounding a crisis (e.g., the dotcom bubble, recent financial crisis) can increase debt financing costs in a manner unrelated to firm or bond fundamentals. Similarly, the exponential growth of derivatives markets in recent years [23] demands a close control of time effects. For these reasons, we include in our regression model the term δ_t, which accounts for time dummies. In a similar fashion, following past studies in the literature, λ_i controls for industry dummies (at the two-digit SIC code level[24]). Finally, we report robust standard errors clustered at the firm level, which is the most accurate and conservative approach (Petersen, 2009).

3. Main results

We begin the analysis with the results from the regression specification in Eq. 1, which we display in Table 3. In column 1 of Table 3, we start with a specification including only firm-level controls and time and industry dummies for the natural logarithm of bond yield spread as the dependent variable. The same specification for our second dependent variable, *S&P Rating*, is reported in column 3. We extend this analysis to include bond-level controls in columns 2 and 4 of Table 3. Column 5 reports the results of a Poisson regression using *S&P Rating*.

The coefficient on *Ln(Option Volume)* is of high statistical significance (p-value $<$ 0.01) across all specifications in Table 3. Our baseline test reveals a detrimental effect of options trading volume on a firm's cost of debt. In particular, a more liquid option market is related to a higher yield spread over treasuries and a lower credit rating. In sum, increasing options trading volume is associated with costlier debt financing, after controlling for firm and bond characteristics, as well as for industry and time effects. The economic magnitude of the effect is strong. For example, taking the coefficient of 0.037 specified in column 2, a one-standard-deviation increase in options volume from its mean of \$165.01 million is associated with an increase in the *Yield Spread* of nearly 10 bps.

The control variables in Table 3 take the expected estimated coefficients for yield

[23] The growth is especially surprising in equity options markets, the volume of which increased from 200 million contracts in 1996 to almost 4,000 million in 2015 (see Options Clearing Corporation).

[24] Table B6 in the robustness section shows that our results are robust to the inclusion of four-digit SIC dummies.

spread and credit rating. While firm size, growth opportunities, profitability and liquidity relate negatively with the cost of debt, leverage, firm risk and the existence of a callable option on the bond are positively associated with the cost of debt financing. One special case is maturity, which is associated with an increasing yield spread but a higher (better) credit rating. The relationship between spreads and time to maturity is not surprising and reflects reduced uncertainty over coupon and par value payments as the bond's maturity date approaches. The case of credit ratings can be explained by a tendency on the part of larger, financially stable, companies to issue debt with longer maturities, leading agencies to evaluate these issues with better ratings.

[Insert Table 3 around here]

3.1. Endogeneity

In this section, we address concerns related to endogeneity. Option markets are a particularly beneficial trading venue for informed traders where trading and short-selling costs are minimized. Moreover, they are particularly useful in situations of high uncertainty. Given these particular features, it is fair to argue that our results can be explained by reverse causality. Since option markets contain information regarding future stock prices (e.g. Chakravarty, Gulen, and Mayhew, 2004; Roll, Schwartz, and Subrahmanyam, 2010; Johnson and So, 2012; Ge, Lin, and Pearson, 2016b), an increase in option trading volume may be driven by future market expectations of firm distress. For example, investors that operate through option markets may bias their trades toward those companies facing a more turbulent short-term future and, hence, costlier debt financing. We address these concerns by performing a wide range of tests that include instrumental variable regression as well as analyses across firms with different levels of distress and the behavior of equity returns following bond issuance.

3.1.1. Instrumental variable analysis

We first address endogenous effects using an instrumental variable approach and two-stage least squares (2SLS) regression. Instrumental variable regression will help not only to assess the causal direction of the relationship between options volume and cost of

debt but also to mitigate the possible measurement error in the independent variable of interest.

A good instrument for our setting is a variable that is highly correlated with options trading (which we can test, for example, via the first stage of the 2SLS procedure) but uncorrelated with our measures of the cost of debt except through other independent (control) variables (i.e., the exclusion restriction holds). Roll, Schwartz, and Subrahmanyam (2009) introduce two variables that serve as good instruments for our framework: (i) open interest in the stock's listed options and (ii) moneyness (i.e., the average absolute difference between the stock's market price and the option's strike price). We devote this section to the analysis of open interest as an instrument and show in Appendix B that the results are similar when, first, using moneyness as an instrument and, then, both instruments together [25]. *Open interest* consists of the number of open options contracts on each day in a listed stock. As Roll, Schwartz, and Subrahmanyam (2009) argue, this measure should not be inherently related to firm value, as it includes the summation of both call and put contracts [26]. Extending this argument, open interest should not be associated either with higher or lower bond yield spreads or credit ratings in any mechanical way. To construct the variable open interest, we average open interest, from Options Metrics, across all options on a stock throughout the calendar quarter. The correlation between open interest and options volume in our full sample is 0.4305, suggesting that open interest is indeed related to options trading volume. As in the case of options volume, we measure open interest in the quarter prior to bond issuance and use the natural log of this variable, *Ln(Open Interest)*, for the 2SLS analysis.

We display the results from the 2SLS procedure in Table 4. Column 1 comprises the results for the first stage of the 2SLS analysis, in which we regress options volume, *Ln(Option Volume)*, on the set of independent variables from Eq. 1 plus open interest, *Ln(Open Interest)*, and a full set of time and industry dummies. The positive and highly significant coefficient of 0.91 for open interest provides additional evidence of the strong relationship between this variable and option volume. Additionally, instrument irrelevancy is rejected (p-value$<$0.01) using the Kleibergen and Paap (2006) statistic test. The

[25] Previous works, including Roll, Schwartz, and Subrahmanyam (2009) and Blanco and Wehrheim (2017), use moneyness as their preferred instrument. However, we note that from 2007 onward, the correlation of moneyness with options volume starts decreasing, and this is probably related to the increased uncertainty related to the financial crisis. Although our results hold when using moneyness in the 2SLS, we retain open interest in the main analysis, as its correlation with options trading is strong throughout the sample period.

[26] High or low levels of call or put interest could be associated with higher or lower firm values but not the sum of the two.

value of the Cragg-Donald Wald F-statistic is above 10 (the standard rule of thumb) and higher than Stock and Yogo (2005) critical values, rejecting the null that the instrument is weak.

Columns 2 and 3 in Table 4 report the second stage from the 2SLS on our two measures of the cost of debt. The coefficients on the instrumented options volume variable for the bond yield spread and bond rating of 0.075 and -0.407, respectively, are strongly significant (p-values < 0.01), thus advocating for a causal effect of options trading on the cost of debt. These coefficients are slightly larger in magnitude that those reported via OLS (0.037 and -0.222, respectively). However, discrepancies between OLS and 2SLS coefficients are common and arise due to various factors primarily related to the mitigation of errors-in-variables biases [27]. Since the analysis with the other instrument (moneyness) reveals similar qualitative results [28], this divergence is unlikely to jeopardize the validity of our results but, rather, provides more accurate estimates that strengthen them.

[Insert Table 4 around here]

In summary, the results from the 2SLS analysis are consistent with the notion of a significant causality running from more active option markets to a firm's cost of debt financing. Moreover, mitigating the bias due to the possible endogenous link between options and debt costs amplifies the main effect.

3.1.2. Options volume and firm distress

In the previous section, we show that the positive association between a firm's cost of debt and its options trading volume is unlikely to be driven by investors more heavily trading options on those firms that they predict will face a more adverse future. However, some questions remain unsolved, namely, whether the effect occurs throughout the distribution of firms or, rather, is concentrated among those firms that are highly distressed. In this section, we perform an in-depth analysis to ensure that our results are not driven by highly distressed firms.

[27] Beaver, McAnally, and Stinson (1997) and Irwin and Terviö (2002) provide a comprehensive analysis of the relevant econometric issues related to this process.

[28] For the sake of space, we report the estimates from the instrumental variable analysis with moneyness as an instrument in Appendix B. Table B1 provides the results from the analysis using moneyness as an instrument, whereas Table B2 displays the results from using both instruments in the 2SLS.

We begin by including a direct measure that proxies for firm distress, the well-known Kaplan and Zingales (1997) index (*K-Z Index*), in the regression specification [29]. We define the *K-Z Index* as in the synthetic specification from Lamont, Polk, and Saaá-Requejo (2001) and defined in Appendix A. A higher value of the *K-Z Index* indicates that a firm relies more strongly on external financing and, ultimately, has larger financial constraints. Table 5 presents the results from including the *K-Z Index* as a control in our baseline regressions (columns 1 and 3) and then interacting it with options volume for our two measures of firms cost of debt (columns 2 and 4). The coefficients on *Ln(Option Volume)* in columns 1 and 3 remain unaltered in significance and magnitude after controlling for firm distress. However, the interaction terms in columns 2 and 4 are significant and consistent with the effect of options on a firm's cost of debt being more pronounced when firms are more distressed. These results are consistent with, first, firm distress not driving the results and, second, our main hypothesis that options exacerbate shareholder-debtholder conflicts, as the effect is more pronounced in those situations where owning voting rights is more valuable. We revisit these results for further discussion in the mechanisms section.

[Insert Table 5 around here]

Next, we assess whether the effect of options on bond yield spread and rating occurs homogeneously across firms with different levels of distress. We begin by running the regression specification in Eq. 1 on the bond yield spread across four quartiles of firm distress (as proxied by the *K-Z Index*), where Q1 indexes the least distressed and Q4 the most distressed firms. Table 6 shows the results. Whereas, as predicted, the effect is economically larger for more distressed firms, it remains significant across all quartiles, even for firms with the lowest level of financial constraints (0.043, p-value$<$0.05).

[Insert Table 6 around here]

To take the analysis of the effect and firm quality to the extreme, we now include as a control Standard and Poor's rating for the firm (which we convert to a numerical scale

[29] The results remain unchanged (unreported) if we instead use the Altman (1968) Z-score to predict corporate bankruptcy. These results are available from the authors upon request.

with lower values indicating lower ratings). This specification is highly demanding for the effect, as bond rating and yield spread are explained primarily by the rating of the firm. Columns 1 and 3 in Table 7 show the results when introducing firm rating as a control for bond yield spread and bond rating as dependent variables, respectively. Columns 2 and 4 contain the regression with bond yield spread and bond rating, respectively, for the subsample of firms rated A or above according to the S&P rating scale. Even with this demanding specification, the results are in line with the existence of an effect of options volume on firm cost of debt beyond firm quality.

[Insert Table 7 around here]

Finally, we perform a quantile regression to check whether the effect is limited to issues of bonds with particularly high yield spreads or poor credit ratings. Table 8 contains the results from a bootstrapped quantile regression with the specification in Eq. 1 for 10th and 90th percentiles of bond yield spread and bond credit rating, respectively. Highly significant coefficients (p-value<0.01) for *Ln(Option volume)* across the different specifications in Table 8 reveal that the effect of options on the cost of debt is not driven by highly distressed firms. Furthermore, the effect is stronger for bond issues of higher quality (10th percentile).

[Insert Table 8 around here]

Taken together, these results are consistent with the view that option markets have a specific effect on a firm's cost of debt that is not driven by lower quality firms. In addition to being consistent with our hypothesis, these results reinforce the thesis that option markets lead the effect toward an increase in the cost of debt, and not *vice versa*. If the effect we find were to appear due to option traders anticipating firms' distress, we should observe (i) no effect whatsoever in financially stable firms and (ii) the absence of statistical significance for the options coefficient after accounting for firm financial quality.

3.1.3. Options volume and subsequent firm value and equity returns

Thus far we have mitigated concerns related to reverse causality by showing that (i) the results from the instrumental variable analysis reinforce the thesis of option markets leading the positive association between options and a firm's cost of debt, (ii) the effect prevails after the inclusion of different proxies for firm distress, and (iii) the effect exists even in those scenarios in which the reverse-causality thesis (firm distress being the main driver behind and increasing in options trading volume) would predict its disappearance. We turn now to investigate the effect on a firm's equity market bond issues preceded by higher options trading volume.

This analysis contributes to the previous discussion on the leading factor in the relationship between options and the cost of debt. If option traders invest more intensively in those firms that they expect to experience a more turbulent future (i.e., future firm distress drives the relationship), bond issues preceeded by higher options trading volume should be associated with lower equity returns and firm value. Conversely, if bond issues from firms with more active option markets are followed by an increase in equity returns, the hypothesis of a volume increase in option markets caused by traders discounting expectations of firm distress becomes groundless.

The previous literature finds a positive association between more active option markets and firm value. Roll, Schwartz, and Subrahmanyam (2009) show that options trading increases future firm value as proxied by Tobin's Q. In a similar vein, Naiker, Navissi, and Truong (2013) investigate whether there is a causal effect of options by reducing the a firm's cost of equity. While these studies seem to support the fact that higher option trading is associated with larger equity returns, the reported results focus on the 'average' firm of a large sample and need not hold for our specific universe of firms. Consequently, we investigate firms' equity returns after bond issues in our sample via two different forward measures: firm value as proxied by *Tobin's Q* and buy and hold abnormal returns (BHAR) post bond issuance.

Table 9 contains the results from an OLS regression of future firm value (*Tobin's Q*) on options volume (Option Volume) and a series of control variables similar to the specification in Roll, Schwartz, and Subrahmanyam (2009). These controls include size (*market capitalization*), share *turnover*, return on assets (*ROA*), *capex* (capital expenditures over sales), *leverage* (long-term debt over total assets) and a *dividend dummy* equal to one if the firm pays dividends [30]. Columns 1 to 4 in Table 9 use

[30]Please refer to Appendix A and/or Roll, Schwartz, and Subrahmanyam (2009) for a complete

as their dependent variable firm value one quarter, two quarters, three quarters and four quarters (one year) ahead, respectively. As shown by the positive and significant coefficients (p-value<0.01) for *Ln(Option Volume)* across all four columns (with magnitudes ranging from 0.059 to 0.064), bond issues from firms with a more active options market are associated with higher subsequent firm values as proxied by Tobin's Q.

