Options Trading and Corporate Debt Structure*

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Abstract

Recent empirical studies find that increased informational efficiency associated with options trading activity enhances firm value by allowing for a more efficient allocation of firm resources. In this paper, we develop and test the hypothesis that, in addition to a more efficient allocation of firm resources, options trading also enhances firm value through a financing channel, by promoting a debt structure that relies more on public debt and less on more expensive bank financing. Consistent with both an information channel (where increased informational efficiency facilitates public debt issuance and reduces demand for the superior ability of banks to access and process private information) and a governance channel (where enhanced informational efficiency improves the effectiveness of alternative governance thereby reducing demand for bank lender governance), we find that options trading leads firms to shift from bank loans to public bonds. Consistent with an information channel effect, we show that the reduced reliance on bank borrowing is concentrated in high information asymmetry firms that are expected to benefit more from the enhanced information environment associated with options trading activity. Consistent with a governance channel effect, we find a more negative relation between options trading activity and bank borrowing in competitive industries where external governance pressure is high. In addition, we find that loan covenant strictness decreases with increases in options trading volume. Overall, our findings suggest that enhanced information efficiency associated with options trading lowers financing costs by reducing firm demand for the unique informational and governance qualities associated with bank borrowing.

Keywords: Options trading; debt structure; new debt choice; information asymmetry

JEL Classification: G13; G12; G32; G34

1. Introduction

Options trading activity can enhance informational efficiency of underlying securities by helping to complete markets and by stimulating information production that leads to informed trades. Recent empirical studies find evidence suggesting that enhanced informational efficiency from options trading translates into higher firm values by allowing for a more efficient allocation of firm resources. For example, consistent with the idea that options trading contributes to information production that managers use to make better investment decisions, Roll, Schwartz, and Subrahmanyam (2009) find that investment sensitivity to stock price increases with options trading volume as does firm value.[1] In this paper, we develop and test the hypothesis that, in addition to a more efficient allocation of firm resources, options trading also enhances firm value, through a financing channel, by promoting a lower cost debt structure, i.e., a combination of public and private debt that serves to increase firm value.

The starting point for our analysis is the recognition that bank debt is more expensive than public debt and that firms willingly pay the cost differential when they expect to sufficiently benefit from the unique advantages that borrowing from banks offer.[2] A large theoretical and empirical literature provides a variety of explanations of the costs and benefits of bank loans versus public debt.[3] One broadly held view arising from this literature is that banks are "special" in their ability to access and process private information about borrowing firms. Thus, more opaque firms with greater information asymmetry, that have difficulty issuing bonds publicly, will borrow from banks because of their superior information processing ability. We hypothesize that the increased informational efficiency associated with options trading reduces information asymmetry thereby enhancing the ability of firms to issue debt publicly and reducing firms' demand for the superior information processing that bank loans offer.

In addition to the information channel, there is also a creditor governance channel through which options trading activity may affect debt structure choices. The creditor governance channel is motivated by the widely-held view that banks, because of their more concentrated ownership of debt claims and greater facility with renegotiating debt contracts,

[1] Consistent with an improved allocation of resources, Blanco and Wehrheim (2017) report that firms with more options trading activity generate more patents and patent citations per dollar invested in research and development.
[2] Schwert (2020) provides evidence that banks, after accounting for seniority, earn an economically large premium relative to the market price of credit risk as measured by bond spreads from the same firm on the same debt. This finding is viewed as direct evidence of the willingness of firms to pay for the unique qualities of bank loans.
[3] See, for example, Diamond (1984, 1991), Fama (1985), James (1987), Berlin and Loeys (1988), Rajan (1992), Chemmanur and Fulghieri (1994), Houston and James (1996) and Park (2000).

are better positioned than public debtholders to provide creditor governance. Thus, firms that can benefit from increased creditor governance will choose to borrow from banks rather than issue debt publicly. The increased informational efficiency associated with options trading can enhance the effectiveness of alternative governance mechanisms thereby reducing the demand for creditor governance associated with bank borrowing.[4] In effect, we test for whether there is substitution out of bank governance when options trading increases governance pressure from alternative mechanisms.[5]

The empirical research on debt structure is largely based on cross-sectional analysis of the determinants of firms' *mix* of debt claims as measured by the ratio of bank (and/or public) debt to total firm debt.[6] We follow the cross-sectional approach and supplement our findings using the incremental approach, pioneered by Denis and Mihov (2003), that analyzes the determinants of the source of *new* debt issues, i.e., the choice between bank loans and public debt issues.[7]

We begin by providing baseline evidence that options trading volume reduces firm reliance on costly bank financing. Our dependent variable in this analysis is the ratio of bank loans to total debt and our key test variable is the level of options dollar trading volume. Using standard controls from the debt structure literature, we find that firms with higher options trading volumes have debt structures that rely significantly less on bank borrowing. Specifically, a one standard deviation increase in options trading volume is associated with a 4.88% decrease in the ratio of bank loans to total debt.

Well-known endogeneity concerns make it difficult to determine whether there is a causal link going from options trading activity to debt choice. We use a variety of methods to address these concerns. We begin with an instrumental variable approach that follows Roll, Schwartz, and Subrahmanyam (2009). Using options open interest and moneyness as

[4] See Ferreira, Ferreira, and Raposo (2011) and Garcia (2019) for evidence showing that increased price efficiency enhances governance pressure from alternative governance mechanisms.
[5] The substitution hypothesis we consider is based on the idea that firm managers can be exposed to "too much" governance (Hermalin and Weisbach, 2012). Consistent with a "substitution of governance mechanisms" hypothesis, Avedian, Cronqvist, and Weidenmier (2015) show that firms substitute away from independent board governance in response to the added external governance pressure arising from the creation of the Securities and Exchange Commission. More closely related to our study, Bharath and Hertzel (2019) show that firms substitute out of bank governance following an exogenous shock (import tariff reduction) that increased governance pressure from the product market.
[6] See, for example, Houston and James (1996), Johnson (1997), Krishnaswami, Spindt, and Subramaniam (1999).
[7] Multinomial logit estimates in Denis and Mihov (2003) show that the primary determinant of debt source is a firm's credit quality with high credit quality firms issuing public debt and lower credit quality firms issuing bank debt. They also present evidence that the level of asymmetric information and project quality explain debt source.

instrumental variables in a 2SLS analysis, we confirm that options trading causes firms to shift from bank debt to public debt. We also use two quasi-natural experiments that examine the effects of exogenous increases in options trading activity. In the first experiment, we exploit the CBOE's Penny Pilot Program which cut tick sizes for selected options classes thereby lowering trading costs and increasing trading volumes. The second experiment uses the CBOE's introduction of shorter maturity weekly options which similarly served to exogenously increase trading volumes. For both experiments, we find that the exogenous increases in options trading volumes are associated with declines in bank debt ratios that are mirrored by increases in public debt ratios.

To complement our analysis of the relation between debt structure and options trading volumes, we analyze the extensive margin of options trading by examining changes in debt structure in the years surrounding the *options listing year* in which options are initially available for trading. Using a propensity score matching framework, univariate tests show that the ratio of bank debt to total debt declines significantly (by 5.66%) over the three years following option listing compared with matched firms without listed options. Highlighting the importance of options trading *volume* in enhancing price efficiency, the reduction in bank debt in the years following options listing is larger and more significant for firms with listed options that are more heavily traded.[8] Such effects are robust when we apply a multivariate difference-in-differences analysis. In addition, we use a quasi-natural experiment, as in Hu (2018), to address the concern that options listing is an endogenous choice.

Taken collectively, our results based on debt ratios at both the intensive and extensive margin are consistent with the view that the enhanced information environment promoted by options trading benefits firms by making public debt issuance less costly and also by reducing the demand for the unique qualities that more-costly bank loan financing offers. To provide corroborating evidence and an additional perspective on our debt ratio results, we conduct an incremental analysis that examines the effect of options listing and trading activity on the *choice* between bank borrowing and public debt issuance as the source of *new* debt financing. Several findings are of particular interest. First, at the intensive margin, we find that firms with higher options trading volumes are significantly more likely to choose public debt issuance over bank loans as the source of new debt financing. Similarly, at the extensive margin, we

[8] This finding is consistent with the argument and evidence in Roll, Schwartz, and Subrahmanyam (2009) that "the valuation benefit from options to a firm should depend on options trading activity, over and beyond the presence of an options market on the firm's stock."

find that following the initiation of options trading, firms with traded options are significantly more likely to choose public debt over bank loans as compared with otherwise similar firms without listed options. Perhaps most striking, when comparing firms with debt structures that are 100% bank debt, we find that firms with newly listed options are significantly more likely to issue public debt for the first time than 100% bank debt firms without listed options. These findings lend further support to our argument that options trading enhances information transparency and thereby improves access to the public debt market.

We investigate the cross-sectional nature of our sample to further characterize the effect of changes in options trading volume on firm debt choice and to add support for the validity of our conclusions and tests that control for endogeneity concerns. We consider cross-sectional characteristics that are expected to generate differing effects through both an information channel and a governance channel. Our first set of tests focuses on firms that are expected to have more severe information asymmetry problems (as proxied by firm size) and firms with non-investment grade credit ratings. Consistent with the prediction that the enhanced informational environment associated with options trading is more beneficial for firms with more severe information problems and firms with lower credit ratings, we find that the relation between options trading volume and the ratio of bank debt to total debt is significantly more negative for smaller firms and firms with non-investment grade credit ratings. This evidence suggests that the reduced reliance on more expensive bank financing we document for the full sample is driven in large part by firms that are expected to benefit most from the enhanced information environment associated with options trading activity.

Also through the information channel, we examine the effect of options trading on bank loan syndicate structure. Extant theory and evidence suggest that when information asymmetry is high, less informed syndicate members will require lead arrangers of bank loan syndicates to take a larger share of the loan in order to mitigate potential agency costs associated with information asymmetry. Consistent with options trading enhancing the information environment, we find that lead arrangers take significantly lower loan shares when borrowers have more actively traded options.

We also find cross-sectional evidence that options trading affects debt structure through a governance channel. Previous research finds evidence that managers of firms operating in competitive industries face intense product market governance pressure. To the extent that the improved information environment associated with options trading enhances the efficiency of alternative governance mechanisms, we expect a more significant negative relation between

options trading volume and the use of bank debt for firms in operating in competitive industries. Our findings are consistent with this expectation.

We also test for a governance channel effect by examining the relation between options trading volume and the strictness of bank loan covenants. We use the covenant strictness measure from Murfin (2012), which approximates the probability that the bank will obtain contingent control through a covenant violation, as well as the measure constructed by Demerjian and Owens (2016) which covers 15 types of capital-based and performance-based covenants. In effect, tighter restrictions are used to keep borrowers on a "shorter leash" thereby imposing greater governance pressure on the firm. Consistent with a governance mechanism substitution effect, we find that covenant strictness decreases with increases in options trading volume. That is, governance pressure from banks is reduced as governance pressure from alternative governance mechanisms increases.

Taken collectively, our cross-sectional findings provide additional perspective on the relation between options trading activity and the channels through which this relation manifests itself. Perhaps more importantly, the cross-sectional findings bolster support for the validity of our conclusions and tests that control for endogeneity concerns by limiting the range of potential alternative explanations of our findings.

Our paper contributes to several strands of literature. First, our central finding that options trading allows for a lower-cost debt structure contributes to the literature examining whether financial markets affect corporate decision-making or are simply a sideshow with no real economic consequences. Figlewski and Webb (1993) argue that options, by effectively alleviating short-sale constraints through put options and written calls, increase informational efficiency. Previous studies have largely focused on the asset side of the balance sheet showing that increases in firm value associated with options trading activity reflect improvements in firm resource allocation and investment. For example, Roll, Schwartz, and Subrahmanyam (2009) provide evidence that investment sensitivity to stock price increases with options trading volume as does firm value. A more recent study by Bernile, Hu, Li, and Michaely (2019) shows that an active options market leads to changes in corporate policies that are consistent with reduced information asymmetry. Our study is the first to focus on the liability side of the balance sheet by showing that options markets have real economic consequences by fostering an enhanced information environment that increases firm value by allowing for a lower cost financing structure.

Second, our study contributes to the literature on the debt structure of public firms and, in particular, the choice between bank loans and public debt issuance. Our finding that firms shift away from more-costly bank loan financing to public debt issuance when options trading enhances the information environment, provides new evidence on the importance of asymmetric information in explaining debt structure. Furthermore, we show that the effect on debt structure comes through two channels. First, the reduction in information asymmetry eases information problems associated with issuing public debt and reduces the demand for the information processing services associated with more expensive bank borrowing. Second, the enhanced information environment reduces the cost of alternative governance mechanisms resulting in a substitution away from more-costly bank monitoring. Previous evidence on the importance of ex post governance in explaining debt choice is limited to Bharath and Hertzel (2019). To our knowledge, our study is the first study to consider how exogenous shifts in a firm's information environment affects governance structure through the choice between bank loans and public debt.

The remainder of the paper is organized as follows: Section 2 describes the data and the construction of our variables. Section 3 presents the main empirical results on the relation between options trading and debt structure. Section 4 presents evidence on the extensive margin by investigating the effects of options listing on corporate debt structure. Section 5 extends the basic tests by considering the cross-sectional nature of our sample. Section 6 concludes.

