Credit Default Swaps and Corporate Debt Structure

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Abstract

Credit default swaps (CDSs) are bilateral contracts that contain private information about the underlying firm. CDS trading could reveal such information to the market, thereby altering firms' financing choices. We find that firms use more public debt and less bank debt when there is CDS trading on their debt. The results are robust to the endogeneity of CDS trading. Furthermore, the effect of CDS trading is more pronounced for informationally opaque firms, suggesting that CDS trading improves the information environment. These findings suggest that the informational role of CDSs has real effects on corporate debt structure.

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1. Introduction

Firms use multiple types of debt to meet their external financing needs and experience significant changes in their debt composition from year to year, even when they show no significant changes in their total leverage (Rauh and Sufi, 2010). U.S. public firms have two major sources of debt financing. They can issue debt securities to arms-length investors such as public bondholders or borrow directly from financial intermediaries such as commercial banks. Public debt and bank debt each constitutes a significant proportion of total debt financing, although the relative composition of these two debt instruments varies significantly over time (Federal Reserve, 2014). Given the increase in debt financing and the change in debt composition, an investigation of firms' choice between public debt and bank debt is an important research question.[1] Nevertheless, our understanding of the factors that influence firm debt structure choice remains limited, partly because detailed data on firm debt structure have become available only recently (Colla, Ippolito, and Li, 2013; Li, Lin, and Zhan, 2018).[2] In this study, we contribute to this topic by examining how credit default swaps (CDSs) affect firms' debt financing choices. To our knowledge, our paper is the first to provide large-sample evidence on the effect of CDSs on firm debt structure.

The rapid growth of the CDS market has attracted significant attention, particularly in the recent crisis period. CDS contracts are an effective tool to trade credit risk. By paying periodical fees (i.e., CDS spreads) to CDS sellers, CDS buyers obtain protection against credit events of the reference entity. The onset of a CDS market not only provides alternative hedging and speculating opportunities but also changes the incentives of the reference firms and their creditors. Therefore, CDSs can have a prolonged effect on the credit market. There are increasing concerns about the real effects of CDSs on reference firms and other stakeholders.

[1] The debt of the top 2000 non-financial S&P corporations totaled $6.6 trillion in 2015 (S&P Global Ratings).
[2] Notable exceptions include Lin et al. (2013), Florou and Kosi (2015), and Boubaker et al. (2018).

One important but unanswered question is how the emergence of the CDS market affects firm debt financing choice, i.e., the choice between different types of debt.

Debt structure is an important aspect of corporate capital structure decisions. The informational environment, the efficiency of debt renegotiation, and the value of creditors' monitoring are among the top concerns when firms choose their debt structure. Arguably, the key difference between public and private debt stems from the informational role of bank lenders. Compared with public bondholders, banks have advantages in accessing private information and pricing securities with greater information opacity (Fama, 1985, James and Smith, 2000, Hadlock and James, 2002). Firms might prefer bank debt to public bonds not only because bank lenders have an informational advantage but also because banks are better able to keep proprietary information confidential (Campbell, 1979; Boubaker, Saffar, and Sassi, 2018). Additionally, bank lenders are more efficient in making the optimal liquidation or renegotiation decisions because of their information advantage from private information (Rajan, 1992) or from costly monitoring and information production (Berlin and Loeys, 1988; Chemmanur and Fulghieri, 1994). Thus, firms might prefer bank debt due to its efficiency in renegotiation, which is particularly valuable for firms with greater distress risk (Cantillo and Wright, 2000; Bolton and Freixas, 2000; Hackbarth, Hennessy, and Leland, 2007). However, when the rent extraction or hold-up concern is severe in bank debt negotiations, firms can choose to use less bank debt (Sharp, 1990; Rajan, 1992; Morellec, Valta, and Zhdanov, 2015). Furthermore, lender monitoring can have counterbalancing effects on firms' preference for bank debt. On one hand, by considering shareholders' asset substitution or underinvestment incentives, creditor monitoring can add value to firms by reducing moral hazard problems and encouraging borrowers to make efficient investment decisions. Bank lenders are more efficient in monitoring shareholders or managers (Diamond, 1984, 1991; Besanko and Kanatas, 1993). On the other hand, corporate managers can have tunneling incentives and might choose public

debt to avoid bank monitoring (Hoshi, Kashyap, and Scharfstein, 1993; Almazan and Suarez, 2003).

The empirical evidence is generally consistent with these theoretical predictions. For example, Li, Lin, and Zhan (2018) document that firms use more bank debt and less public debt after an increase in information asymmetry. Additionally, Denis and Mihov (2003) find that the issuers' credit quality is the primary determinant of debt choice. High-credit-quality firms use public debt, medium credit-quality firms use bank debt and low credit-quality firms use non-bank private debt. Lin, Ma, Malatesta, and Xuan (2013) provide cross-country evidence for the bank monitoring-avoidance hypothesis.