[Insert Table 9 around here]

Because the adjustment in equity markets can occur as rapidly as within days from bond issuance, we now turn to explore short-term abnormal returns in the stock following the issue. Table 10 contains information regarding the effect of options trading volume on buy and hold abnormal returns (BHAR) around bond issuance. We calculate BHAR using the market model with an estimation window of a minimum of 100 days ending 50 days prior to bond issuance for two different windows: [-1,+10] (columns 1 and 2 in Table 10) and [+1,+30] (columns 3 and 4) days surrounding the issue. Columns 1 and 3 contain the results from a pooled OLS regression of BHAR on options volume with time and industry fixed effects, whereas columns 2 and 4 add to the specification control variables previously used that account for firm size and growth opportunities, return-on-assets, leverage, firm risk and liquidity. Coefficients for *Ln(Option Volume)* are not significant, but positive, across all specifications in Table 10, revealing no significant short-term reaction of equity markets to bond issues preceded by higher options trading volume.

[Insert Table 10 around here]

We show that the positive impact of options on the firm's cost of debt is not driven by poorer firm quality or traders anticipating future firm distress. Overall, these results suggest that options indeed have a causal effect on a firm's cost of debt. We discuss these mechanisms in further detail in Section 5.

definition and justification of these variables.

4. Robustness

Having established that our results are not due to reverse causality, we turn to analyze the robustness of our results along other dimensions. In this section, we consider various issues that may jeopardize the validity of our results at different levels. Specifically, we begin by considering a time-series sample of bond prices, which enables us to extend our baseline specification to consider a much more demanding one with bond fixed effects. We also expand the analysis to consider different measures of stock-return volatility and stock market liquidity, two well-known determinants of option listing by exchanges (Mayhew and Mihov, 2004). More important, we discuss the impact of price informativeness on our results, which is an important effect associated with more active options markets. Finally, we perform a set of other miscellaneous robustness checks that include different econometric specifications, the exploration of the monotonicity of the effect and the inclusion of other additional controls.

Taken together, all these tests confirm the robustness of our main results and provide a foundation for the discussion of the main mechanisms by which the effect is channeled, which we perform in Section 5..

4.1. Bond fixed effects and time series analysis

Although our regression models include a full set of firm and bond characteristics with high explanatory power, time and industry dummies, and the considerably large r-squared statistics we report (e.g., ranging from 0.668 to 0.742 in Table 3), some concerns remain regarding biases related to omitted variables and time-series effects. We address these issues, following most studies in the corporate finance literature, by including time and bond fixed effects in the regression specification. This approach allows us to control for every possible unobservable, time-invariant bond and time characteristic that may influence the results.

To perform this analysis, however, the at-issue data employed for the baseline procedure are of no use, as we need panel data that include time-bond observations. To this end, we retrieve from Thomson Reuters Eikon (Datastream) bond-quarter information on bonds matching our initial criteria (i.e., bonds with fixed coupons, issued by U.S. corporations). After applying the usual filters and merging these data with the CRSP-Compustat variables described in Section 2., and defined in Appendix A, we are left with 2,028 bond-quarter observations with non-missing yield to maturity for 292 bonds. We

follow the previous methodology to calculate the variable *Yield spread* (i.e., bond yield to maturity in excess of a maturity-matched Treasury bond) for each bond and quarter. Because the Thomson Reuters Eikon database only offers time-series data for active bonds, our sample covers the period 2002-2015. Table 11 provides the main summary statistics, which confirm that our time-series sample includes similar firms, on average, as our main sample. For example, the average firm in our main sample has total assets equal to $33 billion vs. $39 billion in the time-series sample; *Tobin's Q* of 1.8 vs. 2.2 in the time-series sample; or *Leverage* equal 0.27 in the main sample vs. 0.35. However, the summary statistics for our options volume variable are radically different across the two samples. This issue, however, is far from posing a problem, as this divergence results from a significant number of quarter observations coming from firms with no options trading [31].

[Insert Table 11 around here]

Extending our core analysis to this data sample has a dual benefit. The first advantage is in terms of mitigating concerns related to omitted variables. Second, it allows us to investigate whether the main effect of options trading on yield spreads occurs beyond the time of bond issuance. For this purpose, we use the following econometric model, which is similar to that of Eq. 1:

$$Spread_{i,t} = \alpha_{i,t} + \beta Ln(OptionVolume)_{i,t} + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon \tag{2}$$

where t indexes time and i indexes a specific bond. $Spread_{i,t}$ is the bond yield spread over the maturity-equivalent Treasury at the end of quarter t. $Ln(OptionVolume)_{i,t}$ measures option trading volume in quarter t. We include time and bond fixed effects with the variables δ_t and λ_i, respectively. Finally, the vector X contains the set of time-varying controls used above, including *size*, *Tobin's Q*, *return on assets*, *leverage*, *firm risk*, *bid-ask spread* and bond time to *maturity* [32].

[31] As before, we set options volume to zero when a firm has no options trading. Because of the time-series nature of this particular data set, the number of observations with positive options volume is lower. Specifically, 1,003 out of 2,028 observations have positive (greater than zero) options trading volume.

[32] Obviously, we exclude any bond-level invariant characteristics, as we already account for them using bond fixed effects. We include the time to maturity of a bond as control, as it is well recognized that yields tend to decrease as maturity approaches.

The results from Eq. 2 are shown in Table 12. Columns 1 and 2 display the results of the regression model without bond fixed effects, which we include in columns 3 and 4. Additionally, columns 2 and 4 extend the analysis by clustering the standard errors at the bond level, the most demanding specification. The coefficients in Table 12 range from 0.112 to 0.098 and exhibit high significance across all four columns, with p-values lower than 5% even in the most constrained specification. These results provide further evidence regarding the nature of our main effect. First, the detrimental effect of active options markets on a firm's cost of debt is not limited to the time of the issue but, rather, seems to occur dynamically. Second, and more important, time-invariant omitted variables related to bond characteristics are not the drivers of the effect.

[Insert Table 12 around here]

Because time-invariant characteristics are not the only source of omitted variable bias, we perform a battery of additional robustness tests in the next sections, which range from the in-depth exploration of the monotonicity of the effect to the inclusion of additional controls.

4.2. Stock return volatility

In our baseline regression model we follow existing literature and control for firms' volatility using cash-flow volatility (*firm risk*), as this should be the primary channel by which debtholders perceive firm risk. However, it is another measure of risk, *stock return volatility*, that is considered one of the key determinants of options listing by exchanges (Mayhew and Mihov, 2004). Furthermore, investors may trade out-of-the-money options to speculate in volatility (Ni et al., 2008) and, thus, may be particularly interested in highly volatile firms.

To ensure that our results are not driven by firms with higher stock return volatility that attract more option traders, we replace the control variable of cash-flow volatility with that of stock returns [33]. Specifically, we include in Table 13 the volatility of daily stock returns during the quarter prior to bond issuance (columns 1 and 3), as well as that of the year (columns 2 and 4), in the main regression specification for our two measures of the cost of debt. Although the estimates for *Stock volatility* are statistically relevant,

[33] Including stock return volatility simultaneously with that of cash flows yields similar results.

the coefficients for options volume remain positive and highly significant (p-value<0.01), with a slight decrease in economic magnitude (e.g., the coefficient with yield spread as the dependent variable drops from 0.037 to 0.035 after including the quarterly volatility of stock returns).

[Insert Table 13 around here]

4.3. Information asymmetries and price informativeness

Prior literature finds a role of option markets in increasing price informativeness (e.g., Back, 1993; Easley, O'Hara, and Srinivas, 1998; Cao, 1999) which ultimately decreases information asymmetries. This informational enhancement has been shown to benefit shareholders by increasing firm value (Roll, Schwartz, and Subrahmanyam, 2009) or lowering the cost of equity capital (Naiker, Navissi, and Truong, 2013). Similarly, a reduction of informational asymmetries can also have positive effects for debtholders. These results highlight the importance of information in our setting.

Although it is nearly impossible to isolate the effect of options that is not directly related to the firm's informational environment, we can perform some tests that ensure our main results are not driven by different levels of information asymmetries across firms. To this end, we introduce in our main regression specification control variables that proxy for the degree of information asymmetries regarding a firm. First, we use analyst coverage. Previous studies support an inverse relationship between the number of analysts covering a stock and the severity of the information asymmetry problem (Brennan and Subrahmanyam, 1995; Hong, Lim, and Stein, 2000). Second, we use the probability of informed trading (PIN) as a proxy for stock price informativeness. The PIN measure is based on a structural market microstructure model developped in a series of studies (Easley, Kiefer, O'hara, and Paperman, 1996; Easley, Kiefer, and O'Hara, 1997; Easley, O'Hara, and Srinivas, 1998; Easley, Hvidkjaer, and O'hara, 2002) and measures the probability that a trade comes from an informed party. The strong theoretical foundations of PIN have made it one of the preferred measures in the literature on the effects of private information on other variables (e.g., Chen, Goldstein, and Jiang, 2007; Ferreira, Ferreira, and Raposo, 2011).

We include these two variables that proxy for the information content of a stock as controls in the main specification from Eq. 1 and display the results in Table 14. Specifically, we include the natural logarithm [34] of the number of analysts covering the firm's stock as reported in I/B/E/S, *Ln(Analyst coverage)*, in columns 1 and 3 of Table 14 with bond yield spread and rating as dependent variables, respectively. Because we lack information on analyst coverage for some firms in our sample, our initial number of observations suffers a slight decrease (from 4,330 to 4,184 obs.). Despite the high statistical significance of the coefficients on analyst coverage for both dependent variables, the coefficients on option volume remain highly statistically significant (p-value<0.01), with a slight increase in economic magnitude.

[Insert Table 14 around here]

Columns 2 and 4 in Table 14 include the PIN measure as a control for price informativeness.[35]. We follow Roll, Schwartz, and Subrahmanyam (2009) and use the logistic transformation[36] of this measure, which we call *PINL*, since PIN varies between zero and one. As before, PIN estimates are not available for all stocks in our sample and the number of observations declines substantially (from 4,330 to 1,792 obs.). Even with this reduced sample of bond issues, the *PINL* coefficients exhibit statistical significance (p-value<0.05). Moreover, the coefficientes for *Ln(Option volume)* remain statistically and economically significant after the inclusion of *PINL* as a control for both dependent variables accounting for the firm's cost of debt.[37].

Taken together, these results provide support for a relationship between information asymmetries and a firm's cost of debt. When information asymmetries are higher (lower analyst coverage and greater PIN), debtholders demand a higher return for their money.

Even after the inclusion of different proxies for a firm's information environment, the regression coefficients on *Ln(Option volume)* exhibit strong significance and economic magnitude for both measures of the cost of debt. In sum, price informativeness does

[34]Given the distribution of analyst coverage across our sample taking logartihms is a more accurate specification, although the results remain intact when using the raw number of analysts.

[35]We are grateful to Professor Stephen Brown for kindly making the PIN estimates available through his website: http://scholar.rhsmith.umd.edu/sbrown/pin-data

[36]This transformation does not affect the nature of our results, only the significance of PIN estimates.

[37]The statistical significance of options volume when using bond yield spread as the dependent variable declines relative to the baseline results (p-value<0.05). However, we check that this reduction comes from the use of a significantly lower number of observations rather than the inclusion of *PINL* in the specification.

not explain the effect of option markets on debtholders. These results support the view that options markets affect bondholders through a channel not directly related to price informativeness. As we argue, option markets may facilitate bondholder expropriation by providing shareholders with a financial instrument that enables high trading profits in situations that are especially harmful for bondholders. These potential profits result in a shift in shareholders incentives that, in turn, increases the risk borne by bondholders. We discuss the validity of this hypothesis in the mechanisms section and dedicate the next section to a set of miscellaneous robustness checks.

4.4. Other robustness tests

We devote this section to performing an extensive battery of robustness checks. For the sake of space, we report the empirical results of these analyses in Appendix B.

Our additional robustness tests begin with the investigation of the monotonicity of options trading. That is, we are interested in determining whether the effect occurs monotonically or is limited to extreme values of options volume. To do so, we include in our main regression specification (from Eq. 1) two additional features, reported in Table B3 in Appendix B. First, we add a squared term for *Ln(Option volume)*, which is displayed in columns 1 and 3 of Table B3 for bond yield spread and credit rating, respectively. Second, we use the interaction of our main variable, *Ln(Option volume)*, with a dummy variable, *High options volume*, that takes value one if a firm's options' volume is above the median for that year and zero otherwise. These results are reported in columns 2 and 4. The coefficients for *Ln(Options volume)* in columns 1-4 of Table B3 remain of high statistical significance (p-value < 0.01) after accounting for the effect of extreme values of options trading, thus supporting the notion that the effect is not limited to extreme cases of options trading volume.