2. Data and Variables

To investigate the effect of options trading on debt structure and the source of new debt issues, we begin by assembling a large sample of existing debt claims, new bank loans, and public debt issues for U.S. public companies over the period from year 2003 to year 2016.[9] We obtain detailed debt structure data from S&P Capital IQ. In our analysis, we consider two measures of debt structure: (i) the ratio of bank debt (the sum of revolving credit and term loans) to total debt and (ii) the ratio of public debt (the sum of senior and subordinated bonds and notes) to total debt.[10] We exclude observations where the sum of these two ratios is more than

[9] Following previous literature, our sample period begins in 2003, when the coverage of Capital IQ became more comprehensive (Colla, Ippolito, and Li (2013); Li, Lin, and Zhan (2019)).
[10] Other debt and capital leases are excluded, as it is not clear whether these belong to private or public debt.

one to avoid potential data errors. We obtain bank loan issuance data from DealScan, and public bond issuance data from Thomson Reuters SDC Platinum.

Daily options trading data is from OptionMetrics. Following Roll, Schwartz, and Subrahmanyam (2009), we calculate the annual dollar trading volume for each stock in our sample. To begin, for each option, we use the midpoint of the daily closing bid and ask price as the trading price and multiply this price by the trading volume for that day. Then, for each stock, we sum up the daily dollar trading volume for all listed options over the year to obtain the stock-year level of options trading volume. We also obtain measures of moneyness and open interest from OptionMetrics.

Financial and accounting data is from Compustat. We control for firm characteristics that have been documented to affect a firm's choice of debt. Firm size is measured as the logarithm of total book assets. Firm leverage is the amount of long-term debt and debt in current liabilities scaled by total assets. Market-to-Book ratio is defined as market value scaled by book value and measures growth opportunities and also potential asset substitution risk. ROA, operating income before depreciation scaled by total assets, captures firm profitability. PPE, the amount of property, plant, and equipment scaled by total assets, represents the tangibility of the firms' assets. We include stock return volatility calculated as the standard deviation of daily stock returns measured over one year. We also control for long-term credit rating in our analysis. More detailed definitions can be found in Appendix A.

Table 1 presents the distribution of unique firms with non-missing debt structure and control variables across the years of our sample period. The table shows the distribution according to whether a firm has listed options or not. While the number of unique public firms has declined over the sample period, the number of firms with traded options has increased. For example, in 2002, around 49% of our sample firms had traded options. The percentage increased to more than 80% in 2015. The evidence is consistent with the fact that the options market has become larger and more liquid in recent years (Muravyev and Pearson (2020)).

Table 2 provides summary statistics (calculated over all firms and years) for debt structure, control variables, and options trading volume. Panel A covers the full set of firms while Panel B covers the subset of firms that have positive options trading volumes.[11] For the full sample, as shown in Panel A, the mean (median) value of the bank-to-total debt ratio is

[11] For the full set of firms, we define options trading volume to be zero for firms with no options listed. All continuous variables are winsorized at the 1st and 99th percentiles to remove the effect of outliers.

41.58% (27.91%). Panel B shows that the mean (median) value of this ratio is much smaller, 35.14% (17.12%), for the subsample of firms with positive options volumes. The results for public debt mirror this finding showing greater usage of public debt for firms with positive options trading volumes. These preliminary findings are consistent with our main hypothesis that options trading reduces the demand for bank financing and facilitates the ability to issue public debt. On average, for firms with options listed, the annual options dollar trading volume is 1.28 million USD. The median, however, is only 0.075 million USD. These findings show that options trading volume is highly skewed. Thus, in our baseline analysis, we take the natural logarithm of total dollar trading volume (Ldvol) to study the relation between options trading and debt structure. As in Roll, Schwartz, and Subrahmanyam (2009), firms with traded options tend to be larger and more profitable than firms without options.

Figure 1 provides a graphical depiction of the relation between debt structure and options trading volume. We first sort firms into terciles by size to account for the positive relation between size and options trading volume. Then we sort the firms with listed options into deciles by options trading volume within each size tercile and plot the average bank debt (public debt) ratio for each option trading volume decile. Consistent with our argument that firms with higher options trading volumes have less need for relatively more expensive bank debt, we find that bank debt (public debt) financing decreases (increases) monotonically with options trading volume. From firms with the lowest options trading volume (decile 1) to firms with the highest options trading volume (decile 10), bank debt financing decreases from 50.08% to 24.51% and public debt financing increases from 29.47% to 57.54%. These differences are both statistically significant and economically meaningful.

The univariate results from Figure 1, however, do not account for other firm fundamental differences. Table 3 presents the correlations among the variables from Table 2 for both the full sample and the subsample of firms with listed options. Again, the results provide preliminary evidence consistent with our hypothesis that greater options trading activity reduces firm reliance on costly bank financing. The correlation between the bank-to-total debt ratio and options volume is negative (and significant at the 1% level) for both samples: -0.20 for the full sample and -0.17 for the subsample with listed options. The results for public debt mirror these findings showing a positive correlation between the use of public debt and options trading volume. The simple correlation between options trading volumes and bank debt ratios is consistent with our expectation. The other correlations in the table highlight the need

to use control variables in our regression analysis. In particular, the usage of bank debt is highly negatively correlated with firm size and credit rating.

3. Empirical Evidence

3.1 Baseline results

To examine the empirical relation between options trading and debt structure, we first run OLS regressions for the subsample of firms with positive options trading using the following specification:

$$y_{i,t} = \alpha + \beta_1 \times Ldvol_{i,t-1} + \delta' X_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ is debt structure (as measured by bank debt ratio and public debt ratio) for firm *i* in year *t*, $Ldvol_{i,t-1}$ is the natural logarithm of the options dollar trading volume for firm *i* in year *t-1*; and $X_{i,t-1}$ is a vector containing a set of control variables, firm- and year- fixed effects. All standard errors are robust and clustered at the firm level.

Columns (1) and (2) of Table 4 present our baseline results. The impact of options trading volume on corporate debt structure is statistically (at the 1% level) and economically significant. A one standard deviation increase in options trading volume (2.69) is associated with a decrease of 4.88% in bank loan financing and an increase of 3.18% in corporate bond financing, relative to their respective unconditional means.[12] We further provide evidence of robustness using OLS and Tobit regressions with different fixed effects. Columns (3) and (4) present the marginal effects from Tobit regressions, which address the concern that some of our sample firms have zero bank debt or zero public debt. Again, the results support our argument that firms with more actively traded options should have more public debt and less bank debt because of the enhanced information efficiency provided by options trading. In columns (5) and (6), we also include the firms without options listed and define the trading volume to be zero. Again, we obtain consistent results.

[12] We calculate economic significance, here and throughout the rest of the paper, by multiplying the standard deviation of the focal variable by its estimated coefficient and then dividing by the unconditional mean of the dependent variable. To express as a percentage we multiply by 100%. Thus, for example, we calculate 4.88% as equal to (2.69 × 0.638 × 100%) ÷ 35.14.

Coefficients of other control variables are mostly consistent with the literature. For example, larger company size and higher tangibility reduce the use of bank loan financing while increasing the use of public debt because of less information asymmetry. In addition, firms with better credit ratings use more public debt and less bank debt as a result of lower default risk.

As a robustness check, we replace *Ldvol* with a ranking variable *Dvol Rank*. We rank firms into 100 groups according to the dollar trading volume of options every year, then assign the group rank *Dvol Rank* to each firm. We re-estimate the effect of *Dvol Rank* on debt structure and obtain results consistent with our earlier findings (reported in Appendix Table B1). In Appendix Table B2, we conduct an additional robustness test using an entropy balancing approach, which better controls for the differences across firms with different levels of options trading volume, and obtain consistent results.

3.2 Controlling for endogeneity of options trading and debt structure

Although the baseline results are consistent with the hypothesis that options trading volume affects a firm's debt choices, potential concerns with endogeneity bias make it difficult to identify a causal link going from options trading volume to debt structure. One possibility is that options trading and debt choice may both be affected by omitted factors that are not observable. As described below, we use an instrumental variable (IV) approach and two quasi-natural experiments to address these concerns.

3.2.1 Instrumental variable approach

Our instrumental variable approach follows the procedure employed by Roll, Schwartz, and Subrahmanyam (2009) and Blanco and Wehrheim (2017) that uses moneyness and open interest of listed options as instrumental variables. Moneyness is the average absolute difference between the stock's market price and the option's strike price. Open interest is the average open interest across all options on a stock throughout the calendar year.

For satisfying the relevance condition, it is evident that open interest is positively associated with options trading volume. In terms of the relation between moneyness and options trading volume, Roll, Schwartz, and Subrahmanyam (2009) provide several arguments from the perspectives of agents and traders. The agents would speculate on volatility by

avoiding deep in-the-money and out-of-the-money options. The informed traders are more likely to be attracted by out-of-the-money options, while uninformed traders are more interested in in-the-money options. Thus, while moneyness is related to trading volume, the direction of the relation is an empirical question. For the exclusion condition, it is unlikely that moneyness and open interest of options could directly affect firm debt structures. As the exchanges periodically list new options that are at-the-money, moneyness has no direct link with a firm's debt choice. Open interest contains both call and put options, it is not clear how the sum of open interest on these options can have a direct impact on debt choice. Consequently, neither of these instrumental variables has a direct association with firms' debt structures without the channel from options trading volume.

In Panel A of Table 5, we present a two-stage least square (2SLS) estimate of the baseline regression. The second stage results, presented in columns (1) and (2) for bank debt and public debt, respectively, are consistent with our previous results showing that options trading volume reduces the use of bank debt and increases the use of public debt. Column (3) reports the first stage result which shows that options trading volume is positively associated with open interest while negatively associated with moneyness. We also conduct relevance, weak instrument, and overidentification tests and find no evidence that our instrumental variables are invalid.

The results from the IV approach help establish the causal effect on firms' debt structure from options trading activities. With actively traded options, firms benefit from a better information environment which allows them to switch from relatively more expensive bank debt to less expensive public debt.

3.2.2 Quasi-natural experiment: The Penny Pilot Program

To further address endogeneity concerns, we exploit the Chicago Board Options Exchange (CBOE) Penny Pilot Program as an exogenous positive shock to options trading volumes. Motivated by improved electronic trading capabilities of exchanges, the Penny Pilot Program (hereafter PPP), introduced in January 2007, reduced the minimum bid-offer spread for options for a select group of pilot firms. By reducing transaction costs and improving liquidity, the PPP potentially led to increases in options trading volumes. Because the inclusion of individual option classes is determined by the exchange, and is not a choice of the firm, the PPP serves as a quasi-natural experiment that allows us to examine the effect of an exogenous shock to

trading volume on corporate debt structures of piloting firms. In addition, the staggered inclusion of options in the PPP over time allows us to address concerns about omitted variables that would arise when considering a one-time shock. Consistent with improvements in the information environment brought on by greater options trading activity, we expect that after being included in the PPP, piloting firms rely less on bank debt and more on public debt, compared with non-piloting firms.

We obtain the list of pilot option classes from the CBOE Options Exchange Regulatory Circulars.[13] The Circulars publish piloting option classes and the files (along with other regulatory documents) are organized by calendar year. We manually search the files related to the PPP and then match the option classes with our main sample according to *Ticker* symbol. There are 171 firms in our sample that are included in the program from 2007 to 2015. We treat the other firms in our sample as non-piloting firms. Such treatment generates an unbalanced sample with many more non-piloting firms than piloting firms. In Appendix Table B3, we match each piloting firm with only one non-piloting firm according to firm fundamental characteristics and obtain similar results.

Although inclusion in the PPP program is an exogenous shock from the firm's perspective, the CBOE's decision on which firms to include in the PPP is unlikely to be random. Thus, inclusion of a firm's options in the PPP may reflect selection biases that hinder identification of the program's treatment effect on debt structure. To address this concern, we use an instrumental variable (IV) approach to establish causality. We use inclusion in the PPP as our instrumental variable. More specifically, we instrument the options trading volume by a dummy variable, *Pilot* which equals one for the years after a firm is included in the PPP, and zero otherwise. The results of our IV analysis are reported in Panel B of Table 5. All specifications employ year and firm fixed effects and use the same set of control variables as in the baseline regressions in Table 4.

Column (3), which reports the first stage regression results, shows that the program has a positive and significant effect on options trading volumes for pilot firms relative to non-pilot (control) firms. The coefficient on *Pilot* is 0.356 and significant at the 1% level and implies that after inclusion in the PPP the options trading volume of piloting firms, compared with that of non-piloting firms, increases by 4.87%, relative to the sample mean. This finding confirms that our IV, *Pilot*, satisfies the *relevance condition* for being a valid instrument. We note that a

[13] https://markets.cboe.com/us/options/regulation/circulars/cone/regulatory/

valid instrument must also satisfy the *exclusion restriction*. We know of no theoretical argument or empirical evidence that would suggest that inclusion in the PPP could affect a firm's debt structure decisions other than through its effect on trading volume.

Using the predicted options trading volume from the first stage, the second stage results in columns (1) and (2) provide causal evidence that the increase in options trading volumes associated with inclusion in the PPP leads firms to shift from bank loans to public debt. The negative (positive) coefficient of instrumented options trading volume on bank (public) debt is highly significant at 1% level. We also conduct under-identification, weak instrument, and overidentification tests and find no evidence that our instrumental variable is invalid.[14]

3.2.3 Introduction of weekly options as a shock to the information environment

We provide additional evidence for a causal relation between options trading and debt structure by exploiting the introduction of weekly options as a positive shock to a firm's information environment. Weekly options, first introduced by the Chicago Board Options Exchange (CBOE) for individual stocks in 2010, are one-week options as opposed to traditional options with longer maturities. Due to the significant increase in the number of available options to trade, we expect that the introduction of weekly options led to increases in options trading volumes. As with the Penny Pilot Program discussed in the previous section, the introduction of weekly options is useful as a quasi-natural experiment not only because the selection of weekly options trading is made by the exchange, but also because decisions on which firms to include were staggered over time. We expect that the introduction of weekly options improves the information environment, by increasing both the contracting space and trading volume. Thus, we expect that firms with weekly options will rely less on bank debt and more on public debt, compared with firms with options with longer maturities only.

We identify sample firms with weekly options using the OptionMetrics database. We initially identify 158 firms (and their respective listing dates) between 2010 and 2014. We match each of these firms with a control firm in the same industry (2-digit SIC) using a propensity score approach that matches on market capitalization and options trading volume. The matching process yields a sample of 148 unique pairs of treated and control firms.

[14] Results of the under-identification test (Kleibergen-Paap rk LM statistic), the weak instrument test (Cragg-Donald Wald F statistic), and the Hansen-J test for over-identification are reported in the table.

Again as with the PPP, although selection for weekly options trading is an exogenous shock from the firm's perspective, the CBOE's selection process is unlikely to be random. Thus, selection for weekly trading may reflect biases that hamper identification. To establish causality, we use an instrumental variable (IV) approach that uses an indicator variable for whether weekly options are traded as our instrumental variable. In particular, we instrument the options trading volume with *Weekly* which equals one for the years that a firm trades weekly options, and zero otherwise. The results of our analysis are reported in Panel C of Table 5. All specifications employ year and firm fixed effects and use the same set of control variables as in the baseline regressions in Table 4.

Column (3), which reports the first stage regression results, shows that weekly options trading has a positive and significant effect on options trading volumes relative to control firms without weekly options trading. The coefficient on *Weekly* is 0.294 (significant at the 1% level) which implies that the options trading volume of firms with weekly options, compared with that of the control firms without weekly options, increases by 2.62% relative to the sample mean. This finding confirms that our instrumental variable, *Weekly*, satisfies the relevance condition for being a valid instrument. With respect to the exclusion restriction, we know of no theoretical argument or empirical evidence that would suggest that weekly options trading could affect a firm's debt structure decisions other than through its effect on the information environment.

Using the predicted options trading volume from the first stage, the second stage results in columns (1) and (2) provide causal evidence that the increase in options trading volumes associated with weekly options introduction leads firms to shift from bank loans to public debt. The negative (positive) coefficient of instrumented options trading volume on bank (public) debt are highly significant at 1% level. We also conduct relevance, weak instrument, and overidentification tests and find no evidence that our instrumental variable is invalid. Taken collectively with the results of the IV analysis in Panel A, and the evidence from the PPP quasi-natural experiment in Panel B, the findings here constitute broad support for our conclusion that the increased information efficiency associated with options trading enables firms to shift from bank borrowing to public debt issuance.

3.3 Evidence from issuance decisions on the source of new debt financing

In this section we provide complementary evidence for our baseline findings by examining how options trading activity affects the choice between bank borrowing and public debt as the source of *new* debt financing. Intuitively, if options trading improves the information environment, firms will be better positioned to issue debt publicly and their demand for the information and governance benefits from borrowing from banks will be reduced. Thus, a shift in debt structure ratios will reflect incremental decisions regarding the source of new debt.

To examine issuance decisions, we collect bank loan and public bond issuance data for our sample firms. We obtain bank loan issuance data from DealScan and public bond issuance data from Thomson Reuters SDC Platinum. Next, we merge the debt issuance data with the debt structure data and control variables used in our earlier analysis to obtain a sample of 10,912 firm-year observations. Summary statistics (reported in Table B4) show that 80.29% (19.71%) of new debt issues over the sample period are bank loans (public debt issues).

Table 6 provides a multivariate analysis of the effect of options trading volume on the choice between bank loans and public debt issues in sourcing new debt financing. Specifically, column (1) shows estimates of the following linear probability model:

$$z_{i,t} = \alpha + \beta_1 \times Ldvol_{i,t-1} + \delta' X_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

where $z_{i,t}$ is a binary variable equal to one if firm *i* issues a bank loan, and equal to zero if firm *i* issues a public bond in year *t*. $Ldvol_{i,t-1}$ is the natural logarithm of the options dollar trading volume in year *t-1*; and $X_{i,t-1}$ is a vector containing a set of control variables and industry- and year-fixed effects. All standard errors are robust and clustered at the firm level.

Column (1) shows that the coefficient of options trading volume, -0.009, is significant at the 1% level, implying that firms with active options trading choose to decrease their reliance on bank loan financing. We further demonstrate the robustness of our findings by replacing the binary variable in Equation (2) with a ratio measure calculated as the dollar amount of bank loan issuances in a year scaled by the dollar amount of all debt issuances in that year. The results are reported in column (2). The significant negative coefficient of options trading volume is consistent with the result in the linear probability model shown in column (1). Economically, a one standard deviation increase in options trading volume (2.67, according to Table B4) is associated with a decline of 2.99% in the probability of issuing bank debt rather

than public debt and a reduction of 4.14% of bank loan issuance as the source of new debt financing, relative to the unconditional means. Using an incremental approach, we again confirm that options trading activities have an impact on corporate debt structure.

4. Additional Evidence from Options Listings: Debt Structure Changes and New Debt Issues

To complement our analysis of the relation between debt structure and options trading volume (i.e., the intensive margin), we conduct a battery of tests that examine changes in debt structure in the years surrounding the initiation of options trading (i.e., the extensive margin).[15] Our hypothesis predicts a shift from bank debt to public debt when options trading is initiated, with a more significant shift for firms with greater options trading activity.

4.1 Debt structure changes around options listings: *PSM Approach*

We begin by using a propensity score matching approach to compare firms with newly initiated options trading (i.e., treated firms) with similar, matched, firms without listed options (i.e., control firms). Specifically, we match the treated and control firms by debt structure, size, leverage, Market-to-Book ratio, and ROA.[16] Panel A of Table 7 presents the average changes in bank debt ratios in the 7-year window surrounding the year that options are first listed. Given the lumpy nature of debt issuances and retirements, we expect changes in debt structure to be gradual over time. Indeed, the panel shows that over the three years before the initiation of options trading, there are no significant differences in bank debt ratios between treated firms and control firms. In the options listing year, treated firms start to diverge from the control firms with a difference in bank debt ratios of -6.66%, significant at the 1% level. The decline continues over the following three years and the difference with the control firms continues with similar magnitude and statistical significance. We visualize the changes in debt structure around the options listing year in Figure 2.[17]

[15] We define the initiation of options trading for a firm (sometimes referred to in the text "as options listing") as the first year that there is positive options trading volume.

[16] To match on debt structure, we rank firms each year according to their bank debt and public debt ratios, respectively. The ranks are then assigned to firms and we match the firms according to the rank, following Naiker, Navissi, and Truong (2013).

[17] Figure 2 shows bank and public debt ratios for the years around options listings for (i) all treated firms, (ii) treated firms after deleting the quintile of firms with the lowest options trading volumes over the following three years, and (iii) control firms without listed options. Consistent with the argument that improvements in informational efficiency associated with options trading should be greater as options trading volume increases,

Panel B of Table 7 presents a multivariate difference-in-differences (DID) analysis that compares changes in debt structure for firms selected by the exchange for options listings (*Treated*) to changes in debt structure of firms with similar characteristics but not selected for options listing (*Control*). We use an options listing selection model similar to Mayhew and Mihov (2004) to construct the matched control sample. More specifically, we estimate a logistic regression model that predicts the likelihood of listing as a function of annual average daily stock trading volume, annual stock return volatility, abnormal average daily stock trading volume, abnormal stock returns volatility and the market value of equity. We then match each treated firm to a control firm with the nearest estimated probability in the year prior to option listing. The matching process yields 10,449 firm-year observations containing 1,283 unique pairs of treated and control firms. *Treated* is a binary variable that equals one for firms with option listing, and zero for their matched control firms. *Post* is a binary variable that equals one for years after option listing. We only keep sample period from five years before and after the inclusion years to mitigate potential influence due to years that are far away from the listing years.

The key test variable in columns (1) and (2), the interaction of *Treated* and *Post*, captures the effect of option listing on debt structure. The findings show a significant shift away from bank borrowing following option listing. The estimated coefficients -7.149 for bank debt (column (1)) and 5.457 for public debt (column (2)), are both significant at 1% level. Moreover, the economic significance is large. Treated firms reduce (increase) bank (public) debt by 13.79% (15.26%) relative to their respective unconditional means.

Columns (3) and (4) report evidence on the dynamic effects of options listing. The key test variables in these specifications are interactions of *Treated* and indicator variables that target specific years before and after the option listing year. $Before^{1}$ ($After^{1}$) is a binary variable that equals one for the year before (after) the option listing year. $Before^{2+}$ ($After^{2+}$) is a binary variable that equals one for years two through five before (after) the option listing year. For both the bank debt and public debt regressions, the coefficients on the $Before^{1}$ and $Before^{2+}$ interaction terms are not significantly different from zero indicating that changes in debt structure do not occur prior to option listing. The coefficients on the post-listing year dummies are consistent with a shift away from bank debt financing after option listing that increases over time. For example, the coefficient on $Treated \times After^{1}$ for the bank loan regression in column

the figure shows that changes in debt structure around options listings are larger for firms with more actively traded options.

(3) is -3.948 (significant at the 5% level) indicating a shift to public debt financing in the year following option listing. Consistent with the time it takes for firms to shift debt structures, the coefficient on *Treated* $\times$ *After*$^{2+}$ is more negative, -7.162, and significant at the 1% level. The findings for public bonds reported in Column (4) mirror these findings.

4.2 Quasi-natural experiment on option listing

Although propensity score matching can mitigate differences between firms with and without options listings, it still can be hindered by unobservable variables which can affect listing decisions. To address this possibility, we employ a quasi-natural experiment on options listing used by Hu (2018) that exploits the mandated minimum stock price of option listing as a quasi-natural experiment to identify the listing effects. To list options, the SEC requires firms to have a minimum stock price of $3.00. If two firms have negligible differences regarding their characteristics, and one marginally meets listing requirements but the other marginally fails to meet, then the listing decision is more likely to be random for these marginal firms. Therefore, we exploit the randomness around the minimum stock price ($3.00) to investigate the causal effect of options listing on debt structure. To define the treated group (firms with options listings), we only include firms that have stock prices above the mandated minimum price by less than two dollars at the end of the last month prior to listing date and have information in CRSP for at least 252 trading days before listing. In total, 67 unique firms are identified as treated firms. For the control group, we first select all non-listing firms that have prices below the minimum mandated price by less than two dollars. The non-listing firms are then further matched to listing firms based on the closest propensity score generated following Mayhew and Mihov (2004).

Appendix Table B5 compares the bank debt ratios among listing firms and control firms within this small stock price margin. Before options are listed, there is no significant difference in bank debt ratios between listing firms and control firms. In the year following options listings, listing firms, on average, have bank debt ratios that are 20.18% lower than the average for control firms, significant at the 5% level. Consistent with our expectations, the quasi-natural experiment also supports the negative relation between options listings and bank debt ratios. [18]

[18] As the changes in public debt ratios mirror those of the bank debt ratios, we present the results for the public debt ratios in Appendix Table B6 for brevity.

4.3 Source of new debt issuance after options listing

In section 3.3 we examined how options trading volume affects the choice between bank borrowing and public debt as the source of new debt financing. In this section, we complement the trading volume tests that consider the effect of options trading at the intensive margin, by examining the effect of option listing on debt issuance choices. If the availability of options trading made possible by the initial listing of options improves the information environment, we expect that firms will be better able to issue debt publicly and that their demand for the information and governance benefits from borrowing from banks will be reduced. Thus, we expect that the shift in debt structure ratios that we observe after options listing will reflect incremental decisions regarding the source of new debt issues.

Results of our analysis are presented in Table 8. To begin, we use a PSM approach to match firms with listed options with otherwise similar firms without listed options. We match on leverage in the year prior to the listing year and choose the firm with the highest propensity score as the control. We then use a linear probability regression with *Bond Issue* as the dependent variable to examine how options listing affects a firm's choice between bank loans and corporate bonds as the source of new debt issuance using. *Bond Issue* is a dummy variable that equals one if a post-listing debt issue is public debt and equals zero if the issue is a bank loan. *Treated* is a binary variable that equals one for firms with listed options, and zero otherwise. We examine all the issues of debt after the listing year as well as the first issue of debt after the listing year. As demonstrated in columns (1) and (2) of Table 8, after options listing, treated firms are more likely to issue corporate bonds when financing with debt. More specifically, after options listing, treated firms, compared with control firms are 38.6% more likely to issue corporate bonds than bank loans. Moreover, treated firms are 34.2% more likely to issue public bonds as the source of debt for their first issuance after the options listing.