Next, we consider possible time-varying omitted variables. Specifically, we augment the main econometric specification with the *Principal* amount of the bond issue and the level of *Institutional ownership* of the firm as controls. Firms demanding a larger principal amount may be those in a more fragile situation and urgent need of financing, which would explain why debtholders demand a higher return on their money. Moreover, Cremers, Nair, and Wei (2007) find a positive association between shareholder control and yield spreads. Because institutions are the group most prone to exert active shareholder control, we include total institutional ownership from the Thomson Reuters 13F filing

[38] to rule out the possibility that our results are driven by correlations between active option markets and a firm's level of institutional ownership. Table B4 in Appendix B contains the results from both additions. The coefficient of *Ln(Option Volume)* remains highly statistically significant (p-value<0.01) with a small decrease in magnitude (0.032 from 0.037 for yield spread and -0.192 from -0.207 for bond rating) as a result of the inclusion of both control variables. These results provide evidence of option markets having a direct impact on a company's cost of debt, rather than being a secondary effect from preexisting findings.

To test the robustness of the effect on bond ratings and given the special construction of this variable, we perform 2 different tests. First, we run the baseline OLS model on a transformed variable equal to the natural log of one plus the bond rating, *Ln(*1+*Rating)*. Second, we fit ordered logit and negative binomial models to the specification in Eq. 1. The results are reported in Table B5 in Appendix B and confirm the validity of our initial results.

Because different industries may have special features that lead to mechanically higher or lower costs of debt, we include two-digit SIC code fixed effects in our regression analysis, the most common specification in the literature. We expand this analysis by including the more restrictive four-digit SIC code fixed effects in columns 1 and 3 of Table B6 in Appendix B. Furthermore, columns 2 and 4 in Table B6 include industry (SIC-4) by time fixed effects, to control for assymetric growth in option market volume across indsutries and over time. All of these tests validate our initial results.

Given that our sample period includes the 2007-2008 financial crisis, one concern is that our results are driven by bond issues during this financially turbulent period. To investigate whether this is the case, we estimate the regression in Eq. 1 for two subsamples of bond issues during and outside the financial crisis period. We consider the financial crisis period to be those years between, and including, 2007 and 2010 [39]. Table B7 in Appendix B contains the results, which do not support the thesis of unstable financial periods driving the results.

Previous literature highlights the importance of stock market liquidity in the decision of exchanges to quote options on a firm's stock (Mayhew and Mihov, 2004). Although we control for stock market liquidity in our baseline tests by including the natural log of the bid-ask spread, we further investigate the effect of liquidity to ensure that it is not

[38] As noted in Bushee (1998), not all institutions are interested in active governance. We explore this issue in the mechanisms section.

[39] In untabulated tests, we also consider as the 'crisis' the years covering the tech bubble of the 2000s, and the results are unchanged.

the main driver of our results. We begin by replacing the bid-ask spread with a different proxy for stock liquidity, the Amihud (2002) illiquidity measure. Table B8 in Appendix B contains the results of this analysis, which provide support for our initial results and display an even larger economic magnitude of the options volume coefficient. Second, we divide the sample into firms with high and low stock market liquidity according to the median bid-ask spread and run the regression in Eq. 1. Table B9 in Appendix B displays the results, which demonstrate that the effect occurs in both subsamples of stock market liquidity. Overall, these tests show that our results are not driven by stock market liquidty but, rather, by trading activity in the options market.

5. Possible mechanisms

Our evidence thus far is consistent with a detrimental effect of options trading volume on a firm's cost of debt, even after accounting for potential endogeneity concerns and performing a rich set of additional robustness tests that discard other variables such as price informativeness, stock volatility, or poorer market expectations as the main drivers of this effect. In this section, we turn to the last part of our analysis and discuss potential underlying mechanisms through which this may occur. It is of course challenging to provide definite proof, and hence, our tests are only suggestive.

In our main thesis, we argue that option markets produce a shift in shareholders' attitudes toward certain events by enabling them to extract trading gains in situations that may have especially harmful results for bondholders. This imbalance in incentives contributes to the exacerbatation of shareholder-bondholder conflicts and results in bondholders facing higher expropriation risk and, ultimately, increases a firm's cost of debt. Consistent with this hypothesis, the effect of options on firm cost of debt should be larger in certain scenarios, which we proceed to explore in detail.

First, the presence of an active options market that shareholders can exploit should damage bondholders more intensively as the firm is closer to a shift in the control of the company that damages bondholders' interests while being potentially beneficial to shareholders. In such cases, the expropriation trade-off must be a distinct concern. Second, bondholders will suffer more severely from the presence of a liquid options market when the shareholder structure of the company is more prone to be actively informed about firm fundamentals and likely to influence managerial decisions. Third, the expropriation risk faced by bondholders will increase with the threat of shareholders forcing actions

that can directly reduce bondholder wealth, such as default.

5.1. Corporate events and shift in control

We consider two different events that can produce a change in ownership that is detrimental to bondholders: default and takeover. Firm default forces a change in control whereby creditors become the new owners of a defaulted firm through the distribution of stock during restructuring. As a firm becomes more seriously distressed, the probability of a shift in control to bondholders increases, as does the likelihood of bondholders being expropriated by shareholders. Ge, Hu, Humphery-Jenner, and Lin (2016a) explore how informed traders exploit the options market to increase their payoff in the event of bankruptcy, providing a direct channel through which shareholders can benefit from this event. Acquisitions are another important corporate event to bondholders. Cremers, Nair, and Wei (2007) and Qiu and Yu (2009) document a negative effect of takeovers on firm bondholders. Intense shareholder governance (facilitated by an open market for corporate control) reduces bondholder wealth. Cao, Chen, and Griffin (2005) and Chan, Ge, and Lin (2015) study the use of option markets by traders prior to acquisition announcements. Both studies find evidence consistent with investors using option markets to extract trading gains before the event of a takeover. Combining all of these considerations, our thesis predicts that the detrimental effect of option markets on a firm's cost of debt financing will be exacerbated when a firm is more financially constrained (closer to experiencing default) and more vulnerable to a takeover.

5.1.1. Firm distress

Table 5 contains information regarding the effect of options on the cost of debt and firm distress. Columns 2 and 4 display the results from interacting the coefficient of options volume, *Ln(Option volume)*, with the Kaplan and Zingales (1997) index (our measure of firm distress). The coefficients for the interaction term are positive (p-value<0.05) with bond yield spread as the dependent variable and negative (p-value<0.01) for the regression using bond ratings. These results are consistent with our main thesis. The effect of options trading volume on a firm's cost of debt is more pronounced as the firm becomes more financially constrained.

5.1.2. Takeover vulnerability

To measure a firm's takeover vulnerability, we rely on the anti-takeover index (ATI) in Cremers and Nair (2005) and Cremers, Nair, and Wei (2007). The index is constructed based on the presence in a firm of three anti-takeover provisions that the literature has recognized to be critical for takeovers. These provisions include the existence of blank check preferred stock, classified boards, and restrictions on calling special meetings and actions through written consent.[40] ATI values vary from 1 to 4, substracting one point from 4 if any of these provisions is in place. The larger the value of ATI, the more prone a firm is to takeovers.

[Insert Table 15 around here]

We classify companies with ATI values of 4 and 3 (2 and 1) as firms with high (low) takeover vulnerability. Consequently, we run our baseline regression in Eq. 1 for two subsamples, depending on the firm's level of takeover vulnerability (high and low). Table 15 contains the coefficient estimates of these regressions. Columns 1 and 3 (2 and 4) display information for the subsample of *High* (*Low*) takeover vulnerability firms for bond yield spread and credit rating, respectively. Consistent with data in Cremers and Nair (2005) and Cremers, Nair, and Wei (2007), the number of firms with one or no anti-takeover provisions (high vulnerability) is lower as, therefore, is the number of observations for this subsample. Despite this difference in the number of observations in the estimates, the coeffcients for *Ln(Option volume)* are significant (p-value$<$0.01) across all four regressions. More interestingly, the coeffcient estimates for the subsample of high takeover vulnerability firms are considerably larger in economic magnitude than those for the low vulnerability firms when bond yield spread is the dependent variable (0.080 vs. 0.035) and when bond rating is the dependent variable (-0.354 vs. -0.242).

These results demonstrate that the detrimental effect of liquid option markets on the firm's cost of debt is larger when the company is more open to the market for corporate control, as predicted by our theory of bondholder expropriation.

[40] For a detailed description and justification of the use of these provisions, please refer to Cremers and Nair (2005).

5.2. Shareholder control

To provide additional insights into the role of option markets in the bondholder-shareholder conflict, we explore the interaction of *Ln(Option volume)* with variables accounting for the ownership level of institutions with different levels of commitment to governance (control) practices. In particular, we make use of the Bushee (1998) institutional investor classification [41]. In this classification, institutional investors fall into three different types, according to variables such as past performance, portfolio turnover or diversification. *Dedicated* owners are those with low portfolio turnover and concentrated stakes and, hence, those more prone to exert shareholder control. *Transient* institutions are those with high turnover and diversified portfolios, which tend to exhibit momentum returns. *Quasi-index* investors use indexing or buy-and-hold strategies that produce low portfolio concentration and high diversification and are, therefore, the group least likely to perform active control.

Bearing this classification in mind, in line with our prior of active option markets exacerbating the agency cost of debt, we expect the adverse effect of options trading to intensify in cases in which shareholders are more likely to engage in active governance practices (Cremers, Nair, and Wei, 2007). Tables 16 and 17 show the results of interacting, in our baseline specification, *Ln(Option volume)* with the percentage of ownership in hands of *Dedicated* and *Quasi-index* owners, respectively [42].

[Insert Table 16 around here]

The coefficient for the interaction term of options and ownership by dedicated investors in column 2 (4) of Table 16 is positive (negative) and significant at the 5% (1%) level for the regression on yield spread (bond rating). However, the coefficient for the interaction of options and ownership by quasi-indexers in column 2 (4) of Table 17 is negative (positive) and significant at the 5% (1%) level for the dependent variable yield spread (bond rating).

[Insert Table 17 around here]

[41] We are grateful to Brian Bushee for kindly providing these data on his website: http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html

[42] For the sake of space, we report the results of the interaction with *Transient* owners, the least interesting group for our analysis, in Table B10 in Appendix B.

Overall, these results are consistent with the detrimental effect of options being exacerbated in cases in which shareholders have more control and, as a consequence, the risk of unfavorable renegotiation/expropriation for bondholders increases.

5.3. Threat of strategic default

We devote the last part of our analysis to investigating the specific situation in which bondholders' concerns about expropriation might be heightened. Specifically, we focus on shareholders incentives for strategic default, which will fundamentally depend on their potential losses and bargaining power in renegotiation. In firms in which shareholders have an advantage over bondholders in renegotiation, the threat of strategic default becomes more intense, thereby increasing bondholders' expropriation risk. Following this rationale, under the bondholder expropriation hypothesis, we expect the effect of option volume to be particularly large in cases in which shareholders' incentives for strategic default are higher.

It is important to note that this mechanism does not require the actual occurrance of firm default but, rather, depends on each claimholder's advantages in future renegotiation. Garlappi et al. (2008) and Favara et al. (2012) find a negative relationship between shareholders' bargaining power relative to bondholders and equity risk and return in distressed firms, consistent with shareholders' ability and expectations to extract rents from other claimholders when they have sufficient advantage.

Following Garlappi et al. (2008) and Favara et al. (2012), we define two variables that proxy for shareholders' advantages. First, we consider liquidation costs, as proxied by the degree of tangibility of the firms' assets. A higher value of intangible assets should make liquidation costlier (as these assets are lost in the event of default) and, hence, strategic default by shareholders less likely. We measure liquidation costs using the intangibles measure introduced in Berger, Ofek, and Swary (1996) and displayed in Eq. 3.

$$Intangibles = 1 - \frac{(Cash + 0.715 \times Receiv. + 0.547 \times Invent. + 0.535 \times PPE)}{Assets} \quad (3)$$

We report the interaction of *Ln(Option volume)* and *Intangibles* in Table 18. The interaction coefficients of -0.070 in column 2 for yield spread and of 0.602 in column 4 for bond rating are statistically significant at the 10% and 1% levels, consistent with the idea of options trading activity being especially harmful for bondholders when liquidation

costs are low.

[Insert Table 18 around here]

Our second proxy for shareholders' advantage in renegotiations over bondholders is shareholders' bargaining power. As in previous literature, we define bargaining power as the ratio between total shares held by insiders (which we obtain from Worldscope) and total shares outstanding. We name this variable *Insider ownership* and display the results from its interaction with options volume in Table 19.

[Insert Table 19 around here]

The interaction coefficient with yield spread as the dependent variable in column 2 of Table 19 is positive and significant at the 5% level. When using bond ratings, the coefficient from the interaction between insider ownership and options volume in column 4 is negative, although not statistically significant. These results confirm that the relationship between options and the cost of debt is worsened when shareholders have high bargaining power.

Overall, these analyses support the thesis of options markets increasing a firm's cost of debt by exacerbating conflicts of interest between shareholders and debtholders. Specifically, options seem to induce a change in shareholders' incentives with respect to the expropriation of bondholder wealth. Bondholders respond to this shift by demanding a higher return for their money in firms with a more liquid options market, which shareholders can exploit to their own advantage.

6. Conclusion

In this paper, we novelly investigate the extent to which an active options market relates to a firm's cost of debt. The increasing importance of options markets in the contemporary financial world contrasts with the relatively few papers studying the effects of such growth in real variables. Whereas previous research finds that the positive informational enhancement flowing from high-volume option markets translates into greater firm value (Roll, Schwartz, and Subrahmanyam, 2009), higher innovation quality (Blanco and Wehrheim, 2017) or a lower cost of equity capital (Naiker, Navissi, and Truong, 2013),

our results show a perverse effect of these instruments for a group that is highly relevant in the corporate structure: debtholders. We find that a one-standard-deviation increase in options volume from its mean is associated with an increase in the bond at-issue yield spread of nearly 10 basis points.

Additionally, we explore the specific paths along which this effect is channeled. The results from several analyses that include interaction terms suggest that the impact of option markets occurs via the exacerbation of the traditional debtholder-shareholder conflict. The effect of options volume is more pronounced in situations in which the expropriation risk for bondholders is higher. Thus far, our results are consistent with the notion of options markets inducing a shift in shareholders' incentives toward certain events, such takeovers or firm default, which has detrimental results for bondholder wealth, thereby revealing a hidden cost of these financial derivatives for a firm's debtholders. However, we do not conclude that there is not a positive informational impact from options for bondholders, by reducing information asymmetries, but instead we empirically find that, at least, the net effect of options trading on bondholders is negative, thereby augmenting firms' cost of debt. In other words, the bondholders' gains from information enhancement seem to be outweighed by the threat of expropriation.

While our study draws on one particular "hidden cost" of financial derivatives, we are agnostic about how these instruments may affect other stakeholder groups in other dimensions. Moreover, we do not provide evidence on how options modify firms' financing decisions, for instance, whether a liquid option market makes bank loans ex ante more attractive than bonds or vice versa. We leave a proper evaluation of the net effects on ex ante firm financing decisions for future research.

In this study, we empirically demonstrate that option markets have a net detrimental effect on bondholders. Since firm financing is vital for the real economy, further theoretical and empirical research on the direct effects of derivatives markets on firm financing decisions is needed.

Tables and figures

Table 1: Number of Bond Issues per Year

Year	Number of Issues	Number of Firms
1996	77	53
1997	144	85
1998	188	111
1999	101	71
2000	118	76
2001	170	102
2002	131	65
2003	101	66
2004	31	26
2005	87	56
2006	159	101
2007	229	117
2008	253	125
2009	349	213
2010	400	253
2011	384	212
2012	470	257
2013	441	224
2014	497	259
Total	4330	

Table 2: Summary Statistics

	Mean	StdDev	25%	Median	75%	Observation
Yield Spread (bps)	215.582	170.244	96.000	157.300	280.800	4330
S&P Rating	11.545	3.322	10.000	12.000	14.000	4330
Option Volume ($ Millions)	165.016	414.441	3.450	22.465	111.857	4330
Open Interest	1006.922	1728.727	117.367	382.986	1164.368	4328
Moneyness	0.283	0.138	0.200	0.256	0.323	4328
Total Assets ($ Billions)	33.488	59.883	5.062	13.586	33.883	4330
Tobin's Q	1.804	0.792	1.231	1.573	2.151	4330
ROA	0.015	0.015	0.006	0.014	0.023	4330
Leverage	0.273	0.156	0.161	0.251	0.355	4330
Bid-Ask Spread	0.003	0.006	0.000	0.001	0.003	4330
Firm risk	0.073	0.099	0.022	0.041	0.079	4330
Callable Dummy	0.045	0.207	0.000	0.000	0.000	4330
Public Bond Dummy	0.995	0.071	1.000	1.000	1.000	4330
Maturity (in years)	11.353	8.296	5.353	10.014	10.077	4330
Principal Amount ($ Millions)	558.060	457.799	250.000	450.000	700.000	4330

Notes: This table presents the summary statistics for the variables used in this study. Definitions of all variables are provided in Appendix A. The sample period is 1996-2014.

Table 3: Options Volume and Cost of Debt

	Ln(Yield Spread)		S&P Rating		
	OLS (1)	OLS (2)	OLS (3)	OLS (4)	Poisson (5)
Ln(Option Volume)	0.038***	0.037***	-0.224***	-0.222***	-0.019***
	(0.010)	(0.010)	(0.046)	(0.045)	(0.004)
Ln(Total Assets)	-0.288***	-0.280***	1.530***	1.526***	0.130***
	(0.017)	(0.017)	(0.089)	(0.089)	(0.008)
Tobin's Q	-0.310***	-0.296***	1.359***	1.364***	0.100***
	(0.024)	(0.023)	(0.104)	(0.104)	(0.009)
ROA	-4.868***	-5.313***	24.192***	23.629***	2.345***
	(0.893)	(0.896)	(3.837)	(3.810)	(0.365)
Leverage	0.913***	0.833***	-6.018***	-6.045***	-0.611***
	(0.105)	(0.101)	(0.431)	(0.429)	(0.046)
Ln(Firm risk)	0.033***	0.035***	-0.076	-0.074	-0.010**
	(0.013)	(0.012)	(0.047)	(0.047)	(0.004)
Ln(Bid-Ask Spread)	0.137***	0.148***	-0.231**	-0.224**	-0.032***
	(0.029)	(0.030)	(0.098)	(0.097)	(0.011)
Public Bond Dummy		-0.220		0.674	0.066
		(0.179)		(0.623)	(0.050)
Ln(Maturity)		0.230***		0.193***	0.020***
		(0.021)		(0.050)	(0.004)
Callable Dummy		0.311***			
		(0.042)			
Observations	4330	4330	4330	4330	4330
R^2	0.668	0.706	0.741	0.742	

Notes: This table presents OLS and Poisson regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. Detailed definitions of all variables are provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 4: Options Volume and Cost of Debt: Open Interest as Instrument

	First stage	Second stage	
	Ln(Option Volume)	Ln(Yield Spread)	S&P Rating
	(1)	(2)	(3)
Ln(Open Interest)	0.910***		
	(0.040)		
Ln(Option Volume) (instrumented)		0.075***	-0.407***
		(0.015)	(0.065)
Ln(Total Assets)	0.565***	-0.335***	1.786***
	(0.050)	(0.023)	(0.105)
Tobin's Q	0.544***	-0.328***	1.512***
	(0.060)	(0.026)	(0.112)
ROA	3.640*	-5.490***	24.843***
	(2.142)	(0.890)	(3.739)
Leverage	-0.750***	0.863***	-6.175***
	(0.240)	(0.098)	(0.420)
Ln(Firm risk)	0.082***	0.026**	-0.025
	(0.030)	(0.011)	(0.044)
Ln(Bid-Ask Spread)	-0.221***	0.149***	-0.228**
	(0.072)	(0.031)	(0.102)
Public Bond Dummy	-0.005	-0.201	0.581
	(0.362)	(0.195)	(0.700)
Ln(Maturity)	-0.034	0.231***	0.189***
	(0.028)	(0.021)	(0.051)
Callable Dummy	0.129	0.292***	
	(0.116)	(0.039)	
Observations	4328	4328	4328
R^2	0.860	0.702	0.739

Notes: This table presents 2SLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables with average quarterly open interest (Open interest) as the instrumental variable. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 5: Options and Financial Distress: K-Z Index

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.039***	0.041***	-0.245***	-0.265***
	(0.011)	(0.011)	(0.048)	(0.048)
K-Z Index	0.046	-0.040	-1.147**	-0.491
	(0.094)	(0.096)	(0.542)	(0.646)
Ln(Option Volume) × K-Z Index		0.064**		-0.489***
		(0.026)		(0.177)
Ln(Total Assets)	-0.281***	-0.277***	1.542***	1.510***
	(0.018)	(0.018)	(0.092)	(0.091)
Tobin's Q	-0.316***	-0.315***	1.451***	1.446***
	(0.025)	(0.025)	(0.113)	(0.115)
ROA	-4.866***	-4.588***	18.345***	16.211***
	(0.920)	(0.901)	(3.748)	(3.527)
Leverage	0.849***	0.849***	-6.166***	-6.168***
	(0.110)	(0.110)	(0.474)	(0.474)
Ln(Firm risk)	0.034***	0.037***	-0.061	-0.084*
	(0.013)	(0.013)	(0.049)	(0.047)
Ln(Bid-Ask Spread)	0.141***	0.144***	-0.196*	-0.221**
	(0.032)	(0.032)	(0.103)	(0.103)
Public Bond Dummy	-0.223	-0.224	0.745	0.756
	(0.173)	(0.163)	(0.574)	(0.503)
Ln(Maturity)	0.224***	0.226***	0.195***	0.186***
	(0.022)	(0.022)	(0.053)	(0.052)
Callable Dummy	0.310***	0.314***		
	(0.043)	(0.042)		
Observations	3782	3782	3782	3782
R^2	0.702	0.704	0.748	0.752

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with the K-Z Index (Kaplan and Zingales, 1997) as a measure of financial constraints. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 6: Options Volume and Cost of Debt: Firm Distress Quartile

	Ln(Yield Spread)			
	Firm distress quartile			
	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.043**	0.040**	0.061***	0.053***
	(0.019)	(0.020)	(0.019)	(0.017)
Ln(Total Assets)	-0.321***	-0.282***	-0.326***	-0.204***
	(0.033)	(0.039)	(0.034)	(0.036)
Tobin's Q	-0.300***	-0.339***	-0.362***	-0.318***
	(0.038)	(0.043)	(0.055)	(0.063)
ROA	-3.478***	-2.585	-4.051***	-3.672**
	(1.332)	(1.574)	(1.399)	(1.610)
Leverage	0.487***	0.809***	0.695***	0.971***
	(0.179)	(0.205)	(0.261)	(0.232)
Ln(Firm risk)	0.017	0.055**	-0.004	0.030
	(0.025)	(0.025)	(0.026)	(0.023)
Ln(Bid-Ask Spread)	0.116***	0.120**	0.221***	0.096**
	(0.043)	(0.051)	(0.048)	(0.045)
Public Bond Dummy	1.336***	0.000	-0.552***	-0.032
	(0.167)	(.)	(0.065)	(0.142)
Callable Dummy	0.272*	0.405***	0.344***	0.192***
	(0.157)	(0.099)	(0.085)	(0.053)
Ln(Maturity)	0.307***	0.222***	0.270***	0.065
	(0.027)	(0.028)	(0.037)	(0.056)
Observations	945	946	945	946
R^2	0.771	0.708	0.714	0.698

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables on two subsamples of data. Quartiles of firm distress are defined according to values of the K-Z Index (Kaplan and Zingales, 1997). A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 7: Options Volume and firm distress: Firm rating

	Ln(Yield Spread)		S&P Rating	
	All firms (1)	A-tranche (2)	All firms (3)	A-tranche (4)
Ln(Option Volume)	0.022**	0.037**	-0.174***	-0.156**
	(0.010)	(0.016)	(0.047)	(0.067)
Firm Rating	-0.105***		0.384***	
	(0.013)		(0.052)	
Ln(Total Assets)	-0.227***	-0.308***	1.357***	1.446***
	(0.019)	(0.030)	(0.093)	(0.156)
Tobin's Q	-0.241***	-0.237***	1.185***	0.948***
	(0.023)	(0.036)	(0.115)	(0.143)
ROA	-4.183***	-5.535***	18.351***	31.053***
	(0.924)	(1.340)	(4.125)	(5.770)
Leverage	0.796***	0.744***	-6.126***	-5.135***
	(0.093)	(0.153)	(0.433)	(0.668)
Ln(Firm risk)	0.019	0.007	0.008	-0.035
	(0.012)	(0.023)	(0.047)	(0.079)
Ln(Bid-Ask Spread)	0.106***	0.067	-0.054	0.088
	(0.031)	(0.049)	(0.097)	(0.137)
Public Bond Dummy	-0.068	-0.741***	0.111	2.348***
	(0.206)	(0.096)	(0.686)	(0.413)
Ln(Maturity)	0.239***	0.289***	0.195***	0.132**
	(0.020)	(0.032)	(0.054)	(0.066)
Callable Dummy	0.280***	0.327**		
	(0.043)	(0.147)		
Observations	3891	1785	3891	1785
R^2	0.727	0.721	0.757	0.787

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. Firm rating is measured as Standard and Poor's rating. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 8: Options Volume and Cost of Debt: Quantile Regression

	Ln(Yield Spread)		S&P Rating	
	10th perc. (1)	90th perc. (2)	10th perc. (3)	90th perc. (4)
Ln(Option Volume)	0.040***	0.026***	-0.216***	-0.117***
	(0.011)	(0.009)	(0.063)	(0.036)
Ln(Total Assets)	-0.271***	-0.266***	1.819***	1.256***
	(0.022)	(0.016)	(0.095)	(0.068)
Tobin's Q	-0.333***	-0.270***	1.420***	1.272***
	(0.033)	(0.023)	(0.123)	(0.088)
ROA	-3.544***	-4.988***	23.158***	19.443***
	(0.944)	(0.937)	(5.928)	(3.086)
Leverage	1.000***	0.849***	-6.535***	-6.008***
	(0.093)	(0.096)	(0.517)	(0.341)
Ln(Firm risk)	0.004	0.057***	-0.316***	0.065
	(0.013)	(0.012)	(0.067)	(0.044)
Ln(Bid-Ask Spread)	0.134***	0.114***	-0.229**	0.001
	(0.020)	(0.021)	(0.112)	(0.070)
Public Bond Dummy	-0.506	-0.012	0.458	-0.085
	(0.572)	(0.091)	(0.461)	(1.137)
Ln(Maturity)	0.303***	0.082***	0.002	0.140**
	(0.018)	(0.023)	(0.043)	(0.068)
Callable Dummy	0.346***	0.216***		
	(0.063)	(0.040)		
Observations	4330	4330	4330	4330
Pseudo R^2	0.484	0.469	0.544	0.520

Notes: This table presents regression results of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables from a bootstrapped quantile regression at the 10th and 90th percentiles with 200 replications. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 9: Options Volume and future firm value