The table also reports results for the subsample of firms with newly-listed options that have debt structures that were 100% bank debt before listing. These firms are of particular interest since information problems may have previously precluded them from issuing debt in the public debt market. Despite the small sample size, the results in columns (3) and (4) show that, after options listing, these firms are significantly more likely to issue debt in the public market as compared with similar 100% bank debt firms without listed options. More specifically, after options listing, 100% bank debt firms, compared with their control firms, are 53.8% more likely to issue corporate bonds than bank loans and 216.5% more likely to issue public debt in their first post-listing debt financing. These findings are consistent with our

expectation that options listing is particularly beneficial for firms that previously did not have public debt.

To summarize, we document an economically large shift from bank loan financing to public debt after a firm's options are listed. After options are listed, a firm's bank debt ratio declines significantly, and it becomes significantly more likely that the firm will issue public debt at their next debt financing. We also show that firms with no public debt outstanding prior to options listing are significantly more likely to issue public debt for the first time after listing their options. Taken together, this evidence lends further support to our argument that options trading enhances information transparency and alters firm debt choices.

5. Cross-sectional Tests

In this section, we investigate the cross-sectional nature of our sample to further characterize the effect of options trading on firm debt choice and to bolster support for the validity of our conclusions, i.e., the cross-sectional tests in this section are aimed at narrowing the range of potential alternative explanations for our findings. We consider cross-sectional characteristics that are expected to generate differing effects through both the information channel and the governance channel. As the results of public debt mirror these of bank loans, we report all the cross-sectional tests with public debt ratios as dependent variables in Appendix Table B7.

5.1 Cross-sectional effects through the information channel

If options trading indeed alters a firm's debt choice by enhancing the information environment, we would expect more significant effects for firms with greater information asymmetry and worse credit ratings. Results based on sample splits along these dimensions are presented in Section 5.1.1. In Section 5.1.2, we provide evidence on the information channel by examining the effect of options trading on bank loan syndicate structure.

5.1.1 The effect of firm size and credit rating

To further explore the information channel, we use alternative measures to proxy for firm level of information asymmetry. We employ firm size and credit rating as measures of the information environment of firms. Our assumption in this analysis is that small firms are more likely to suffer from asymmetric information problems in debt financing. Thus, we expect that

the improved information environment from options trading will be more beneficial for these firms as compared with firms with less information asymmetry. We also classify firms into two groups based on their long-term credit rating. The Investment group represents firms that have investment grade credit ratings. Otherwise, they belong to the Non-investment grade group. Intuitively, firms with good credit ratings are more transparent than firms with bad ratings. According to our hypothesis that options trading mitigates information asymmetry, we should expect the impact of trading volume to be more pronounced for firms with more significant asymmetric information, i.e., Small Size group, and Non-investment credit rating group. Table 9.A presents results consistent with our hypothesis. Columns (1) and (2) show that the coefficient of options trading volume in the Small Size subsample (-0.815) is more than five times the size of the coefficient found for the Big Size subsample (-0.156). Additionally, the Non-investment grade group has a coefficient of -1.934 significant at the 1% level, while the Investment grade group has an insignificant coefficient.

To further verify the differences between subsamples indeed exist and are statistically significant, we use the permutation test to examine whether the differences are statistically significant. The bottom rows in Panel A show that the differences in the effect of options trading across the firm size, and credit rating subsamples are all significant at least at the 5% level. These results support our prediction that options trading reduces the reliance on bank debt significantly more for firms with greater information asymmetry.

5.1.2 Options trading and bank loan syndicate structure

If options trading enhances a firm's information environment, we expect that this will lead to a reduction in the information asymmetry between participants and lead arrangers in syndicated bank loans. Empirical literature (e.g., Sufi (2007); Amiram, Beaver, Landsman, and Zhao (2017); Beatty, Liao, and Zhang (2019)) provides evidence that uninformed lenders (i.e., syndicate participants) require informed lenders (i.e., lead arrangers) to take a larger share of the loan when information asymmetry is higher in order to provide incentives for the lead arranger to engage in appropriate levels of due diligence and monitoring. We expect that, if options trading helps to reduce information asymmetry, syndicate members will not require lead arrangers to take as large a share of the loan when options trading volumes are high, i.e., shares of the loan taken by lead arrangers should be smaller for higher options trading volume borrowers. Table 9.B provides evidence on this conjecture. Columns (1) and (2) show the

relation between loan shares and options trading volume. *Loan Shares* is the amount of the loan taken by a participant divided by the total amount of the loan. *Leader* is a binary variable that equals one for the lead arranger, zero otherwise. otherwise. Consistent with expectations, the results show that lead arrangers on average hold a lower loan share (significant at the 1% level) for loans to borrowers with higher options trading volumes. Overall, our results regarding syndicate structure provide support for the view that options trading reduces information asymmetry and affects real decisions in the bank loan market.

5.2 Cross-sectional effects through the governance channel

Increased information efficiency created by active options trading also has important implications for corporate governance. Previous literature has documented that with higher price efficiency, firms reduce the number of independent directors as a result of enhanced external and internal monitoring (Ferreira, Ferreira, and Raposo (2011)). In the same vein, we hypothesize that the increased price efficiency associated with options trading enhances the effectiveness of alternative governance mechanisms, thereby reducing the need for creditor governance provided by banks. Thus, through the creditor governance channel, we also expect that options trading activity allows firms to shift away from bank debt to public debt. In this section, we provide evidence on the governance channel by examining the relation between options trading volume and the strictness of loan covenants (Section 5.2.1) and by investigating the differential effects of options trading on debt structure for firms in competitive versus non-competitive industries (Section 5.2.2).

5.2.1 Bank loan covenant strictness

If options trading enhances the efficiency of alternative governance mechanisms, we would expect a substitution away from the creditor governance provided by banks. One way to identify a substitution effect is to examine how options trading activity affects the strictness of bank loan covenants. Covenants are the essential mechanism lending banks use to obtain control and impose effective monitoring. Therefore, to the extent that a more active options market increases pressure from alternative governance mechanisms, we expect bank loan contracts to have looser covenants. We use the covenant strictness measure from Murfin (2012) which approximates the probability that the bank will obtain contingent control through a

covenant violation.[19] Consistent with a governance mechanism substitution effect, we find that covenant strictness decreases with increases in options trading volume. The results are presented in columns (1) and (2) of Table 9.C. The coefficient of options trading volume is -1.001, significant at the 10% level. The impact of options trading volume on strictness is economically significant as well. A one standard deviation increase in options trading volume is associated with a decrease of 11.49% in covenant strictness relative to its unconditional mean.

In addition, we also show the robust effect of options trading on loan covenant strictness by examining an alternative strictness measure, PVIOL, which is aggregate probability of covenant violation (at the loan inception date) across all covenants included on a given loan package from the total set of fifteen covenant categories as outlined by Demerjian and Owens (2016). We obtain consistent results that options trading reduces the strictness of loan covenants. A one standard deviation increase in options trading volume (2.37) is associated with a decline of 4.34% of probability of covenant violation. Taken together, our empirical findings on the change in covenant strictness supports the argument that options trading enhances the governance pressure from alternative governance mechanisms and reduces the need for governance from banks.

5.2.2 Product market governance: Competitive versus non-competitive industries

Previous research finds evidence that managers of firms operating in competitive industries face intense product market governance pressure.[20] To the extent that the improved information environment associated with options trading enhances the efficiency of alternative governance mechanisms, we expect a more significant negative relation between options trading volume and the use of bank debt for firms operating in competitive industries. This expectation is based on the idea that firm managers can be exposed to "too much" governance (Hermalin and Weisbach (2012)).

Table 9.D provides evidence on the differential impact of options trading on debt structure for firms operating in competitive versus less competitive industries. In columns (1) and (2), we sort firms into terciles based on the Herfindal-Hirschman index (HHI) at the two-digit SIC level. *Low HHI* represents firms in the bottom tercile and is our indicator of industry

[19] We thank Justin Murfin for sharing the covenant strictness data.

[20] See, for example, Giroud and Mueller (2010) who show that the "quiet life" effects associated with the passage of business combination laws are only observed in noncompetitive industries. These, among other, findings are consistent with the widely-held view, as articulated for example by Shleifer and Vishny (1997), that "product market competition is probably the most powerful force towards economic efficiency in the world…"

competitiveness. *High HHI* represents firms in the top tercile and indicates more concentrated, less competitive industries. Consistent with the argument that options trading has a more significant effect on debt structure in competitive industries we find that the coefficient of options trading volume in competitive industries (-0.952) is approximately three times as large as the coefficient found for concentrated industries (-0.437); the difference in these coefficients is statistically significant at the 1% level.

In columns (3) and (4), we partition the sample according to firm-level exposure to competitive threats as measured by the Hoberg, Phillips, and Prabhala (2014) *Fluidity* measure. *Fluidit*y measures the similarity between a firm's products and the aggregate changes in its competitors' products and is constructed by comparing the similarity in product descriptions in 10-K files. *High Fluidity* indicates that the firm faces more competitive threats from inter- and intra-industry competitors. Consistent with the HHI findings, we find that firms that face more product market governance pressure have a significantly (at the 1% level) more negative relation between options trading and reliance on bank financing. More specifically, the coefficient of options trading volume for *High Fluidity* firms (-1.026) is an order of magnitude larger than the coefficient found for *Low Fluidity* firms.

The results in this section suggest that substitution away from bank governance when options trading improves alternative governance mechanisms is more significant for firms operating in more competitive environments. This finding provides additional support for the hypothesis that options trading reduces the demand for the superior governance of banks by increasing efficiency of alternative mechanisms. In addition to providing additional evidence on the influence of options trading on debt structure decisions, these results extend the literature on the substitutional relation between different governance mechanisms.

6. Conclusion

Options trading activity can enhance informational efficiency of underlying securities by helping to complete markets and by stimulating information production that leads to informed trades. Recent research finds evidence suggesting that enhanced informational efficiency from options trading leads to higher firm values by allowing for a more efficient allocation of firm resources. This paper provides evidence that, in addition to a more efficient allocation of firm resources, options trading also enhances firm value through a financing channel, by promoting a debt structure that relies more on public debt and less on more

expensive bank financing. Consistent with both an information channel (where increased informational efficiency facilitates public debt issuance and reduces the demand for the superior ability of banks to access and process private information) and a governance channel (where enhanced informational efficiency reduces the demand for bank lender governance), we find that bank loan issuance and the ratio of bank debt to total debt are negatively related to options trading activity. We interpret our findings as contributing to the debt structure literature that considers how a firms' information environment affects the choice between bank borrowing and public debt issuance. More broadly, our finding that options trading activity affects firm debt structure choices contributes to the literature that contends that trading in financial markets affects corporate decision-making and is more than simply a sideshow with no real economic consequences.

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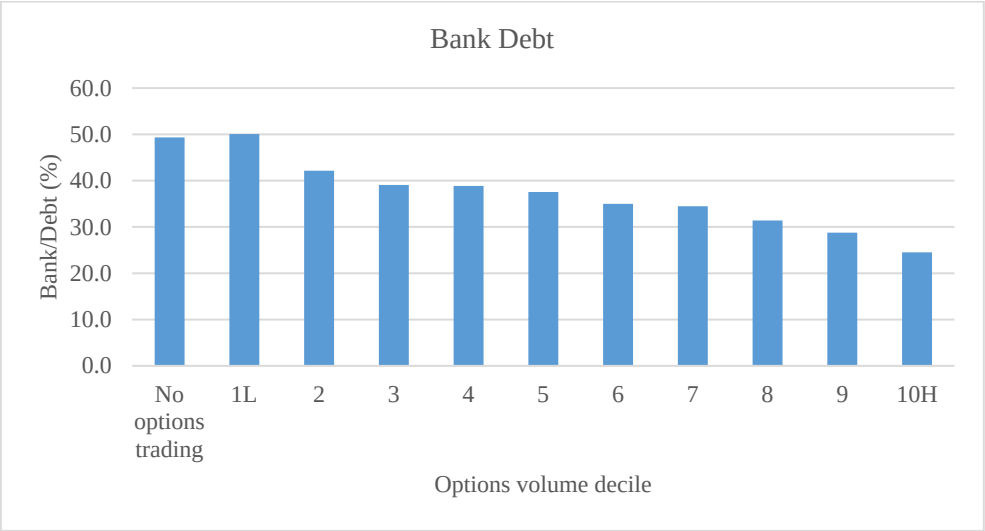
Figure 1
Debt Structure and Options Trading Volume

This figure presents bank debt and public debt ratios for firms sorted across options trading volume deciles. Firms with positive options trading volume during 2002–2015 are sorted each year into deciles by options trading volume within each size decile. *Bank Debt* is the amount of bank debt scaled by the total amount of debt. *Public Debt* is the amount of public debt scaled by the total amount of debt. Firms without options trading are listed on the left.



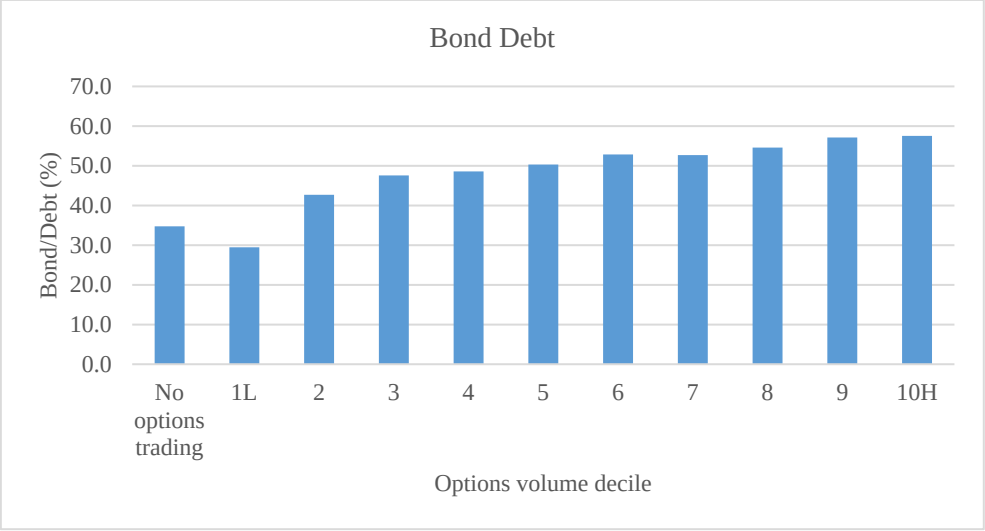
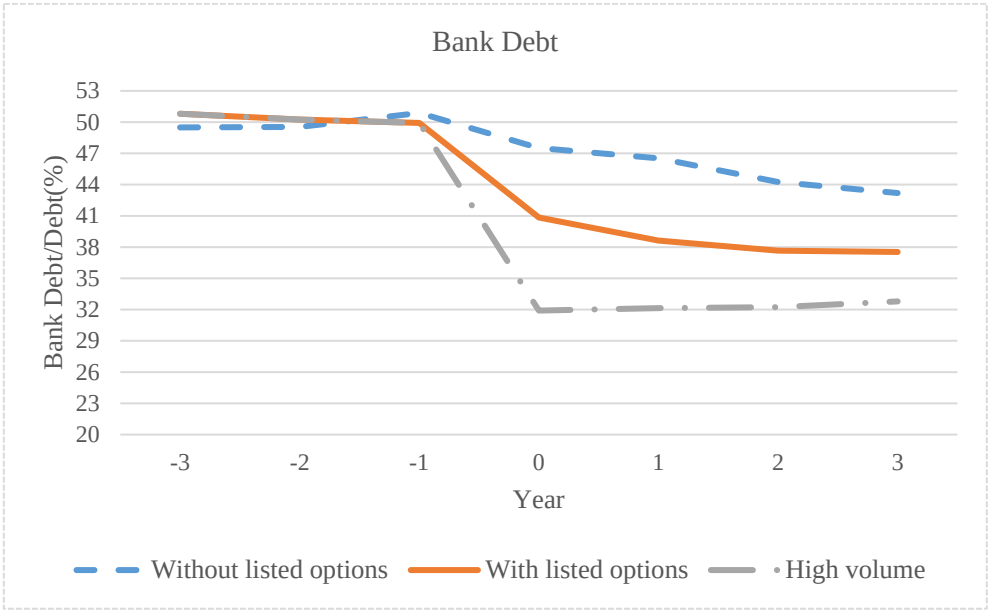


Figure 2
Changes in Debt Structure around Options Listing

This figure presents changes in debt structure around options listing as compared with matched firms without listed options. We first estimate an individual propensity score of having an option listing for all observations in the whole sample. Firms with listed options are then matched to firms without listed options based on the closeness of the propensity scores of having an option listing. We calculate three-year average trading volume after listing, sort firms into quintiles based on average trading volume and exclude firms in the bottom quintile, i.e., low trading volume firms, to construct the *High* volume group. The top figure shows the dynamics of bank debt, and the bottom figure shows the dynamics of public debt. The sample period is from 2002 to 2015.



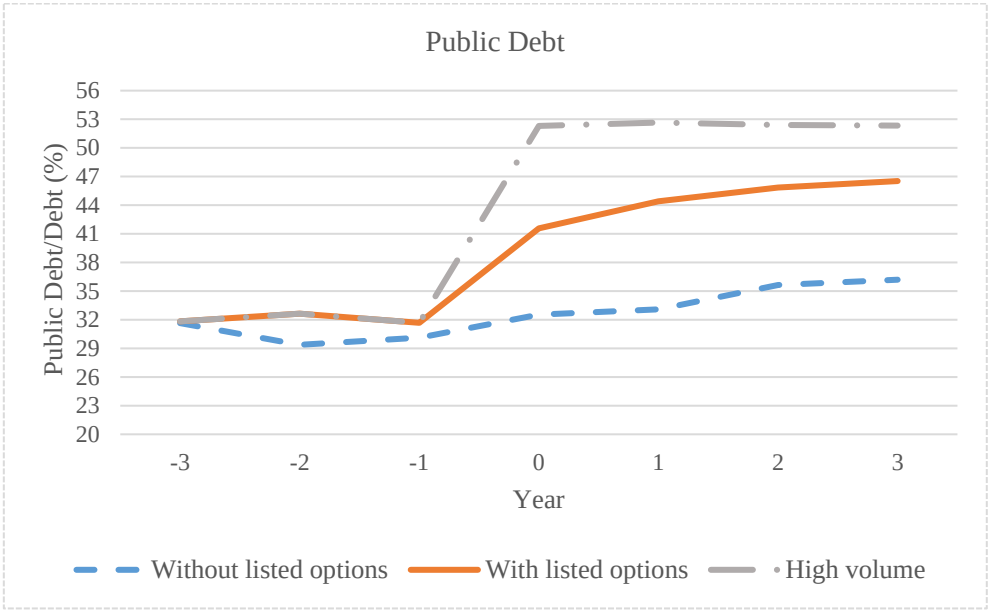


Table 1
Number of Firms with Non-Missing Data

This table contains the sample size of firms each year. Column (1) lists the total number of firms with available data for debt structure and the control variables including Size, Leverage, Market-to-Book ratio, ROA, PPE, Rating, and one-year stock return volatility. Column (2) lists the number of firms with listed options and column (3) lists the number of firms without listed options. Column (4) lists the percentage of all firms with listed options.

Year	All Firms	Firms with Listed Options	Firms without Listed Options	Firms with Listed Options /All Firms
	(1)	(2)	(3)	(4)
2002	2,647	1,322	1,325	49.9%
2003	2,607	1,311	1,296	50.3%
2004	2,551	1,333	1,218	52.3%
2005	2,560	1,367	1,193	53.4%
2006	2,523	1,452	1,071	57.6%
2007	2,537	1,549	988	61.1%
2008	2,479	1,578	901	63.7%
2009	2,343	1,568	775	66.9%
2010	2,217	1,536	681	69.3%
2011	2,215	1,656	559	74.8%
2012	2,138	1,686	452	78.9%
2013	2,098	1,723	375	82.1%
2014	2,128	1,751	377	82.3%
2015	1,916	1,601	315	83.6%
Total	32,959	21,433	11,526	65.0%

Table 2
Summary Statistics

This table reports descriptive statistics for our debt structure, options trading volume, and control variables. We construct two variables to measure the debt structure of firms. *Bank Debt* is a ratio measure which is the amount of bank debt scaled by the total amount of debt. *Public Debt* is a ratio measure which is the amount of public debt scaled by the total amount of debt. *Dvol* is the dollar volume of options trading in millions. *Ldvol* is the natural log of dollar trading volume of options. Other variable definitions are shown in Appendix A. Panel A presents summary statistics for all firms. Firms with no data on options trading activity are assumed to have options volume equal to zero. Panel B presents summary statistics for 3,652 unique firms with positive options trading volume. The sample period is from 2002 to 2015. All variables are winsorized at the 1% and 99% levels.

Panel A: All firms

Variables	Observations	Mean	S.D.	P25	Median	P75
Bank Debt (%)	32,959	41.580	40.821	0.000	27.914	90.782
Public Debt (%)	32,959	45.446	40.650	0.000	46.524	88.004
Dvol (in millions)	32,959	0.677	2.266	0.000	0.010	0.175
Ldvol	32,959	7.296	5.775	0.000	9.235	12.070
Size	32,959	6.680	2.053	5.246	6.682	8.050
Leverage	32,959	0.268	0.252	0.086	0.228	0.381
MtoB	32,959	1.860	1.785	1.106	1.425	2.042
ROA	32,959	0.065	0.274	0.050	0.104	0.156
PPE	32,959	0.516	0.417	0.178	0.409	0.789
Rating	32,959	2.015	1.391	1.000	1.000	3.000
RetStd	32,959	0.032	0.022	0.019	0.027	0.039

Panel B: Firms with positive options trading volume

Variables	Observations	Mean	S.D.	P25	Median	P75
Bank Debt (%)	21,433	35.141	38.831	0.000	17.117	71.084
Public Debt (%)	21,433	52.024	39.976	0.000	61.709	91.418
Dvol (in millions)	21,433	1.280	4.118	0.012	0.075	0.513
Ldvol	21,433	11.242	2.688	9.408	11.220	13.148
Size	21,433	7.521	1.733	6.358	7.470	8.649
Leverage	21,433	0.270	0.233	0.099	0.239	0.383
MtoB	21,433	1.934	1.602	1.163	1.514	2.160
ROA	21,433	0.092	0.191	0.067	0.114	0.166
PPE	21,433	0.500	0.403	0.170	0.393	0.767
Rating	21,433	2.379	1.480	1.000	3.000	4.000
RetStd	21,433	0.028	0.016	0.017	0.024	0.034

Table 3
Correlation Matrix

This table reports the correlation matrix for our debt structure, options trading, and control variables. We construct two variables to measure the debt structure of firms. *Bank Debt* is a ratio measure which is the amount of bank debt scaled by the total amount of debt. *Public Debt* is a ratio measure which is the amount of public debt scaled by the total amount of debt. *Dvol* is the dollar volume of options trading in millions. *Ldvol* is the natural log of dollar trading volume of options. Other variable definitions are shown in Appendix A. Panel A presents the correlation matrix regarding all firms. Firms with no data on options trading activity are assumed to have options volume equal to zero. Panel B presents the correlation matrix regarding firms with listed options, which contains 3,652 unique firms with positive options trading volume. The sample period is from 2002 to 2015. All variables are winsorized at the 1% and 99% levels.

Panel A: All firms

	Bank Debt	Public Debt	Dvol	Ldvol	Size	Leverage	MtoB	ROA	PPE	Rating	RetStd
Bank Debt	1.00										
Public Debt	-0.76	1.00									
Dvol	-0.20	0.18	1.00								
Ldvol	-0.28	0.29	0.42	1.00							
Size	-0.35	0.42	0.43	0.66	1.00						
Leverage	-0.06	0.21	-0.01	0.02	0.15	1.00					
MtoB	-0.03	-0.04	0.06	0.09	-0.18	0.08	1.00				
ROA	0.02	0.03	0.08	0.15	0.31	-0.14	-0.39	1.00			
PPE	-0.01	0.09	-0.01	-0.05	0.01	0.17	-0.08	0.08	1.00		
Rating	-0.39	0.46	0.34	0.46	0.71	0.15	-0.08	0.16	0.09	1.00	
RetStd	0.13	-0.17	-0.10	-0.28	-0.49	0.06	0.02	-0.34	0.00	-0.34	1.00

Panel B: Firms with positive options trading volume

	Bank Debt	Public Debt	Dvol	Ldvol	Size	Leverage	MtoB	ROA	PPE	Rating	RetStd
Bank Debt	1.00										
Public Debt	-0.76	1.00									
Dvol	-0.17	0.13	1.00								
Ldvol	-0.30	0.28	0.54	1.00							
Size	-0.36	0.42	0.41	0.58	1.00						
Leverage	-0.08	0.22	-0.02	0.03	0.16	1.00					
MtoB	0.01	-0.09	0.06	0.13	-0.27	0.00	1.00				
ROA	0.02	0.03	0.08	0.12	0.30	-0.08	-0.27	1.00			
PPE	-0.04	0.12	0.00	0.01	0.06	0.18	-0.10	0.11	1.00		
Rating	-0.40	0.47	0.28	0.40	0.71	0.15	-0.14	0.17	0.13	1.00	
RetStd	0.11	-0.15	-0.05	-0.09	-0.43	0.05	0.00	-0.35	0.00	-0.33	1.00

Table 4
Options Trading Volume and Debt Structure: Baseline Results

This table presents baseline results regarding the impact of options trading on debt structure. The dependent variable, *Bank Debt*, is the amount of bank debt scaled by the total amount of debt. *Public Debt* is the amount of public debt scaled by the total amount of debt. Other variable definitions are shown in Appendix A. Columns (1) and (2) report OLS regressions with firm and year fixed effects. Columns (3) and (4) use Tobit regressions to address potential problems with a certain number of firms having zero private debt or zero public debt. In columns (5) and (6), we include firms with no data on options trading activity and assume that they have options trading volume of zero. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Firms with Positive Options Trading Volume				All Firms	
	OLS		Tobit		OLS	
	Bank Debt	Public Debt	Bank Debt	Public Debt	Bank Debt	Public Debt
	(1)	(2)	(3)	(4)	(5)	(6)
Ldvol	-0.638***	0.615***	-2.469***	1.150***	-0.750***	0.503***
	(-2.88)	(3.01)	(-6.81)	(3.41)	(-7.54)	(5.19)
Size	-2.375**	3.622***	-3.586***	6.164***	-3.664***	3.641***
	(-2.24)	(3.31)	(-4.19)	(7.95)	(-9.45)	(9.21)
Leverage	-9.045***	26.440***	3.302	44.748***	1.854	21.582***
	(-3.54)	(8.49)	(0.97)	(13.94)	(0.95)	(10.77)
MtoB	-0.055	-0.544**	-1.148	-1.476**	-0.740**	-0.529*
	(-0.20)	(-1.99)	(-1.27)	(-2.55)	(-2.38)	(-1.94)
ROA	7.478***	-7.130***	31.216***	-20.130***	15.215***	-9.210***
	(3.47)	(-2.77)	(5.43)	(-4.99)	(7.71)	(-5.23)
PPE	-0.688	-2.074	-2.239	6.005***	-1.585	1.641
	(-0.26)	(-0.80)	(-1.03)	(2.77)	(-1.14)	(1.27)
Rating	-3.418***	4.609***	-7.252***	8.512***	-6.882***	8.076***
	(-5.83)	(7.25)	(-11.53)	(13.21)	(-16.86)	(18.27)
RetStd	-5.252	-16.896	46.008	-151.934***	-84.659***	20.100
	(-0.19)	(-0.61)	(0.93)	(-3.08)	(-3.31)	(0.80)
Industry FE	No	No	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	No	No	No	No
Observations	20,916	20,916	21,433	21,433	32,959	32,959
Adj./ Pseudo R^2	0.654	0.701	0.029	0.048	0.232	0.293