	Tobin's Q			
	Q_{t+1} (1)	Q_{t+2} (2)	Q_{t+3} (3)	Q_{t+4} (4)
Ln(Option Volume)	0.059***	0.062***	0.064***	0.062***
	(0.013)	(0.013)	(0.014)	(0.014)
Market Cap	0.027***	0.028***	0.027***	0.025***
	(0.007)	(0.007)	(0.007)	(0.007)
Turnover	-0.002***	-0.003***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
ROA	7.653***	7.354***	7.158***	6.638***
	(1.536)	(1.537)	(1.613)	(1.523)
CapX	0.001	0.004	0.002	-0.004
	(0.015)	(0.016)	(0.016)	(0.017)
Leverage	0.522***	0.501***	0.493**	0.477**
	(0.179)	(0.187)	(0.200)	(0.196)
Dividend dummy	-0.066	-0.042	-0.038	-0.018
	(0.051)	(0.054)	(0.060)	(0.058)
Observations	4107	4101	4082	4062
R^2	0.464	0.458	0.444	0.443

Notes: This table presents OLS panel regression estimates of future firm value (as proxied by Tobin's Q) on options trading volume (Option volume) and a set of control variables following Roll, Schwartz, and Subrahmanyam (2009) . The variables are constructed on a quarterly basis. The time period reference is also quarterly, meaning that Q_{t+1} refers to firm value one quarter ahead, Q_{t+2} to two quarters ahead, etc. A detailed definition of all variables is provided in Appendix A. Robust standard errors are in parentheses. All regressions include a full set of time and industry dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 10: Options Volume and future equity returns

	Buy-Hold Abnormal Returns (BHARs)			
	$[-1,+10]$		$[+1,+30]$	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.001	0.038	0.064	0.076
	(0.052)	(0.055)	(0.090)	(0.102)
Tobin's Q		-0.810***		-1.037***
		(0.192)		(0.359)
ROA		4.397		10.403
		(10.149)		(17.682)
Leverage		-1.474		-2.914*
		(0.973)		(1.692)
Ln(Firm risk)		-0.036		-0.133
		(0.136)		(0.204)
Ln(Bid-Ask Spread)		0.024		-0.057
		(0.184)		(0.334)
Observations	4170	4170	4170	4170
R^2	0.043	0.052	0.046	0.052

Notes: This table presents OLS regression estimates of Buy and hold abnormal returns (BHARs) calculated using the market model with an estimation window of 100 days ending 50 days prior to bond issuance on options trading volume (Option Volume) and a set of control variables. Time windows in all columns refer to days with respect to bond issuance. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 11: Summary Statistics: Time-series Sample

	Mean	StdDev	25%	Median	75%	Observation
Yield spread	57.267	497.285	-147.465	111.003	236.604	2028
Option Volume ($ Millions)	30.910	195.222	0.000	0.000	0.329	2028
Total Assets ($ Billions)	39.974	50.324	8.180	23.484	47.392	2028
Tobinś Q	2.202	2.356	0.976	1.213	2.200	2028
ROA	-0.007	0.040	-0.012	0.004	0.009	2028
Leverage	0.355	0.165	0.260	0.323	0.405	2028
Bid-ask spread	0.001	0.001	0.000	0.001	0.001	2028
Firm risk	0.118	0.209	0.024	0.043	0.110	2028
Maturity	8.657	7.922	4.000	5.000	8.000	2028

Notes: This table presents the summary statistics for the variables used in the time-series analysis. A definition of all variables is provided in Appendix A and Section 4.1.. Observations with positive options volume total 1,003. The sample period is 2002-2015.

Table 12: Options Volume and Cost of Debt: Time-series Analysis

	Yield spread			
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.112***	0.112**	0.098***	0.098**
	(0.038)	(0.047)	(0.037)	(0.049)
Ln(Total assets)	-0.375**	-0.375	-4.080***	-4.080***
	(0.184)	(0.341)	(0.425)	(1.014)
Tobin's Q	-1.352***	-1.352***	-2.013***	-2.013***
	(0.074)	(0.153)	(0.099)	(0.249)
ROA	-13.520***	-13.520***	-10.266***	-10.266**
	(2.356)	(4.511)	(2.414)	(4.622)
Leverage	6.733***	6.733***	7.621***	7.621***
	(0.873)	(1.696)	(1.100)	(1.962)
Ln(Firm risk)	-0.482***	-0.482***	-0.506***	-0.506***
	(0.088)	(0.181)	(0.090)	(0.168)
Ln(Bid-Ask spread)	3.245***	3.245***	3.304***	3.304***
	(0.180)	(0.713)	(0.192)	(0.832)
Ln(Maturity)	-0.224	-0.224	-1.570***	-1.570**
	(0.346)	(0.421)	(0.536)	(0.709)
Bond Fixed Effect	No	No	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
Clustered S.E.	No	Bond level	No	Bond level
Observations	2028	2028	2028	2028
R^2	0.458	0.458	0.843	0.843

Notes: This table presents OLS panel regression estimates of firm-level measures of bond yield spread over Treasuries on options trading volume (Option volume) and a set of control variables. The variables are constructed on a quarterly basis. A detailed definition of all variables is provided in Appendix A and Section 4.1.. Robust standard errors are in parentheses. All regressions include a full set of time dummies, whereas columns 3 and 4 also include bond fixed effects. Observations with positive options volume total 1,003. The sample period is 2002-2015. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 13: Options Volume and Cost of Debt: Stock return volatility

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.035***	0.030***	-0.220***	-0.189***
	(0.010)	(0.010)	(0.046)	(0.046)
Stock volatility (quarter)	0.526**		-0.877	
	(0.225)		(0.591)	
Stock volatility (year)		0.366***		-1.437***
		(0.082)		(0.408)
Ln(Total Assets)	-0.280***	-0.269***	1.528***	1.473***
	(0.018)	(0.018)	(0.090)	(0.093)
Tobin's Q	-0.286***	-0.283***	1.344***	1.328***
	(0.023)	(0.022)	(0.103)	(0.101)
ROA	-5.730***	-5.472***	24.510***	23.460***
	(0.926)	(0.891)	(3.763)	(3.778)
Leverage	0.819***	0.798***	-6.019***	-5.916***
	(0.100)	(0.098)	(0.429)	(0.419)
Ln(Bid-Ask Spread)	0.143***	0.143***	-0.217**	-0.193**
	(0.029)	(0.029)	(0.097)	(0.095)
Public Bond Dummy	-0.181	-0.175	0.609	0.503
	(0.180)	(0.179)	(0.626)	(0.629)
Ln(Maturity)	0.234***	0.233***	0.187***	0.181***
	(0.021)	(0.021)	(0.050)	(0.049)
Callable Dummy	0.309***	0.310***		
	(0.040)	(0.040)		
Observations	4330	4330	4330	4330
R^2	0.711	0.711	0.743	0.748

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, using stock return volatility as a control. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 14: Options volume and information production

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.051***	0.038**	-0.289***	-0.333***
	(0.010)	(0.016)	(0.046)	(0.071)
Ln(Analyst Coverage)	-0.157***		0.631***	
	(0.036)		(0.166)	
PINL		0.852**		-4.083**
		(0.400)		(1.728)
Ln(Total Assets)	-0.270***	-0.202***	1.506***	1.299***
	(0.018)	(0.026)	(0.095)	(0.132)
Tobin's Q	-0.271***	-0.253***	1.285***	1.335***
	(0.024)	(0.029)	(0.105)	(0.132)
ROA	-5.374***	-5.570***	22.911***	21.680***
	(0.843)	(0.952)	(3.680)	(4.997)
Leverage	0.795***	0.855***	-5.966***	-6.407***
	(0.101)	(0.160)	(0.435)	(0.612)
Ln(Firm risk)	0.031**	0.015	-0.066	-0.098
	(0.012)	(0.017)	(0.046)	(0.066)
Ln(Bid-Ask Spread)	0.140***	0.155***	-0.165*	-0.095
	(0.029)	(0.027)	(0.089)	(0.110)
Public Bond Dummy	-0.497***	0.000	1.880***	0.000
	(0.067)	(.)	(0.352)	(.)
Ln(Maturity)	0.230***	0.236***	0.191***	0.194***
	(0.022)	(0.031)	(0.052)	(0.073)
Callable Dummy	0.303***	0.479***		
	(0.043)	(0.065)		
Observations	4184	1792	4184	1792
R^2	0.713	0.707	0.750	0.698

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, including analyst coverage as a measure of firm adverse selection (Brennan and Subrahmanyam, 1995) and the logistic transformation of the probability of informed trading (PINL) (Easley, O'Hara, and Srinivas, 1998) as a proxy for price informativeness. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 15: Options Volume and Cost of Debt: Takeover vulnerability

	Ln(Yield Spread)		S&P Rating	
	High (1)	Low (2)	High (3)	Low (4)
Ln(Option Volume)	0.080***	0.035***	-0.354***	-0.242***
	(0.024)	(0.012)	(0.096)	(0.057)
Ln(Total Assets)	-0.339***	-0.255***	1.607***	1.471***
	(0.043)	(0.022)	(0.185)	(0.117)
Tobin's Q	-0.251***	-0.298***	1.293***	1.414***
	(0.040)	(0.026)	(0.192)	(0.119)
ROA	-2.519	-6.000***	7.614	25.394***
	(1.842)	(1.031)	(5.896)	(4.826)
Leverage	0.910***	0.757***	-6.752***	-5.567***
	(0.178)	(0.143)	(0.837)	(0.585)
Ln(Firm risk)	0.015	0.015	0.007	0.045
	(0.026)	(0.015)	(0.090)	(0.057)
Ln(Bid-Ask Spread)	0.216***	0.156***	-0.283*	-0.295***
	(0.040)	(0.025)	(0.154)	(0.102)
Public Bond Dummy	0.059	-0.444***	-0.802	1.943***
	(0.148)	(0.047)	(0.666)	(0.325)
Ln(Maturity)	0.245***	0.247***	0.144	0.142**
	(0.035)	(0.024)	(0.088)	(0.058)
Callable Dummy	0.399***	0.491***		
	(0.101)	(0.060)		
Observations	929	3353	929	3353
R^2	0.729	0.675	0.761	0.699

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and by subsamples of takeover vulnerability as proxied by the anti-takeover index (ATI) developed in Cremers and Nair (2005). A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 16: Options Volume and Cost of Debt: Dedicated Owners

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.035***	0.028***	-0.215***	-0.176***
	(0.011)	(0.011)	(0.046)	(0.046)
Own. Dedicated	0.134	-0.120	0.237	1.706*
	(0.239)	(0.232)	(0.945)	(0.883)
Ln(Option Volume) × Own. Dedicated		0.164**		-0.950***
		(0.067)		(0.281)
Intitutional Ownership	0.050	0.046	-0.965***	-0.945***
	(0.072)	(0.072)	(0.311)	(0.309)
Ln(Total Assets)	-0.277***	-0.276***	1.452***	1.443***
	(0.019)	(0.019)	(0.092)	(0.091)
Tobin's Q	-0.302***	-0.304***	1.301***	1.313***
	(0.025)	(0.025)	(0.112)	(0.111)
ROA	-5.881***	-5.778***	26.145***	25.533***
	(0.881)	(0.872)	(3.957)	(3.889)
Leverage	0.865***	0.876***	-6.236***	-6.289***
	(0.108)	(0.108)	(0.434)	(0.431)
Ln(Firm risk)	0.034***	0.034***	-0.096*	-0.096*
	(0.013)	(0.013)	(0.050)	(0.049)
Ln(Bid-Ask Spread)	0.137***	0.138***	-0.193*	-0.194*
	(0.033)	(0.032)	(0.102)	(0.099)
Public Bond Dummy	-0.547***	-0.552***	1.107**	1.141***
	(0.051)	(0.052)	(0.468)	(0.439)
Ln(Maturity)	0.209***	0.210***	0.194***	0.188***
	(0.023)	(0.023)	(0.053)	(0.053)
Callable Dummy	0.322***	0.316***		
	(0.045)	(0.045)		
Observations	3649	3649	3649	3649
R^2	0.712	0.713	0.748	0.750

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with ownership by dedicated institutions as defined in Bushee (1998). A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 17: Options Volume and Cost of Debt: Quasi-index Owners

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.029***	0.060***	-0.183***	-0.357***
	(0.011)	(0.020)	(0.046)	(0.087)
Own. Quasi-Index	-0.768***	-0.625***	4.111***	3.292***
	(0.191)	(0.207)	(0.793)	(0.837)
Ln(Option Volume) × Own. Quasi-Index		-0.068**		0.384***
		(0.030)		(0.140)
Intitutional Ownership	0.583***	0.593***	-3.738***	-3.788***
	(0.155)	(0.154)	(0.638)	(0.629)
Ln(Total Assets)	-0.258***	-0.259***	1.351***	1.354***
	(0.019)	(0.019)	(0.092)	(0.092)
Tobin's Q	-0.287***	-0.290***	1.220***	1.235***
	(0.025)	(0.025)	(0.110)	(0.109)
ROA	-6.063***	-5.980***	27.165***	26.661***
	(0.878)	(0.879)	(3.906)	(3.892)
Leverage	0.817***	0.819***	-5.941***	-5.941***
	(0.104)	(0.104)	(0.422)	(0.419)
Ln(Firm risk)	0.031**	0.031**	-0.079	-0.081*
	(0.012)	(0.012)	(0.048)	(0.048)
Ln(Bid-Ask Spread)	0.136***	0.134***	-0.185*	-0.173*
	(0.032)	(0.032)	(0.097)	(0.096)
Public Bond Dummy	-0.537***	-0.554***	1.062*	1.160*
	(0.056)	(0.059)	(0.582)	(0.616)
Ln(Maturity)	0.209***	0.210***	0.196***	0.190***
	(0.023)	(0.023)	(0.053)	(0.054)
Callable Dummy	0.317***	0.305***		
	(0.043)	(0.043)		
Observations	3649	3649	3649	3649
R^2	0.716	0.717	0.754	0.756