Table 5
Evidence on the Causal Effect of Options Trading Volume on Debt Structure

Panels A, B, and C of this table present evidence on the causal effect of dollar options trading volume on debt structure. *Bank (Public) Debt* is the amount of bank (public) debt scaled by the total amount of debt. Other variable definitions are shown in Appendix A. In all three panels, columns (1) and (2) report the second stage results and column (3) presents the first stage result. Panel A presents results that use open interest and absolute moneyness as instrumental variables for options trading volume. *Open Interest* is the average open interest across all options on a stock throughout the calendar year. *Moneyness* is the average absolute difference between the stock's market price and the option's strike price. Panel B presents evidence from a quasi-natural experiment that exploits the Chicago Board Options Exchange (CBOE) Penny Pilot Program as an exogenous positive shock to options trading volumes. The panel reports IV estimates where options trading volume is instrumented by pilot status. *Pilot* is equal to one if the firm participates in the pilot program in year t, and zero otherwise. Panel C presents evidence from a quasi-natural experiment that uses the introduction of shorter maturity weekly options as a shock to options trading volumes. The table reports IV estimates where options trading volume is instrumented by the weekly option introduction status. *Weekly* is equal to one if the firm has weekly options in year t, and zero otherwise. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Panel A: Options Trading Volume and Debt Structure: Instrumental Variable Approach

Variables	Bank Debt	Public Debt	First stage
	(1)	(2)	(3)
Predicted Ldvol	-0.857***	0.770***	
	(-3.13)	(3.08)	
Open Interest			1.063***
			(119.19)
Moneyness			-1.629***
			(-6.58)
Size	-2.111*	3.438***	0.329***
	(-1.94)	(3.08)	(12.23)
Leverage	-9.114***	26.467***	-0.442***
	(-3.58)	(8.52)	(-6.27)
MtoB	0.010	-0.594**	0.155***
	(0.04)	(-2.13)	(8.58)
ROA	7.677***	-7.306***	0.823***
	(3.53)	(-2.82)	(7.20)
PPE	-0.756	-2.024	-0.363***
	(-0.28)	(-0.78)	(-5.70)
Rating	-3.402***	4.592***	0.006
	(-5.81)	(7.23)	(0.48)
RetStd	-0.054	-20.375	13.221***
	(-0.00)	(-0.73)	(11.03)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	20,910	20,910	20,910
Adjusted R^2	0.655	0.702	0.947

First stage tests		
Under-identification test	Kleibergen-Paap rk LM statistic	1057.56
	P value	(0.000)
Weak instrument test	Cragg-Donald Wald F statistic	2.6×10^4
	Stock-Yogo weak ID test critical values	19.9
Over-identification test	Hansen J statistic	0.456
	P value	(0.499)

Panel B: Options Trading Volume and Debt Structure: Evidence from the Penny Pilot Program

Variables	Bank Debt	Public Debt	First stage
	(1)	(2)	(3)
Predicted Ldvol	-16.160***	21.384***	
	(-4.04)	(4.43)	
Pilot			0.356***
			(4.98)
Size	18.711***	-24.837***	1.365***
	(3.35)	(-3.69)	(28.72)
Leverage	-21.347***	47.491***	-0.615***
	(-5.69)	(11.26)	(-4.67)
MB	6.892***	-9.983***	0.479***
	(3.59)	(-4.25)	(23.65)
ROA	26.042***	-30.126***	1.022***
	(4.90)	(-5.07)	(5.00)
PPE	-4.722	3.364	-0.232*
	(-1.57)	(1.12)	(-1.80)
Rating	-3.277***	4.302***	-0.002
	(-5.80)	(6.95)	(-0.09)
RetStd	430.466***	-604.640***	28.094***
	(3.80)	(-4.47)	(16.44)
Observations	20,916	20,916	20,916
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Adjusted R^2	0.655	0.703	0.821

First stage tests		
Under-identification test	Kleibergen-Paap rk LM statistic	22.68
	P value	(0.000)
Weak instrument test	Cragg-Donald Wald F statistic	47.45
	Stock-Yogo weak ID test critical values	16.38
Over-identification test	Hansen J statistic	0.000
		(equation exactly identified)

Panel C: Options Trading Volume and Debt Structure: Evidence from Weekly Options Introductions

Variables	Bank Debt	Public Debt	First stage
	(1)	(2)	(3)
Predicted Ldvol	-11.539***	18.988***	
	(-2.77)	(3.23)	
Weekly			0.294***
			(3.77)
Size	12.392**	-21.560***	1.362***
	(2.11)	(-2.68)	(28.59)
Leverage	-18.581***	46.057***	-0.595***
	(-4.88)	(10.33)	(-4.50)
MB	4.694**	-8.843***	0.476***
	(2.34)	(-3.17)	(23.50)
ROA	21.240***	-27.637***	1.029***
	(3.97)	(-4.23)	(5.03)
PPE	-3.605	2.785	-0.240*
	(-1.21)	(0.90)	(-1.86)
Rating	-3.268***	4.297***	-0.003
	(-5.73)	(6.90)	(-0.11)
RetStd	300.592**	-537.291***	28.033***
	(2.54)	(-3.28)	(16.42)
Observations	20,916	20,916	20,916
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Adjusted R^2	0.654	0.703	0.821

First stage tests		
Under-identification test	Kleibergen-Paap rk LM statistic	13.02
	P value	(0.000)
Weak instrument test	Cragg-Donald Wald F statistic	23.39
	Stock-Yogo weak ID test critical values	16.38
Over-identification test	Hansen J statistic	0.000
		(equation exactly identified)

Table 6
Options Trading Volume and the Source of New Debt Issues: Bank Loans vs Bonds

This table presents evidence regarding the impact of options trading volume on the source of new debt issues. The dependent variable in column (1), *Bank Loan Issuance*, is a binary variable that equals one if the firm issued a bank loan and equals zero if the firm issued a bond. The dependent variable in column (2), *Dollar Amount of Bank Loan Issuance*, is the ratio of the dollar amount of bank loan issuance scaled by the total dollar amount of debt issuance. Other variable definitions are shown in Appendix A. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Linear Probability	OLS
	Bank Loan Issuance	Dollar Amount of Bank Loan Issuance
	(1)	(2)
Ldvol	-0.009***	-0.011***
	(-2.73)	(-3.34)
Size	0.014*	0.020**
	(1.83)	(2.47)
Leverage	-0.062*	-0.064**
	(-1.70)	(-2.15)
MtoB	-0.024***	0.000
	(-2.73)	(0.03)
ROA	0.553***	0.370***
	(8.30)	(5.08)
PPE	-0.044**	-0.024
	(-2.07)	(-1.30)
Rating	-0.041***	-0.042***
	(-8.19)	(-9.56)
RetStd	-0.272	-0.621
	(-0.47)	(-1.29)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	8,388	10,911
Adj. R^2	0.165	0.134

Table 7
Options Listing and Debt Structure: Changes in Debt Structure around Options Listing

This table presents evidence on the effect of options listing on debt structure. Panel A reports changes in bank debt ratios for treated and control firms in the seven-year window around the year of the options listing. Control firms without listed options are selected using a propensity score matching (PSM) approach that matches on size, leverage, market-to-book ratio, ROA, and lagged bank debt ratio rank. Panel B presents a multivariate difference-in-differences analysis. Following Mayhew and Mihov (2004), we estimate a logit model that predicts the likelihood of listing as a function of annual average daily stock trading volume, annual stock return volatility, abnormal average daily stock trading volume, abnormal stock returns volatility and the market value of equity. We first estimate the probability using Mayhew and Mihov (2004) approach. Thus, for each treated firm in the year prior to option listing, we match it with a control firm with the nearest estimated probability. The matching process leads us to 10,449 firm-year observations containing 1,283 unique pairs of treated and control firms. *Treated* is a binary variable that equals one for firms with option listing, and zero for their matched control firms. *Post* is a binary variable that equals one for years after option listing. $Before^{1}$ ($After^{1}$) is a binary variable that equals one indicating one year before (after) option listing. $Before^{2+}$ ($After^{2+}$) is a binary variable that equals one indicating two years or more before (after) the inclusion. We only keep sample period from five years before and after the inclusion years to mitigate potential influence due to years that are far away from the listing year. Other variable definitions are shown in Appendix A. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Panel A: Changes in Bank Debt Ratios around Options Listing: Univariate Comparison

Year	Treated (T)	Control (C)	T-C	t-statistics
Listing Year-3	50.81	49.50	1.31	0.67
Listing Year-2	50.24	49.53	0.71	0.40
Listing Year-1	49.92	50.88	-0.96	-0.61
Listing Year	40.85	47.51	-6.66***	-6.65
Listing Year+1	38.63	46.52	-7.89***	-7.34
Listing Year+2	37.66	44.25	-6.59***	-5.77
Listing Year+3	37.53	43.19	-5.66***	-4.67

Panel B: Changes in Debt Structure around Options Listing: Difference-in-Differences Analysis

Variables	Bank Debt	Public Debt	Bank Debt	Public Debt
	(1)	(2)	(3)	(4)
Treated x Post	-7.149***	5.457***		
	(-3.42)	(2.79)		
Post	3.091**	-2.272**		
	(2.45)	(-1.96)		
Treated x Before^{2+}			2.770	-0.467
			(1.25)	(-0.24)
Treated x Before^{1}			-0.318	1.716
			(-0.21)	(1.29)
Treated x After^{1}			-3.948**	3.233**
			(-2.41)	(2.03)
Treated x After^{2+}			-7.162***	6.882***
			(-3.10)	(3.08)
Before^{2+}			-0.625	-0.116
			(-0.43)	(-0.09)
Before^{1}			-0.043	-1.366
			(-0.04)	(-1.46)
After^{1}			1.952	-1.870
			(1.58)	(-1.53)
After^{2+}			1.803	-2.140
			(1.13)	(-1.43)
Size	-3.672***	4.567***	-3.375**	4.406***
	(-2.85)	(3.45)	(-2.56)	(3.27)
Leverage	-7.759**	19.566***	-8.085**	19.703***
	(-2.47)	(4.90)	(-2.57)	(4.92)
MB	-0.152	0.234	-0.131	0.234
	(-0.76)	(0.58)	(-0.64)	(0.58)
ROA	6.493**	-6.554**	6.388**	-6.354**
	(2.18)	(-2.21)	(2.13)	(-2.15)
PPE	0.264	-0.179	0.167	-0.199
	(0.07)	(-0.05)	(0.05)	(-0.06)
Rating	-4.337***	4.514***	-4.308***	4.448***
	(-4.77)	(4.74)	(-4.74)	(4.70)
RetStd	-18.774	-20.416	-19.215	-19.619
	(-0.58)	(-0.54)	(-0.59)	(-0.52)
Observations	10,449	10,449	10,449	10,449
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.657	0.669	0.657	0.669

Table 8
Options Listing and the Source of New Debt Issues

This table presents evidence regarding the source of post-listing debt issues from estimates of linear probability regressions. We use a binary dependent variable, *Bond Issue,* which equals one for public debt issues and equals zero for bank loans. Results for the full sample of firms are reported in Columns (1) and (2). Results for the subsample of firms with debt structures that are 100% bank debt are reported in Columns (3) and (4). For each firm in the full sample with newly initiated options trading (treated firm), we find a firm without options trading (control firm) based on propensity score matching (PSM) using leverage as the matching criteria. Columns (1) and (3) report results for all post-listing debt issues; Columns (2) and (4) report results for only the first post-listing debt issue. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

	Full Sample		100% Bank Debt Subsample	
Dep. var. = *Bond issue*	All issues	First issue	All issues	First issue
	(1)	(2)	(3)	(4)
Treated	0.386***	0.342**	0.538*	2.165***
	(3.27)	(2.26)	(1.70)	(2.87)
Size	-0.042	-0.140**	0.022	0.496
	(-1.24)	(-2.09)	(0.28)	(0.96)
Leverage	0.498***	0.918***	1.022*	5.223***
	(2.84)	(2.97)	(1.78)	(3.23)
MtoB	0.211***	0.217***	0.235**	0.402*
	(4.85)	(2.97)	(2.17)	(1.65)
ROA	-2.637***	-3.209***	-1.524**	-13.170***
	(-7.01)	(-5.11)	(-2.41)	(-3.78)
PPE	0.028	0.060	-0.181	5.032***
	(0.32)	(0.36)	(-0.84)	(3.56)
RetStd	-4.053	-2.586	-7.791	3.733
	(-1.43)	(-0.43)	(-0.99)	(0.14)
Constant	-0.132	0.443	-0.941	-12.560***
	(-0.24)	(0.40)	(-1.09)	(-2.82)
Observations	3,324	798	379	89
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Pseudo R^2	0.114	0.253	0.170	0.545

Table 9.A
Cross-sectional Analyses: Information Asymmetry and Credit Rating

This table presents cross-sectional evidence on the impact of options trading volume on bank debt ratios. Columns (1) and (2) report results for the Big and Small firms by splitting sample firms into size terciles. Results sorted by whether firms have an investment grade credit rating are shown in columns (3) and (4). The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Bank Debt			
	Big Size	Small Size	Investment	Non-investment
	(1)	(2)	(3)	(4)
Ldvol	-0.156	-0.815**	0.206	-1.934***
	(-0.65)	(-2.25)	(0.53)	(-6.71)
Size			-5.463***	-4.933***
			(-6.68)	(-7.69)
Leverage	-6.355	-9.919**	-13.487***	-7.373***
	(-1.58)	(-2.46)	(-3.90)	(-2.83)
MtoB	0.022	0.063	-1.280	0.010
	(0.03)	(0.22)	(-1.48)	(0.02)
ROA	1.133	7.428***	-8.662	23.898***
	(0.22)	(2.72)	(-0.97)	(7.04)
PPE	-0.267	1.293	0.270	-6.453***
	(-0.09)	(0.28)	(0.13)	(-3.32)
Rating	-3.084***	-3.464*		
	(-4.07)	(-1.91)		
RetStd	96.649***	-79.881	154.684***	-39.280
	(2.62)	(-1.52)	(2.65)	(-0.98)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	7,022	6,654	5,695	15,735
Adjusted R^2	0.672	0.610	0.217	0.138
Difference	0.659**		2.141***	
p-values	(0.020)		(0.000)	

Table 9.B
Cross-sectional Analyses: Bank Loan Syndicate Structure

This table reports evidence on the impact of options trading volume on bank loan syndicate structure. *Loan Shares* is the amount of the loan taken by a participant divided by the total amount of the loan. *Leader* is a binary variable equal to one for the lead arranger, zero otherwise. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the facility level and *t*-statistics are reported in parentheses.

Variables	Loan Shares	Loan Shares
	(1)	(2)
Ldvol	-0.002***	0.001
	(-2.80)	(1.18)
Leader	0.128***	0.130***
	(22.77)	(24.90)
Leader × Ldvol	-0.004***	-0.005***
	(-9.36)	(-12.13)
Size	-0.011***	-0.001
	(-4.23)	(-0.62)
Leverage	-0.007	0.002
	(-0.78)	(0.29)
MtoB	0.008***	0.004**
	(3.53)	(2.27)
ROA	-0.067***	-0.051***
	(-2.96)	(-2.79)
PPE	0.002	-0.005
	(0.29)	(-0.89)
Rating	-0.001	-0.001
	(-1.23)	(-1.08)
RetStd	0.200	-0.063
	(1.28)	(-0.48)
Log(loan maturity)		-0.007***
		(-5.76)
Log(loan size)		-0.008***
		(-7.83)
Loan spread		0.007***
		(3.64)
Number of lenders		-0.003***
		(-19.39)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	53,023	47,844
Adjusted R^2	0.601	0.670

Table 9.C
Cross-sectional Analyses: Covenant Strictness

This table presents evidence on the impact of options trading volume on the strictness of bank loan covenants. *Strictness,* developed by Murfin (2012), approximates the probability that the lender will receive contingent control via a covenant violation. *PVIOL*, the covenant strictness measure constructed by Demerjian and Owens (2016), covers 15 types of capital-based and performance-based covenants and is available in Dealscan. *Loan Spread* is the all-in-spread drawn from DealScan. *Log(Loan Maturity)* is the natural log of the loan maturity measured in months. *Log(Loan Size)* is the natural log of the loan facility amount. *CDS Trading* is a dummy variable that equals one if the firm has CDS trading on its debt at loan initiation, and zero otherwise. Other variable definitions are shown in Appendix A. The sample period is from 2002 to 2012. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Strictness	Strictness	PVIOL	PVIOL
	(1)	(2)	(3)	(4)
Ldvol	-1.051*	-1.001*	-1.677**	-1.830***
	(-1.92)	(-1.80)	(-2.51)	(-2.73)
Size	0.062	0.720	-5.789**	-4.599
	(0.03)	(0.37)	(-2.10)	(-1.61)
Rating Flag	8.433***	8.056***	-0.273	1.403
	(2.95)	(2.99)	(-0.06)	(0.32)
Z Score	-2.404***	-2.475***	-3.050***	-2.718***
	(-5.06)	(-5.37)	(-5.06)	(-4.78)
RetStd	193.169**	146.415	586.832***	559.988***
	(2.15)	(1.61)	(4.84)	(4.51)
CDS Trading	-1.462	-0.012	-4.952	-3.850
	(-0.36)	(-0.00)	(-1.08)	(-0.80)
Log(Loan Maturity)		0.005		-0.145
		(0.01)		(-0.17)
Log(Loan Size)		-0.021		-0.630
		(-0.06)		(-1.19)
Log(Loan Spread)		5.958***		7.371***
		(4.72)		(4.15)
Number of Lenders		-0.044		0.019
		(-0.63)		(0.20)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Loan Purpose FE	Yes	Yes	Yes	Yes
Performance Pricing FE	Yes	Yes	Yes	Yes
Observations	2,680	2,473	5,359	4,974
Adjusted R^2	0.640	0.651	0.588	0.598

Table 9.D
Cross-sectional Analyses: Product Market Competitiveness

This table presents evidence on the impact of product market competition on the relation between bank debt ratios and options trading volume. In columns (1) and (2), we sort firms into terciles based on the Herfindal-Hirschman index (HHI) at the two-digit SIC level. High HHI represents firms in the top tercile, while Low HHI represents firms in the bottom tercile. In columns (3) and (4), we sort firms into terciles based on fluidity scores from Hoberg-Phillips's website. High Fluidity represents firms in the top tercile, while Low Fluidity represents firms in the bottom tercile. Other variable definitions are shown in Appendix A. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Bank Debt			
	High HHI	Low HHI	High Fluidity	Low Fluidity
	(1)	(2)	(3)	(4)
Ldvol	-0.437	-0.952***	-1.026***	0.258
	(-1.20)	(-2.72)	(-2.82)	(0.65)
Size	-3.619*	-0.511	-1.671	-3.075
	(-1.95)	(-0.29)	(-0.96)	(-1.43)
Leverage	-17.282***	-2.036	-8.517**	-14.631***
	(-3.62)	(-0.58)	(-2.57)	(-2.94)
MtoB	-0.735	-0.060	0.428	-1.280
	(-0.97)	(-0.19)	(1.51)	(-1.61)
ROA	11.411*	5.905*	9.301***	9.750
	(1.94)	(1.88)	(3.82)	(1.03)
PPE	-3.698	0.764	0.704	-7.214
	(-0.80)	(0.18)	(0.18)	(-1.34)
Rating	-3.103***	-2.632***	-3.613***	-3.303***
	(-2.93)	(-2.77)	(-3.64)	(-3.10)
RetStd	-6.747	-31.486	90.790**	24.203
	(-0.12)	(-0.78)	(2.28)	(0.37)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observation	6,568	7,503	6,449	6,569
Adjusted R^2	0.655	0.676	0.652	0.669
Low-High	-0.515**		1.284***	
p-values	(0.010)		(0.000)	

Appendix A: Variable Definitions

Variable	Definitions
Bank Debt	A ratio measure equals the amount of bank debt scaled by the total amount of debt. Source: S&P Capital IQ
Public Debt	A ratio measure equals the amount of public debt scaled by the total amount of debt. Source: S&P Capital IQ
Dvol	Dollar trading volume of options in millions. Source: OptionMetrics
Ldvol	The logarithm of dollar trading volume of options. Source: OptionMetrics
Size	The logarithm of total assets. Source: Compustat
Leverage	The amount of long-term debt and debt in current liabilities scaled by total assets. Source: Compustat
MtoB	The market value scaled by book value. Source: Compustat
ROA	Operating income before depreciation scaled by total assets. Source: Compustat
PPE	The amount of property, plant, and equipment scaled by total assets. Source: Compustat
Rating	Long-term credit rating, where 1 for none rating, 2 for lowest rating, and 7 for the highest rating. Source: Compustat
RetStd	The stock return standard deviation calculated using daily stock returns in the one year. Source: CRSP.
Open Interest	Average open interest across all options on a stock throughout the calendar year. Source: OptionMetrics
Moneyness	Average absolute difference between the stock's market price and the option's strike price. Source: OptionMetrics
Strictness	A measure developed by Murfin (2012) approximates the probability that the lender will receive contingent control via a covenant violation.
PIVOL	The average strictness measure for all loan covenants constructed by Demerjian and Owens (2016).

Variable	Definitions
Log(Loan Maturity)	The logarithm of the loan maturity measured in months. Source: DealScan
Log(Loan Size)	The logarithm of the loan facility amount. Source: DealScan
Log(Loan Spread)	The logarithm of all-in-spread drawn in the DealScan. Source: DealScan
Number Of Lenders	The number of lenders in a loan syndicate. For sole lender loans, this equals one. Source: DealScan
Rating Flag	A dummy that equals one if the borrower has an S&P credit rating for long-term debt issues and zero otherwise. Source: Compustat
Z Score	A measure developed by Altman's (1968) equals 3.3* EBIT/total assets + 0.999* sales/total assets + 1.4*retained earnings/total assets+ 1.2*(current assets – current liabilities)/total assets+0.6* market value of equity/total liabilities. Source: Compustat
CDS Trading	A dummy variable that equals one if CDS referencing the borrower's name are trading at the time of loan initiation and zero otherwise. Source: GFI Group
Loan Purpose	Dummy variables for loan purposes, including corporate purposes, debt repayment, working capital, takeover, etc. Source: DealScan
Performance Pricing	A dummy variable that equals one if the loan facility used performance pricing, otherwise equals zero. Source: DealScan

Appendix B: Additional Tables

Table B1
Robustness Tests

This table presents robust tests regarding the impact of options trading on the debt structure. We rank firms from one to one hundred each year based on dollar options trading volume, denoted as *Dvol Rank*. We replicate baseline regression in Table 4, replacing *Ldvol* with *Dvol Rank*. Other variable definitions are shown in Appendix A. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Bank Debt	Public Debt	Bank Debt	Public Debt
	(1)	(2)	(3)	(4)
Dvol Rank	-0.064***	0.049**	-0.153***	0.106***
	(-3.02)	(2.47)	(-6.51)	(4.56)
Size	-2.332**	3.758***	-3.764***	3.775***
	(-2.21)	(3.42)	(-6.59)	(6.51)
Leverage	-9.055***	26.378***	-3.215	28.627***
	(-3.55)	(8.48)	(-1.34)	(11.83)
MtoB	-0.034	-0.524*	-0.416	-0.856**
	(-0.13)	(-1.91)	(-0.81)	(-2.17)
ROA	7.553***	-7.074***	22.871***	-15.195***
	(3.51)	(-2.75)	(6.92)	(-5.27)
PPE	-0.774	-2.035	-4.121**	4.105**
	(-0.29)	(-0.79)	(-2.48)	(2.46)
Rating	-3.408***	4.602***	-5.915***	7.041***
	(-5.81)	(7.24)	(-13.19)	(14.00)
RetStd	-2.158	-16.030	34.908	-117.194***
	(-0.08)	(-0.57)	(0.98)	(-3.16)
Firm FE	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes
Observations	20,916	20,916	21,433	21,433
Adjusted R^2	0.654	0.701	0.246	0.313

Table B2
Entropy Balancing Approach

This table presents entropy balancing results regarding the impact of options trading on debt structure. We test the robustness of our findings employing the entropy balancing approach proposed by Hainmueller (2012). Using entropy balancing approach, we could identify weights to equalize the differences across firms with different levels of options trading volume and provide reliable inference in terms of the relation between options trading and debt structure of firms. The dependent variable, *Bank Debt*, is the amount of bank debt scaled by the total amount of debt. *Public Debt* is the amount of public debt scaled by the total amount of debt. Other variable definitions are shown in Appendix A. *High Dvol* equals to one representing firms with high options trading volume above median, otherwise equals zero. Columns (1) and (2) report OLS regressions including firm and year fixed effects with entropy balancing weights, while columns (3) and (4) report results without entropy balancing weights as comparison. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Entropy Balancing		Without Entropy Balancing	
	Bank Debt	Public Debt	Bank Debt	Public Debt
	(1)	(2)	(3)	(4)
High Dvol	-1.449**	0.929	-2.023***	1.360**
	(-2.10)	(1.35)	(-2.79)	(2.03)
Size	-2.330**	2.414**	-2.811***	4.151***
	(-2.22)	(2.13)	(-2.77)	(3.90)
Leverage	-6.780***	23.196***	-8.875***	26.228***
	(-2.60)	(7.86)	(-3.48)	(8.44)
MtoB	-0.707**	-0.557**	-0.139	-0.437
	(-1.97)	(-2.17)	(-0.50)	(-1.57)
ROA	3.030	-2.323	7.184***	-6.774***
	(0.74)	(-0.69)	(3.30)	(-2.63)
PPE	-2.139	-2.674	-0.652	-2.135
	(-0.70)	(-0.91)	(-0.24)	(-0.82)
Rating	-2.816***	4.111***	-3.430***	4.618***
	(-5.00)	(6.40)	(-5.85)	(7.27)
RetStd	23.342	-42.214	-13.875	-6.585
	(0.77)	(-1.24)	(-0.50)	(-0.24)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	20,916	20,916	20,916	20,916
Adjusted R^2	0.678	0.720	0.654	0.701