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with ownership by Quasi-index institutions as defined in Bushee (1998). A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 18: Options and Strategic Default: Liquidation Costs

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.037***	0.084***	-0.221***	-0.622***
	(0.010)	(0.026)	(0.045)	(0.161)
Intangibles	0.430**	0.632***	-2.314***	-4.046***
	(0.171)	(0.200)	(0.789)	(0.929)
Ln(Option Volume) × Intangibles		-0.070*		0.602***
		(0.038)		(0.233)
Ln(Total Assets)	-0.282***	-0.279***	1.534***	1.509***
	(0.018)	(0.018)	(0.091)	(0.089)
Tobin's Q	-0.295***	-0.294***	1.373***	1.370***
	(0.024)	(0.024)	(0.102)	(0.103)
ROA	-5.450***	-5.364***	23.716***	22.971***
	(0.923)	(0.921)	(3.846)	(3.728)
Leverage	0.881***	0.868***	-6.307***	-6.196***
	(0.106)	(0.107)	(0.433)	(0.426)
Ln(Firm risk)	0.034***	0.036***	-0.070	-0.083*
	(0.012)	(0.012)	(0.047)	(0.045)
Ln(Bid-Ask Spread)	0.149***	0.152***	-0.209**	-0.239**
	(0.030)	(0.031)	(0.096)	(0.098)
Public Bond Dummy	-0.205	-0.198	0.625	0.569
	(0.180)	(0.178)	(0.627)	(0.603)
Ln(Maturity)	0.232***	0.233***	0.173***	0.165***
	(0.021)	(0.021)	(0.049)	(0.048)
Callable Dummy	0.329***	0.331***		
	(0.045)	(0.045)		
Observations	4228	4228	4228	4228
R^2	0.705	0.706	0.742	0.745

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with liquidation costs proxied by intangible assets as in Favara, Schroth, and Valta (2012). A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 19: Options and Strategic Default: Insider Ownership

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.030**	0.025**	-0.192***	-0.180***
	(0.012)	(0.012)	(0.051)	(0.054)
Inside Own.	0.333***	0.197*	-1.084***	-0.755
	(0.088)	(0.106)	(0.378)	(0.482)
Ln(Option Volume) × Inside Own.		0.069**		-0.166
		(0.031)		(0.166)
Institutional Ownership	0.110*	0.118*	-1.008***	-1.026***
	(0.063)	(0.063)	(0.281)	(0.280)
Ln(Total Assets)	-0.265***	-0.265***	1.397***	1.398***
	(0.020)	(0.019)	(0.096)	(0.096)
Tobin's Q	-0.315***	-0.318***	1.345***	1.350***
	(0.025)	(0.025)	(0.111)	(0.112)
ROA	-6.347***	-6.271***	26.997***	26.808***
	(0.938)	(0.939)	(3.958)	(3.964)
Leverage	0.883***	0.893***	-6.240***	-6.262***
	(0.113)	(0.113)	(0.421)	(0.422)
Ln(Firm risk)	0.036**	0.036**	-0.091*	-0.090*
	(0.014)	(0.014)	(0.049)	(0.049)
Ln(Bid-Ask Spread)	0.098***	0.098***	-0.092	-0.093
	(0.037)	(0.037)	(0.100)	(0.100)
Public Bond Dummy	-0.566***	-0.560***	1.175***	1.162**
	(0.051)	(0.052)	(0.453)	(0.456)
Ln(Maturity)	0.210***	0.209***	0.181***	0.183***
	(0.024)	(0.024)	(0.056)	(0.056)
Callable Dummy	0.308***	0.303***		
	(0.042)	(0.041)		
Observations	3852	3852	3852	3852
R^2	0.705	0.705	0.748	0.749

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with insider ownership as a measure of shareholders' bargaining power (Favara, Schroth, and Valta, 2012). A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

References

Admati, A. R., Pfleiderer, P., 1988. A theory of intraday patterns: Volume and price variability. Review of Financial studies 1, 3–40.

Altman, E. I., 1968. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. The Journal of Finance 23, 589–609.

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

Aragon, G. O., Martin, J. S., 2012. A unique view of hedge fund derivatives usage: Safeguard or speculation? Journal of Financial Economics 105, 436–456.

Aslan, H., Kumar, P., 2012. Strategic ownership structure and the cost of debt. Review of Financial Studies 25, 2257–2299.

Augustin, P., Brenner, M., Subrahmanyam, M. G., 2015. Informed options trading prior to m&a announcements: Insider trading? Working Paper .

Avramov, D., Jostova, G., Philipov, A., 2007. Understanding changes in corporate credit spreads. Financial Analysts Journal 63, 90–105.

Back, K., 1993. Asymmetric information and options. Review of Financial Studies 6, 435–472.

Beaver, W. H., McAnally, M. L., Stinson, C. H., 1997. The information content of earnings and prices: A simultaneous equations approach. Journal of Accounting and Economics 23, 53–81.

Berger, P. G., Ofek, E., Swary, I., 1996. Investor valuation of the abandonment option. Journal of Financial Economics 42, 257–287.

Blanco, I., Wehrheim, D., 2017. The bright side of financial derivatives: Options trading and firm innovation. Journal of Financial Economics 125, 99–119.

Borisova, G., Fotak, V., Holland, K., Megginson, W. L., 2015. Government ownership and the cost of debt: Evidence from government investments in publicly traded firms. Journal of Financial Economics 118, 168–191.

Brennan, M. J., Subrahmanyam, A., 1995. Investment analysis and price formation in securities markets. Journal of Financial Economics 38, 361–381.

Bushee, B. J., 1998. The influence of institutional investors on myopic r&d investment behavior. The Accounting Review pp. 305–333.

Campbell, J. Y., Taksler, G. B., 2003. Equity volatility and corporate bond yields. The Journal of Finance 58, 2321–2350.

Cao, C., Chen, Z., Griffin, J. M., 2005. Informational content of option volume prior to takeovers. The Journal of Business 78, 1073–1109.

Cao, H. H., 1999. The effect of derivative assets on information acquisition and price behavior in a rational expectations equilibrium. Review of Financial Studies 12, 131–163.

Chakravarty, S., Gulen, H., Mayhew, S., 2004. Informed trading in stock and option markets. The Journal of Finance 59, 1235–1257.

Chan, K., Ge, L., Lin, T.-C., 2015. Informational content of options trading on acquirer announcement return. Journal of Financial and Quantitative Analysis 50, 1057–1082.

Chen, Q., Goldstein, I., Jiang, W., 2007. Price informativeness and investment sensitivity to stock price. Review of Financial Studies 20, 619–650.

Collin-Dufresne, P., Goldstein, R. S., Martin, J. S., 2001. The determinants of credit spread changes. The Journal of Finance 56, 2177–2207.

Cremers, K., Nair, V. B., 2005. Governance mechanisms and equity prices. The Journal of Finance 60, 2859–2894.

Cremers, K. M., Nair, V. B., Wei, C., 2007. Governance mechanisms and bond prices. Review of Financial Studies 20, 1359–1388.

Datta, S., Iskandar-Datta, M., Patel, A., 1999. Bank monitoring and the pricing of corporate public debt. Journal of Financial Economics 51, 435–449.

Dow, J., Gorton, G., 1997. Stock market efficiency and economic efficiency: Is there a connection? The Journal of Finance 52, 1087–1129.

Easley, D., Hvidkjaer, S., O'hara, M., 2002. Is information risk a determinant of asset returns? The Journal of Finance 57, 2185–2221.

Easley, D., Kiefer, N., O'Hara, M., 1997. One day in the life of a very common stock. Review of Financial Studies 10, 805–835.

Easley, D., Kiefer, N. M., O'hara, M., Paperman, J. B., 1996. Liquidity, information, and infrequently traded stocks. The Journal of Finance 51, 1405–1436.

Easley, D., O'Hara, M., Srinivas, P., 1998. Option volume and stock prices: Evidence on where informed traders trade. The Journal of Finance 53, 431–465.

Elton, E. J., Gruber, M. J., Agrawal, D., Mann, C., 2001. Explaining the rate spread on corporate bonds. The Journal of Finance 56, 247–277.

Ericsson, J., Jacobs, K., Oviedo, R., et al., 2009. The determinants of credit default swap premia. Journal of Financial and Quantitative Analysis 44, 109–132.

Faure-Grimaud, A., Gromb, D., 2004. Public trading and private incentives. Review of Financial Studies 17, 985–1014.

Favara, G., Schroth, E., Valta, P., 2012. Strategic default and equity risk across countries. The Journal of Finance 67, 2051–2095.

Feldhütter, P., Hotchkiss, E., Karakaş, O., 2016. The value of creditor control in corporate bonds. Journal of Financial Economics 121, 1 – 27.

Ferreira, D., Ferreira, M. A., Raposo, C. C., 2011. Board structure and price informativeness. Journal of Financial Economics 99, 523–545.

Francis, B. B., Hasan, I., John, K., Waisman, M., 2010. The effect of state antitakeover laws on the firm's bondholders. Journal of Financial Economics 96, 127–154.

Garlappi, L., Shu, T., Yan, H., 2008. Default risk, shareholder advantage, and stock returns. Review of Financial Studies 21, 2743–2778.

Ge, L., Hu, J., Humphery-Jenner, M., Lin, T.-C., 2016a. Informed options trading prior to bankruptcy filings. Working Paper .

Ge, L., Lin, T.-C., Pearson, N. D., 2016b. Why does the option to stock volume ratio predict stock returns? Journal of Financial Economics 120, 601–622.

Glosten, L. R., Harris, L. E., 1988. Estimating the components of the bid/ask spread. Journal of Financial Economics 21, 123–142.

Hasbrouck, J., 1991. Measuring the information content of stock trades. The Journal of Finance 46, 179–207.

Holmström, B., Tirole, J., 1993. Market liquidity and performance monitoring. Journal of Political Economy pp. 678–709.

Hong, H., Lim, T., Stein, J. C., 2000. Bad news travels slowly: Size, analyst coverage, and the profitability of momentum strategies. The Journal of Finance 55, 265–295.

Huang, R. D., Stoll, H. R., 1997. The components of the bid-ask spread: A general approach. Review of Financial Studies 10, 995–1034.

Irwin, D. A., Terviö, M., 2002. Does trade raise income?: Evidence from the twentieth century. Journal of International Economics 58, 1–18.

Johnson, T. L., So, E. C., 2012. The option to stock volume ratio and future returns. Journal of Financial Economics 106, 262–286.

Kaplan, S. N., Zingales, L., 1997. Do investment-cash flow sensitivities provide useful measures of financing constraints? The Quarterly Journal of Economics 112, 169–215.

Kleibergen, F., Paap, R., 2006. Generalized reduced rank tests using the singular value decomposition. Journal of Econometrics 133, 97–126.

Koski, J. L., Pontiff, J., 1999. How are derivatives used? evidence from the mutual fund industry. The Journal of Finance 54, 791–816.

Lamont, O., Polk, C., Saaá-Requejo, J., 2001. Financial constraints and stock returns. Review of Financial Studies 14, 529–554.

Maxwell, W. F., Stephens, C. P., 2003. The wealth effects of repurchases on bondholders. The Journal of Finance 58, 895–920.

Mayhew, S., Mihov, V., 2004. How do exchanges select stocks for option listing? The Journal of Finance 59, 447–471.

Naiker, V., Navissi, F., Truong, C., 2013. Options trading and the cost of equity capital. The Accounting Review 88, 261–295.

Ni, S. X., Pan, J., Poteshman, A. M., 2008. Volatility information trading in the option market. The Journal of Finance 63, 1059–1091.

Odders-White, E. R., Ready, M. J., 2006. Credit ratings and stock liquidity. Review of Financial Studies 19, 119–157.

Pagano, M., 1989. Trading volume and asset liquidity. The Quarterly Journal of Economics 104, 255–274.

Pan, J., Poteshman, A. M., 2006. The information in option volume for future stock prices. Review of Financial Studies 19, 871–908.

Petersen, M. A., 2009. Estimating standard errors in finance panel data sets: Comparing approaches. Review of Financial Studies 22, 435–480.

Poteshman, A. M., 2006. Unusual option market activity and the terrorist attacks of september 11, 2001. The Journal of Business 79, 1703–1726.

Qi, Y., Roth, L., Wald, J. K., 2010. Political rights and the cost of debt. Journal of Financial Economics 95, 202–226.

Qiu, J., Yu, F., 2009. The market for corporate control and the cost of debt. Journal of Financial Economics 93, 505–524.

Rajan, R. G., Zingales, L., 1995. What do we know about capital structure? some evidence from international data. The Journal of Finance 50, 1421–1460.

Roll, R., 1984. A simple implicit measure of the effective bid-ask spread in an efficient market. The Journal of Finance 39, 1127–1139.

Roll, R., Schwartz, E., Subrahmanyam, A., 2009. Options trading activity and firm valuation. Journal of Financial Economics 94, 345–360.

Roll, R., Schwartz, E., Subrahmanyam, A., 2010. O/s: The relative trading activity in options and stock. Journal of Financial Economics 96, 1–17.

Stock, J. H., Yogo, M., 2005. Testing for weak instruments in linear iv regression. Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg p. 80.

Stoll, H. R., 1989. Inferring the components of the bid-ask spread: theory and empirical tests. The Journal of Finance 44, 115–134.

Valta, P., 2012. Competition and the cost of debt. Journal of Financial Economics 105, 661 – 682.

Appendix A Variable definition

A.1. Bond variables

Variable	Definition
Yield spread (in basis points)	Difference in the bond yield to maturity at-issue (reported by SDC Global New Issues) and the yield of a Treasury bond (collected from the Federal Reserve H-15 Release) with the same maturity. In cases in which there is no maturity-equivalent Treasury, we use linear interpolation to calculate the yield of the risk-free bond.
Ln(Yield spread)	Natural logarithm of Yield spread.
S&P Rating	Bond rating by the agency Standard and Poor's (as reported by SDC Global New Issues). We transform the ordinal variable into a numerical scale in the following way: 1-CCC-, 2-CCC, 3-CCC+, 4-B-, 5-B, 6-B+, 7-BB-, 8-BB, 9-BB+, 10-BBB-, 11-BBB, 12-BBB+, 13-A-, 14-A, 15-A+, 16-AA-, 17-AA, 18-AA+, 19-AAA-, 20-AAA, 21-AAA+.
Public Bond Dummy	Dummy variable equal 1 if the bond is public (as reported by SDC Global New Issues) and zero otherwise.
Callable Dummy	Dummy variable equal 1 if the bond is callable (as reported by SDC Global New Issues) and zero otherwise.
Maturity (in years)	Time to maturity (in years) as reported by SDC Global New Issues.
Principal	Principal amount of the issue (in $ millions) as reported by SDC Global New Issues.
Junk Bond Dummy	Dummy variable that equals one if the bond is rated below B- by Standard and Poor's and zero otherwise.

A.2. Option variables

Variable	Definition
Options volume (millions)	Total daily trade in each option multiplied by end-of-day quote midpoint for that option. This number is then aggregated across all options for a single stock on all trading days for a given quarter. Following Roll, Schwartz, and Subrahmanyam (2009). Source: Option Metrics.
Ln(Option volume)	Natural logarithm of Options volume.
Open interest	Quarterly average of the daily Open interest (number of put and call contracts that remain open on a stock) provided by Option Metrics.
Ln(Open interest)	Natural logarithm of Open interest.
Moneyness	Quarterly average of the daily absolute deviation of the exercise price of each traded option from the closing price of the underlying stock. Following Roll, Schwartz, and Subrahmanyam (2009). Source: Option Metrics and CRSP-Compustat.
Ln(Moneyness)	Natural logarithm of Moneyness.
High option volume	Dummy variable that equals one if the firm's value for Options volume is above the median for that year and zero otherwise.

A.3. Firm variables

Variable	Definition
Ln(Total assets)	Natural logarithm of quarterly total assets for a firm reported by CRSP-Compustat.
Tobin's Q	Sum of the market capitalization of a firm's common equity (stock price times shares outstanding at the end of the quarter), liquidation value of its preferred shares and the book value of debt, divided by book value of assets. Calculated for each quarter based on CRSP-Compustat items. (Tobin's Q = (prccq×cshoq + atq - ceqq - txdb)/atq)).
ROA	Return on assets. Net income over total assets (quarterly). Source: CRSP-Compustat.
Leverage	Total debt over total assets (quarterly). Source: CRSP-Compustat.
Firm risk	Standard deviation of quarterly cash-flow from operations (income before extraordinary items plus depreciation and amortization, normalized by total assets) over the previous year. Source: CRSP-Compustat.
Ln(Firm risk)	Natural logarithm of Firm risk.
Bid-ask spread	Average of the daily relative bid-ask spread for a stock and quarter. Relative Bid-ask spread = 100×(Ask - Bid)/(0.5×(Ask + Bid)). Source: CRSP-Compustat.
Ln(Bid-ask spread)	Natural logarithm of Bid-ask spread.
K-Z index	Kaplan and Zingales (1997) Index for financial constraints build under the Lamont, Polk, and Saaá-Requejo (2001) specification: $KZ = -1.001 \times Cash - flow_t/PPE_{t-1} + 0.282 \times Q_t + 3.139 \times Debt_t/Capital_t - 39.367 \times Dividends_t/PPE_{t-1} - 1.314 \times Cash_t/PPE_{t-1}$. Data from Compustat.
Firm rating	Standard and Poor's rating for the firm in the year of bond issue converted to a numerical scale where higher values indicate better ratings. Data from Compustat.
Market Cap	Market capitalization of the firm in the quarter prior to bond issuance. Data from CRSP-Compustat.
Turnover	Share turnover for the quarter prior to bond issuance. Data from CRSP-Compustat.
CapX	Capital expenditures over sales. Data from Compustat.
Dividend dummy	Dummy variable equal one if the firm pays dividends. Data from Compustat.
Stock return volatility	Standard deviation of daily stock returns during the quarter (or year) prior to bond issuance. Data from CRSP.
Ln(Analyst Coverage)	Natural logarithm of the number of analysts covering a stock (firm) in a given year. Data from I/B/E/S.

A.3. Firm variables (continued)

Variable	Definition
PINL	Logistic transformation of the PIN measure (Probability of Informed Trading) as defined by Easley, Kiefer, O'hara, and Paperman (1996). Data from Professor Stephen Brown website: http://scholar.rhsmith.umd.edu/sbrown/pin-data.
ATI	Anti-takeover index from Cremers and Nair (2005) and Cremers, Nair, and Wei (2007). Data from ISS (formerly RiskMetrics).
Institutional ownership	Total shares held by institutional investors from the Thomson Reuters 13F quarterly filing over total shares outstanding from CRSP.
Ownership Dedicated/ Transient/ Quasi-Index	Total shares held by Dedicated/ Transient/ Quasi-index institutional investors from the Bushee (1998) classification and Thomson Reuters 13F filing over total shares outstanding from CRSP.
Ln(Amihud Illiq)	Natural logarithm of the Amihud (2002) illiquidity measure calculated as the ratio between absolute stock return and turnover from CRSP over a trading quarter.
Insiders ownership	Total shares held by insiders from Worldscope over total shares outstanding.
Intangibles	Measured as in Berger, Ofek, and Swary (1996): $Intangibles = 1 - (Cash + 0.715 \times Receivables + 0.547 \times Inventories + 0.535 \times PPE)/Assets$. Data from Compustat.

Appendix B

This Appendix provides additional material to the results in *'The hidden cost of financial derivatives: Options trading and the cost of debt'*. Specifically, we discuss various issues regarding instrumental variable analysis, the monotonicity of the main effect, robustness of the effect to different specifications and the addition of several controls.

We begin by including information regarding the instrumental variable analysis using an alternative instrument to *Open interest*, the results of which are presented in the core of the paper. Table B1 contains the results from performing a 2SLS regression of *Ln(Option volume)* and a set of control variables (defined in Section 2. of the paper and Appendix A) on our two measures of the cost of debt (bond yield spread and S&P rating) using *Moneyness* as an instrument. Similar to the case of *Open interest* (reported in Table 4 in the paper), *Moneyness* is highly relevant for explaining Option volume. Its coefficient in the first stage is large and highly significant (1.157, p-value<0.01), and the Kleibergen and Paap (2006) test rejects its irrelevancy (p-value<0.01). Moreover, the Cragg-Donald Wald F-statistic is not only well above the standard rule of thumb of 10, but it is also higher than the Stock and Yogo (2005) critical values, which rejects the null of a weak instrument. The coefficients for instrumented *Ln(Option volume)* are large, highly significant (p-value<0.01) and in the expected direction. The economic magnitudes of the coefficients, however, are significantly larger than those reported when using open interest as an instrument (e.g., 0.333 vs. 0.075 with bond yield spread as the dependent variable). Although these discrepancies can occur for a variety of reasons (from mitigating errors-in-variables biases to different instruments capturing different correlations with the instrumented variable), we extend our instrumental variable regression specification to simultaneously include both instruments. These results are reported in Table B2. The results reinforce the thesis of an effect of options volume on the cost of debt that is not driven by reverse causality. The coefficients for the instrumented option volume variable are, again, highly significant (p-value<0.01) and closer to the values achieved with open interest as an instrument. Instrument irrelevancy and weakness are again rejected, and the Hansen J-statistic also rejects overidentification problems. Overall, the results from this comprehensive instrumental variable analysis indicate strong causality running from more liquid options markets to a firm's cost of debt.

Next, we provide a set of different robustness tests to our baseline specification in Eq. 1 in the paper. Table B3 analyzes the monotonicity of the effect in two dimensions. First, columns 1 and 3 add to the regression model a squared term for option volume,

Ln(Option volume)×*Ln(Option Volume)*, for bond yield spread and rating as dependent variables, respectively. Second, we include in columns 2 and 4 a dummy variable, *High Options Volume*, that equals one if a firm's option volume is above the median in a given year and zero otherwise, as well as its interaction with *Ln(Option volume)*.

Table B4 contains the results of the baseline regression model after the inclusion of two additional controls, the *Principal* amount of the bond issued and the percentage of *Institutional ownership* of the firm. Because institutional ownership data (which we obtain from Thomson Reuters 13F filing) are not available for all firms in our sample, we lose some observations when adding this control.

Table B5 considers different regression models when using S&P bond rating as the dependent variable. Using the same variables as in the baseline specification, we first modify the ordinal measure of bond rating to the natural log of one plus the rating, *Ln(1+Rating)*. Second, we fit ordered logit and negative binomial models to the main rating variable.

Table B6 considers the case of four-digit SIC (Standard Industry Classification code) fixed effects. We extend the classic two-digit industry dummies (which we use in the remaining analyses) to consider four-digit industry fixed effects. Columns 1 and 3 include four-digit SIC and time fixed effects, while columns 2 and 4 contain industry (four-digit SIC) by time fixed effects.

Although we carefully control for time effects in our baseline regressions, to alleviate concerns related to financially turbulent time periods driving our results, we run our baseline regression model for the financial crisis of 2007. Specifically, Table B7 contains the baseline regression models for the crisis period (columns 1 and 3), defined as the years 2007 thorugh 2010, and outside crisis (columns 2 and 4) with bond yield spread and credit rating as the dependent variable, respectively.

We then discuss the role of liquidity in our results in Tables B8 and B9. We begin by replacing our primary measure of liquidity, stock *bid-ask spread*, for another common measure in the literature, Amihud (2002) liquidity. We report these results in Table B8. Then, we estimate the baseline regression in Eq. 1 for the subsamples of high and low liquidity, defined as being below and above the median bid-ask spread. The results for the high (low) subsample correspond to columns 1 and 3 (2 and 4) in Table B9.

Finally, we report the analysis of the effect of *Transient* owners (as defined in Bushee, 1998) on our main results. Whereas the impact of *Dedicated* and *Quasi-index* owners (reported in Tables 16 and 17 of the paper) is important and aligns with our predictions, we leave the least interesting case of transient owners to the appendix. Columns 1 and 3

in Table B10 contain the baseline regression model with the percentage of institutional ownership and transient ownership as controls for bond yield spread and bond rating, respectively. In columns 2 and 4, we also incorporate the interaction term of ownership by transient investors and *Ln(Option volume)*.

Table B1: Options Volume and Cost of Debt: Moneyness as Instrument

	First stage	Second stage	
	Ln(Option Volume)	Ln(Yield Spread)	S&P Rating
	(1)	(2)	(3)
Ln(Moneyness)	1.157***		
	(0.109)		
Ln(Option Volume) (instrumented)		0.333***	-1.361***
		(0.043)	(0.164)
Ln(Total Assets)	1.377***	-0.697***	3.119***
	(0.036)	(0.062)	(0.249)
Tobin's Q	0.871***	-0.551***	2.332***
	(0.057)	(0.049)	(0.183)
ROA	5.713***	-6.054***	26.903***
	(2.180)	(1.098)	(4.512)
Leverage	-0.914***	1.055***	-6.823***
	(0.305)	(0.133)	(0.534)
Ln(Firm risk)	0.167***	-0.027	0.173***
	(0.037)	(0.017)	(0.067)
Ln(Bid-Ask Spread)	-0.150*	0.155***	-0.255*
	(0.086)	(0.043)	(0.149)
Public Bond Dummy	-0.293	-0.076	0.123
	(0.490)	(0.321)	(1.160)
Ln(Maturity)	-0.008	0.236***	0.169***
	(0.031)	(0.025)	(0.063)
Callable Dummy	0.298*	0.200***	
	(0.157)	(0.056)	
Observations	4328	4328	4328
R^2	0.775		

Notes: This table presents 2SLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables with average absolute moneyness (Moneyness) as the instrumental variable. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B2: Options Volume and Cost of Debt: Both Instruments

	First stage	Second stage	
	Ln(Option Volume)	Ln(Yield Spread)	S&P Rating
	(1)	(2)	(3)
Ln(Open Interest)	0.872***		
	(0.041)		
Ln(Moneyness)	0.360***		
	(0.095)		
Ln(Option Volume) (instrumented)		0.090***	-0.462***
		(0.015)	(0.065)
Ln(Total Assets)	0.591***	-0.355***	1.863***
	(0.050)	(0.023)	(0.106)
Tobin's Q	0.559***	-0.341***	1.559***
	(0.059)	(0.026)	(0.112)
ROA	4.676**	-5.522***	24.961***
	(2.131)	(0.892)	(3.752)
Leverage	-0.802***	0.874***	-6.213***
	(0.241)	(0.098)	(0.422)
Ln(Firm risk)	0.075**	0.023**	-0.013
	(0.030)	(0.011)	(0.044)
Ln(Bid-Ask Spread)	-0.252***	0.149***	-0.230**
	(0.076)	(0.031)	(0.104)
Public Bond Dummy	0.034	-0.193	0.555
	(0.360)	(0.202)	(0.725)
Ln(Maturity)	-0.030	0.231***	0.188***
	(0.027)	(0.022)	(0.051)
Callable Dummy	0.119	0.287***	
	(0.115)	(0.039)	
Hansen J-statistic		63.56	49.49
(p-value)		(0.00)	(0.00)
Observations	4328	4328	4328
R^2	0.861		