Table B3
Options Trading Volume and Debt Structure: Evidence from the Penny Pilot Program

This table presents evidence regarding the impact of options trading volume on bank debt before and after Penny Pilot Program using a DID approach. We construct a matched sample based on estimated the probability of being included in the program as a function of firm characteristics in the baseline regression as well as options trading volume. Thus, for each pilot firm in the year prior to the program inclusion, we match it with a control firm with the nearest estimated probability. The matching process leads us to 2,743 firm-year observations containing 151 unique pairs of pilot and control firms. The dependent variable, *Bank Debt* (*Public Debt*), is the amount of bank debt (public debt) scaled by the total amount of debt. *Treated* is a binary variable that equals one for firms that are selected as Penny Pilot Program, and zero for their matched control firms. *Post* is a binary variable that equals one for years after pilot firms have been included in the program. $Before^{1}$ ($After^{1}$) is a binary variable that equals one indicating one year before (after) the inclusion. $Before^{2+}$ ($After^{2+}$) is a binary variable that equals one indicating two years or more before (after) the inclusion. Other variable definitions are shown in Appendix A. Considering the inclusion of these firms in the program happens gradually over sample period, we only keep sample period from five years before and after the inclusion years to mitigate potential influence due to years far away from the inclusion years. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	(1)	(2)	(3)	(4)
	Bank Debt	Public Debt	Bank Debt	Public Debt
Treated x Post	-4.852**	6.691**		
	(-1.98)	(2.32)		
Post	0.572	-2.986		
	(0.29)	(-1.12)		
Treated x Before^{2+}			4.247	-4.334
			(1.47)	(-1.30)
Treated x Before^{1}			2.935	-3.596
			(1.50)	(-1.42)
Treated x After^{1}			-3.738**	3.882**
			(-2.07)	(2.09)
Treated x After^{2+}			-1.334	3.393
			(-0.57)	(1.29)
Before^{2+}			6.014***	-4.342
			(3.19)	(-1.64)
Before^{1}			1.803*	-2.901*
			(1.70)	(-1.69)
After^{1}			1.034	-3.402*
			(0.62)	(-1.68)
After^{2+}			-0.305	-1.968
			(-0.12)	(-0.60)
Size	-2.580	1.948	-2.245	1.762
	(-1.31)	(0.74)	(-1.14)	(0.67)
Leverage	-13.907*	44.905***	-12.733*	43.917***
	(-1.82)	(3.54)	(-1.70)	(3.52)
MB	0.637	-1.432	0.580	-1.364
	(0.67)	(-1.19)	(0.61)	(-1.13)
ROA	0.364	2.600	1.171	1.825
	(0.06)	(0.40)	(0.18)	(0.28)
PPE	3.476	-5.434	3.872	-5.734
	(0.68)	(-0.89)	(0.74)	(-0.92)
Rating	-1.360	2.286	-1.511	2.382
	(-1.48)	(1.47)	(-1.62)	(1.53)
RetStd	0.427	-35.133	9.590	-41.295
	(0.01)	(-0.38)	(0.17)	(-0.45)
Observations	2,743	2,743	2,743	2,743
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.591	0.647	0.594	0.648

Table B4
Summary Statistics for Debt Issuance Analysis

This table reports descriptive statistics for our debt issuance, options trading, and control variables. We construct two variables to measure the debt issuance of firms. *Bank Loan Issuance* is a binary variable that equals one if the firm issued Bank loan and equals zero if the firm issued a bond. We also compute *Dollar amt. of bank loan issuance*, the ratio of the dollar amount of bank loan issuance scaled by the total dollar amount of debt issuance. *Dvol* is the dollar volume of options trading in millions. *Ldvol* is the natural log of dollar trading volume of options. Other variable definitions are shown in Appendix A. The sample contains 2,626 unique firms with options trading volume from 2002 to 2015. All variables are winsorized at the 1% and 99% level.

Panel A: Summary statistics

Variables	Observations	Mean	S.D.	P25	Median	P75
Bank Loan Issue	10,912	0.823	0.398	1.000	1.000	1.000
Dollar Amt. of Bank Loan Issuance	10,912	0.710	0.405	0.409	1.000	1.000
Bank Debt	10,912	32.004	36.349	0.019	15.319	57.669
Public Debt	10,912	58.226	36.732	24.084	69.905	91.220
Dvol (in millions)	10,912	1.728	4.872	0.018	0.121	0.841
Ldvol	10,912	11.689	2.672	9.805	11.701	13.643
Size	10,912	8.090	1.647	6.956	7.993	9.201
Leverage	10,912	0.292	0.209	0.145	0.271	0.399
MtoB	10,912	1.803	1.350	1.163	1.476	2.042
ROA	10,912	0.116	0.143	0.080	0.120	0.169
PPE	10,912	0.538	0.414	0.187	0.447	0.839
Rating	10,912	2.843	1.497	1.000	3.000	4.000
RetStd	10,912	0.025	0.014	0.015	0.021	0.030

Panel B: Correlation matrix

	Bank Loan Issue	Dollar amt. of bank loan issuance	Bank Debt	Public Debt	Dvol	Ldvol	Size	Leverage	MtoB	ROA	PPE	Rating	RetStd
Bank Loan Issue	1												
Dollar amt. of bank loan issuance	0.87	1											
Bank Debt	0.13	0.22	1										
Public Debt	-0.11	-0.19	-0.83	1									
Dvol	-0.03	-0.09	-0.19	0.12	1								
Ldvol	-0.03	-0.10	-0.32	0.27	0.58	1							
Size	0.02	-0.08	-0.48	0.44	0.46	0.64	1						
Leverage	-0.04	-0.08	-0.09	0.15	-0.04	-0.02	0.10	1					
MtoB	-0.01	0.01	0.08	-0.12	0.07	0.11	-0.21	0.01	1				
ROA	0.16	0.16	-0.01	0.04	0.08	0.11	0.16	-0.10	-0.19	1			
PPE	0.00	-0.02	-0.09	0.14	-0.02	0.00	0.01	0.18	-0.08	0.11	1		
Rating	-0.03	-0.12	-0.51	0.50	0.28	0.42	0.70	0.09	-0.10	0.13	0.08	1	
RetStd	-0.15	-0.13	0.16	-0.16	-0.05	-0.07	-0.38	0.07	-0.06	-0.29	0.03	-0.33	1

Table B5
Options Listing and Debt Structure: Evidence from a Quasi-natural Experiment

This table presents reports changes in bank debt among treated and control firms from a quasi-natural experiment on option listings following Hu (2018). The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Year	Treated (T)	Control (C)	T-C	t-statistics
Listing Year-2	51.34	65.04	-13.70	-1.52
Listing Year-1	61.52	69.44	-7.92	-0.92
Listing Year	50.78	66.26	-15.48	-1.61
Listing Year+1	49.78	69.96	-20.18**	-2.06
Listing Year+2	54.98	64.45	-9.47	-0.94

Table B6
Changes in Public Debt Ratios around Options Listing

This table presents changes in public debt ratio around options listing compared with matched firms without listed options. Panel A reports changes in bank debt among control and treated firms matched on size, leverage, market-to-book ratio, ROA, and public debt rank in a seven-year window around listing. We first estimate an individual propensity score of having an option listing for all observations in the full sample. Firms with listed options are then matched to firms without listed options based on the closeness of the propensity scores of having an option listing. Panel B reports changes in public debt among control and treated firms regarding a quasi-natural experiment on option listings following Hu (2018). *Control* represents matched firms without listed options, while *Treated* represents firms with listed options. Panel C reports changes in public debt among firms with and without weekly option introduction. Treated and control firms are matched on market capitalization and options trading volume, and industry (2-digit SIC). The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Changes in Public Debt in the years around option listing

Year	Treated (T)	Control (C)	T-C	t-statistics
Listing Year-3	31.83	31.65	0.17	0.09
Listing Year-2	32.64	29.37	3.27	1.91
Listing Year-1	31.68	30.12	1.56	1.01
Listing Year	41.57	32.53	9.04***	8.94
Listing Year+1	44.40	33.09	11.31***	10.27
Listing Year+2	45.85	35.64	10.21***	8.57
Listing Year+3	46.53	36.19	10.34***	8.15

Panel B: A quasi-natural experiment on option listings

Year	Treated (T)	Control (C)	T-C	t-statistics
Listing Year – 2	34.03	28.02	6.01	0.69
Listing Year – 1	27.49	24.80	2.69	0.74
Listing Year	38.04	23.11	14.93	1.66
Listing Year +1	37.98	23.00	14.98*	1.67
Listing Year +2	36.55	28.99	7.55	0.77

Panel C: Change in Public Debt ratios around weekly options introduction

Year	Treated (T)	Control (C)	T-C	t-statistics
Listing Year – 3	64.41	71.29	-6.88	1.75
Listing Year – 2	64.70	70.81	-6.11	1.55
Listing Year – 1	65.37	70.65	-5.29	1.30
Listing Year	68.81	68.77	0.03	0.00
Listing Year +1	68.57	67.91	0.67	-0.15
Listing Year +2	68.17	64.70	3.47	-0.85
Listing Year +3	68.87	65.39	3.49	-0.75

Table B7.A
Subsample Evidence for Public Debt

This table presents the impact of options trading on the debt structure in terms of the information channel. We sort firms into terciles based on firm size. Big represents firms in the top tercile, while Small represents firms in the bottom tercile. We also sort firms based on whether firms have investment rating shown in columns (3) and (4). Other variable definitions are shown in Appendix A. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Public Debt			
	Big Size	Small Size	Investment	Non-investment
	(1)	(2)	(3)	(4)
Ldvol	0.231	0.894***	-0.174	1.379***
	(0.76)	(2.94)	(-0.35)	(4.90)
Size			1.564	6.548***
			(1.39)	(10.36)
Leverage	18.250***	27.768***	16.517**	34.162***
	(3.52)	(5.54)	(2.44)	(12.84)
MtoB	-2.283**	-0.455*	-2.513**	-1.007**
	(-1.97)	(-1.70)	(-2.08)	(-2.39)
ROA	-0.629	-6.179*	24.769**	-17.821***
	(-0.11)	(-1.94)	(2.10)	(-5.87)
PPE	-6.685**	-1.820	-3.091	7.549***
	(-2.00)	(-0.46)	(-1.13)	(3.97)
Rating	4.462***	6.072***		
	(4.61)	(3.34)		
RetStd	-43.804	48.765	-67.814	-46.039
	(-0.94)	(1.06)	(-0.86)	(-1.12)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	7,022	6,654	5,695	15,735
Adjusted R^2	0.673	0.656	0.151	0.225
Difference	0.663**		1.553***	
p-values	(0.010)		(0.000)	

Table B7.B
The Effect of Product Market Competition for Public Debt

This table presents the impact of options trading on the debt structure in terms of competition channel. In columns (1) and (2), we sort firms into tercile based on Herfindal-Hirschman index (HHI) at two-digit SIC. High HHI represents firms belonging to the top tercile, while Low HHI represents firms belonging to the bottom tercile. In columns (3) and (4), we sort firms into tercile based on fluidity scores from Hoberg-Phillips's website. High Fluidity represents firms belonging to the top tercile, while Low Fluidity represents firms belonging to the bottom tercile. Other variable definitions are shown in Appendix A. The sample period is from 2002 to 2015. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are robust and clustered at the firm level and t-statistics are reported in parentheses.

Variables	Public Debt			
	High HHI	Low HHI	High Fluidity	Low Fluidity
	(1)	(2)	(3)	(4)
Ldvol	0.274	1.092***	0.930***	-0.202
	(0.79)	(3.35)	(2.60)	(-0.57)
Size	3.439*	3.596**	2.888	3.410
	(1.83)	(2.02)	(1.57)	(1.61)
Leverage	33.252***	19.837***	18.380***	34.516***
	(7.16)	(4.18)	(4.60)	(6.34)
MtoB	0.571	-0.840**	-1.001***	0.929
	(0.84)	(-2.33)	(-2.79)	(1.28)
ROA	-1.940	-12.634***	-13.724***	-8.115
	(-0.35)	(-3.00)	(-4.02)	(-0.93)
PPE	2.199	-1.559	-2.639	3.046
	(0.50)	(-0.38)	(-0.65)	(0.57)
Rating	4.352***	4.008***	4.323***	4.806***
	(3.92)	(3.92)	(4.23)	(4.02)
RetStd	21.153	-45.919	-70.749*	-16.641
	(0.39)	(-1.08)	(-1.67)	(-0.28)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observation	6,568	7,503	6,449	6,569
Adjusted R^2	0.705	0.734	0.705	0.706
Low-High	0.818***		-1.132***	
p-values	(0.000)		(0.000)	