Notes: This table presents 2SLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables with average quarterly open interest (Open interest) and average absolute moneyness (Moneyness) as instrumental variables. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B3: Options Volume and Cost of Debt: Monotonicity

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.042***	0.044***	-0.284***	-0.257***
	(0.013)	(0.012)	(0.060)	(0.055)
Ln(Option Volume) × Ln(Option Volume)	-0.001		0.015*	
	(0.002)		(0.009)	
High Options Volume		-0.017		-0.174
		(0.058)		(0.299)
Ln(Option Volume) × High Options Volume		-0.006		0.078
		(0.015)		(0.076)
Ln(Total Assets)	-0.278***	-0.278***	1.491***	1.505***
	(0.018)	(0.018)	(0.087)	(0.088)
Tobin's Q	-0.295***	-0.294***	1.346***	1.353***
	(0.023)	(0.023)	(0.103)	(0.104)
ROA	-5.283***	-5.312***	23.242***	23.447***
	(0.902)	(0.897)	(3.741)	(3.760)
Leverage	0.828***	0.828***	-5.984***	-6.004***
	(0.100)	(0.100)	(0.420)	(0.423)
Ln(Firm risk)	0.036***	0.035***	-0.081*	-0.077
	(0.012)	(0.012)	(0.046)	(0.047)
Ln(Bid-Ask Spread)	0.150***	0.150***	-0.242**	-0.235**
	(0.030)	(0.030)	(0.097)	(0.098)
Public Bond Dummy	-0.215	-0.216	0.612	0.634
	(0.177)	(0.176)	(0.599)	(0.603)
Ln(Maturity)	0.230***	0.231***	0.196***	0.193***
	(0.022)	(0.021)	(0.050)	(0.050)
Callable Dummy	0.310***	0.308***		
	(0.041)	(0.042)		
Observations	4330	4330	4330	4330
R^2	0.706	0.706	0.743	0.742

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume), its squared term, a dummy variable for high options volume (*High options volume*), its interaction with Options volume, and a set of control variables. *High options volume* equals one if the options volume for firm is above the median in a given year and zero otherwise. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B4: Options Volume and Cost of Debt: Additional Controls

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.033***	0.032***	-0.214***	-0.212***
	(0.010)	(0.010)	(0.045)	(0.046)
Ln(Total Assets)	-0.321***	-0.318***	1.605***	1.526***
	(0.017)	(0.018)	(0.091)	(0.094)
Tobin's Q	-0.300***	-0.307***	1.372***	1.307***
	(0.022)	(0.023)	(0.103)	(0.110)
ROA	-5.455***	-5.757***	23.910***	25.875***
	(0.845)	(0.838)	(3.792)	(3.905)
Leverage	0.824***	0.867***	-6.020***	-6.229***
	(0.094)	(0.101)	(0.419)	(0.424)
Ln(Firm risk)	0.028**	0.030**	-0.060	-0.088*
	(0.012)	(0.012)	(0.047)	(0.049)
Ln(Bid-Ask Spread)	0.144***	0.136***	-0.216**	-0.199**
	(0.029)	(0.033)	(0.096)	(0.101)
Public Bond Dummy	-0.301	-0.549***	0.837	1.124**
	(0.195)	(0.058)	(0.657)	(0.519)
Ln(Maturity)	0.221***	0.199***	0.210***	0.214***
	(0.021)	(0.022)	(0.050)	(0.053)
Callable Dummy	0.291***	0.309***		
	(0.040)	(0.043)		
Principal	0.245***	0.248***	-0.486***	-0.467***
	(0.029)	(0.031)	(0.128)	(0.129)
Intitutional Ownership		0.067		-1.010***
		(0.070)		(0.309)
Observations	4330	3852	4330	3852
R^2	0.709	0.714	0.744	0.750

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables that additionally include the bond principal amount (*Principal*) and total *Institutional ownership*. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B5: Options Volume and Cost of Debt: Alternative distributions for bond rating

	Ln(1+Rating)	S&P Rating	
	OLS	Ordered Logit	Neg.Binomial
	(1)	(2)	(3)
Ln(Option Volume)	-0.019***	-0.237***	-0.019***
	(0.005)	(0.051)	(0.004)
Ln(Total Assets)	0.130***	1.701***	0.130***
	(0.008)	(0.108)	(0.008)
Tobin's Q	0.101***	1.657***	0.100***
	(0.010)	(0.147)	(0.009)
ROA	2.479***	25.767***	2.345***
	(0.380)	(4.374)	(0.365)
Leverage	-0.614***	-6.269***	-0.611***
	(0.046)	(0.475)	(0.046)
Ln(Firm risk)	-0.013***	-0.049	-0.010**
	(0.004)	(0.052)	(0.004)
Ln(Bid-Ask Spread)	-0.036***	-0.159	-0.032***
	(0.011)	(0.103)	(0.011)
Public Bond Dummy	0.051	0.945**	0.066
	(0.060)	(0.458)	(0.050)
Ln(Maturity)	0.024***	0.155***	0.020***
	(0.004)	(0.056)	(0.004)
Observations	4330	4330	4330

Notes: This table presents OLS regression estimates of firms-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of industry and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B6: Options Volume and Cost of Debt: SIC4 Dummies

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.030***	0.072***	-0.203***	-0.419***
	(0.010)	(0.016)	(0.042)	(0.069)
Ln(Total Assets)	-0.303***	-0.377***	1.641***	1.909***
	(0.017)	(0.028)	(0.088)	(0.123)
Tobin's Q	-0.275***	-0.328***	1.068***	1.104***
	(0.025)	(0.043)	(0.113)	(0.198)
ROA	-4.460***	-3.595**	21.292***	20.149***
	(0.792)	(1.418)	(3.483)	(6.835)
Leverage	0.753***	0.932***	-5.386***	-6.012***
	(0.092)	(0.172)	(0.452)	(0.739)
Ln(Firm risk)	0.032***	0.032	-0.055	-0.046
	(0.012)	(0.021)	(0.045)	(0.085)
Ln(Bid-Ask Spread)	0.140***	0.131***	-0.240***	-0.655***
	(0.028)	(0.039)	(0.084)	(0.152)
Public Bond Dummy	-0.312**	-0.557***	0.846	1.761***
	(0.147)	(0.128)	(0.815)	(0.418)
Ln(Maturity)	0.227***	0.267***	0.143***	0.056**
	(0.020)	(0.013)	(0.043)	(0.026)
Callable Dummy	0.234***	0.148***		
	(0.043)	(0.048)		
Fixed effects	Time & Industry	Industry-by-Time	Time & Industry	Industry-by-Time
Observations	4330	4330	4330	4330
R^2	0.756	0.597	0.811	0.655

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. A detailed definition of all variables is provided in Appendix A. Robust standard errors are in parentheses. Industry is defined at the four-digit SIC code level. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B7: Options Volume and firm distress: Financial crisis

	Ln(Yield Spread)		S&P Rating	
	Crisis (1)	No crisis (2)	Crisis (3)	No crisis (4)
Ln(Option Volume)	0.034**	0.044***	-0.171***	-0.255***
	(0.014)	(0.011)	(0.066)	(0.052)
Ln(Total Assets)	-0.232***	-0.303***	1.514***	1.564***
	(0.026)	(0.020)	(0.118)	(0.102)
Tobin's Q	-0.305***	-0.296***	1.643***	1.317***
	(0.040)	(0.027)	(0.180)	(0.114)
ROA	-3.409***	-6.153***	15.918***	27.561***
	(1.192)	(1.114)	(5.705)	(4.471)
Leverage	0.579***	0.927***	-5.649***	-6.220***
	(0.152)	(0.120)	(0.636)	(0.496)
Ln(Firm risk)	0.034**	0.028*	-0.088	-0.050
	(0.017)	(0.014)	(0.080)	(0.055)
Ln(Bid-Ask Spread)	0.284***	0.109***	-0.224*	-0.206*
	(0.052)	(0.033)	(0.132)	(0.114)
Public Bond Dummy	0.319	-0.400***	-0.610	1.009***
	(0.512)	(0.058)	(1.930)	(0.272)
Ln(Maturity)	0.069***	0.284***	0.163**	0.205***
	(0.022)	(0.025)	(0.068)	(0.060)
Callable Dummy	0.294***	0.332***		
	(0.060)	(0.051)		
Observations	1231	3099	1231	3099
R^2	0.709	0.693	0.774	0.738

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. The crisis period is defined as the years 2007, 2008, 2009 and 2010. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B8: Options Volume and Cost of Debt: Amihud Illiquidity

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.049***	0.048***	-0.251***	-0.249***
	(0.012)	(0.011)	(0.048)	(0.048)
Ln(Total Assets)	-0.258***	-0.249***	1.447***	1.442***
	(0.023)	(0.023)	(0.096)	(0.096)
Tobin's Q	-0.298***	-0.284***	1.330***	1.334***
	(0.028)	(0.027)	(0.112)	(0.112)
ROA	-5.150***	-5.553***	24.825***	24.223***
	(0.911)	(0.909)	(3.924)	(3.899)
Leverage	0.951***	0.876***	-6.102***	-6.128***
	(0.107)	(0.104)	(0.420)	(0.417)
Ln(Firm risk)	0.041***	0.043***	-0.099**	-0.096**
	(0.013)	(0.013)	(0.048)	(0.048)
Ln(Amihud Illiq)	0.075***	0.079***	-0.151**	-0.150**
	(0.024)	(0.024)	(0.070)	(0.070)
Public Bond Dummy		-0.221		0.663
		(0.191)		(0.639)
Ln(Maturity)		0.220***		0.207***
		(0.022)		(0.050)
Callable Dummy		0.318***		
		(0.041)		
Observations	4185	4185	4185	4185
R^2	0.666	0.701	0.742	0.743

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables including Amihud (2002) as a measure of liquidity. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B9: Options Volume and Cost of Debt: Liquidity subsamples

	Ln(Yield Spread)		S&P Rating	
	High Liq. (1)	Low Liq. (2)	High Liq. (3)	Low Liq. (4)
Ln(Option Volume)	0.036**	0.049***	-0.294***	-0.219***
	(0.015)	(0.011)	(0.058)	(0.053)
Ln(Total Assets)	-0.274***	-0.292***	1.638***	1.481***
	(0.024)	(0.021)	(0.107)	(0.115)
Tobin's Q	-0.248***	-0.354***	1.329***	1.486***
	(0.029)	(0.029)	(0.124)	(0.133)
ROA	-4.916***	-3.900***	24.564***	18.523***
	(1.343)	(0.917)	(5.100)	(4.680)
Leverage	0.795***	0.826***	-5.806***	-5.825***
	(0.175)	(0.101)	(0.693)	(0.496)
Ln(Firm risk)	0.017	0.040***	-0.015	-0.084
	(0.019)	(0.014)	(0.064)	(0.064)
Ln(Bid-Ask Spread)	0.071	0.104***	0.189	-0.258**
	(0.086)	(0.029)	(0.180)	(0.114)
Public Bond Dummy	-0.468***	-0.296***	1.352***	0.645**
	(0.061)	(0.077)	(0.296)	(0.306)
Ln(Maturity)	0.301***	0.136***	0.049	0.390***
	(0.025)	(0.026)	(0.046)	(0.090)
Callable Dummy	0.460***	0.230***		
	(0.087)	(0.045)		
Observations	2146	2141	2146	2141
R^2	0.653	0.711	0.706	0.735

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables by subsamples of liquidity according to the median. A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B10: Options Volume and Cost of Debt: Transient Owners

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.027**	0.032**	-0.166***	-0.175***
	(0.011)	(0.015)	(0.045)	(0.058)
Own. Transient	0.970***	1.025***	-6.159***	-6.256***
	(0.188)	(0.188)	(0.870)	(0.951)
Ln(Option Volume) × Own. Transient		-0.032		0.057
		(0.049)		(0.243)
Intitutional Ownership	-0.152*	-0.147*	0.414	0.405
	(0.078)	(0.078)	(0.359)	(0.360)
Ln(Total Assets)	-0.252***	-0.254***	1.290***	1.293***
	(0.019)	(0.020)	(0.092)	(0.092)
Tobin's Q	-0.287***	-0.288***	1.204***	1.204***
	(0.024)	(0.024)	(0.109)	(0.109)
ROA	-6.061***	-6.088***	27.288***	27.334***
	(0.877)	(0.879)	(3.884)	(3.867)
Leverage	0.836***	0.837***	-5.993***	-5.994***
	(0.105)	(0.105)	(0.419)	(0.418)
Ln(Firm risk)	0.031**	0.031**	-0.076	-0.075
	(0.013)	(0.013)	(0.049)	(0.048)
Ln(Bid-Ask Spread)	0.137***	0.138***	-0.192*	-0.193*
	(0.032)	(0.032)	(0.099)	(0.099)
Public Bond Dummy	-0.525***	-0.532***	0.981	0.995
	(0.057)	(0.058)	(0.627)	(0.632)
Ln(Maturity)	0.210***	0.210***	0.191***	0.191***
	(0.023)	(0.023)	(0.053)	(0.053)
Callable Dummy	0.299***	0.297***		
	(0.043)	(0.043)		
Observations	3649	3649	3649	3649
R^2	0.716	0.716	0.757	0.757

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of Options volume with ownership by Transient institutions as defined in Bushee (1998). A detailed definition of all variables is provided in Appendix A. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.