Why and how do CDSs affect firms' choice between bank debt and public debt? Three potential channels are at work. First, CDSs can change the corporate information environment – an important consideration when firms choose their debt structure. Given the over-the-counter (OTC) nature of the CDS market, it is easier to bet against a firm by trading CDS contracts (Longstaff, Mithal, and Neis, 2005). Acharya and Johnson (2007) find evidence of insider trading by bank lenders in the CDS market. Informed trading is greater in liquid CDS markets (Qiu and Yu, 2012). Additionally, Batta, Qiu, and Yu (2016) document faster price discovery in the CDS market than in the stock market ahead of earnings announcements. They further find that the CDS market conveys information that is valuable to financial analysts, which can facilitate their information production. Analyst forecast dispersion and forecast errors significantly declined after the introduction of CDS trading. Kim et al. (2017) find that managers' voluntary disclosure increased when there was active CDS trading on corporate debt.[3] Overall, CDS spreads provide an up-to-date market view about corporate default risk

[3] Although previous papers document the overall positive effect of informed trading in the CDS market on firms' information environments, the actual effect on individual firms can depend on the nature of the CDS market information because the information itself might need to be interpreted (Batta, Qiu, and Yu, 2016, page 1317). In addition, there are different aspects of corporate information environments, including, for example, equity/bond

and can reflect bank lenders' insider information. Market participants can refer to corporate CDS spreads when making relevant decisions, and participants rely less on banks for producing information and signaling their debt quality. With the improved informational environment after CDS introduction, firms might not need to disclose their sensitive strategic information to prove their creditworthiness, further reducing the attractiveness of bank debt. Thus, firms might have better access to the public debt market. This *information channel* predicts that firms might switch to using a greater amount of public debt financing and decrease their reliance on bank debt financing after CDS introduction.

Second, CDSs can separate the cash-flow rights and control rights of the firm and turn creditors into tougher negotiators (Hu and Black, 2008; Bolton and Oehmke, 2011; Subrahmanyam, Tang and Wang, 2014). As discussed above, firms might prefer bank debt because of the efficiency of bank lenders in making the proper liquidation or renegotiation decisions. However, with CDS protection, bank lenders tend to be tougher in renegotiation and might push firms into inefficient bankruptcy to trigger the credit event, particularly when lenders over-protect their exposure. This tougher creditor effect reduces the attractiveness of bank debt. In contrast, this tougher creditor concern would be much less relevant for bondholders because bond investors are massive and less involved in monitoring and debt renegotiation in the first place. Therefore, given that CDSs worsen the renegotiation efficiency for bank loans but not for public bonds, i.e., a *tougher creditor channel*, CDSs might make public bonds more attractive than bank loans.

analyst forecasts, voluntary disclosures of the firm's management, equity prices, and ratings. CDSs can have different effects on different aspects of the corporate information environment. For example, Boehmer, Chava, and Tookes (2015) find that the effect of CDS on equity market quality can be state dependent. Hence, our prediction for this information channel focuses on the overall improved information environment from CDS trading.

The third channel relates to bank monitoring avoidance. Managers or controlling shareholders can have an incentive to engage in expropriation activities and avoid monitoring (Lin, Ma, Malatesta, and Xuan, 2013). When bank lenders can use CDSs to hedge their exposure, they might no longer have incentives to monitor the borrower (Morrison, 2005; Parlour and Winton, 2013; Shan, Tang, and Winton, 2016). Managers would find more room for managerial discretion even with bank debt, particularly for those with a higher propensity for exploitative behavior. Without CDSs, such managers would prefer to use arm's-length financing to avoid bank monitoring. With CDSs, such a manager would turn to embrace bank loans because the bank lenders' monitoring incentive is weakened. Therefore, whereas the improved informational environment after CDS introduction might reduce the attractiveness of bank debt to corporations, the *monitoring avoidance channel* predicts a potential increase in bank debt for CDS firms. [4]

In summary, CDSs can affect the reference firm's debt financing choice via channels that have counterbalancing effects. On one hand, the *information channel* and the *tougher creditor channel* effects predict that CDSs result in a greater amount of public debt and less bank debt. On the other hand, the *monitoring avoidance channel* predicts that CDSs result in more bank debt and less public debt. Whether CDSs are associated with a higher proportion of public debt or vice-versa is an empirical question. Note that the *information channel, monitoring avoidance channel*, and *tougher creditor channel* are not mutually exclusive. The net effect of CDSs on corporate debt structure should reflect the tension among different factors and is ultimately an empirical question.

[4] The bank monitoring mechanism of the CDS effect can impact corporate debt structure through two opposite channels: monitoring avoidance and monitoring certification. Although the monitoring avoidance channel predicts an increase in bank debt after CDS introduction, the monitoring certification channel implies a decrease in bank debt for CDS firms because the reduced monitoring after CDS introduction would make the bank lending relationship less valuable to the firm. In this hypothesis, we focus on the monitoring avoidance channel.

We construct a comprehensive sample of firms with CDS trading on their debt based on various data sources, including the GFI Group, CreditTrade, and Markit. Following previous papers (e.g., Colla, Ippolito, and Li, 2013), we use the S&P Capital IQ database to construct corporate debt structure measures, such as bank debt, public bonds, and more-detailed debt types within each category. In our final sample, we have 591 firms with CDS trading on their debt at some time during our sample period of 2002 to 2015. Our main results show that firms with CDS trading on their debt prefer to use a greater amount of public debt and less bank debt. The effect is both statistically and economically important. On average, the ratio of public debt to total debt is 0.067 percentage points higher for firms with CDS trading – an increase of 14.6% compared with the corresponding mean value. Accordingly, the ratio of bank debt to total debt is 0.1 percentage points lower for firms with CDS trading, which constitutes a decrease of 24.2% compared with the corresponding mean value.

The documented statistical associations do not necessarily imply causality because our findings could reflect the effect of some omitted variables that drive both CDS trading and firms' choice of debt structure or reverse causality from firms' debt composition to CDS trading. We perform several tests to address the endogeneity concern that firms with an increase in public bonds and a decrease in bank debt financing might be those selected for CDS trading. Specifically, in our baseline model, we add a dummy variable, *CDS firm*, to control for the unobservable differences between CDS and non-CDS firms. Additionally, following prior studies, we construct matched samples based on various firm characteristics and conduct a debt structure analysis for the CDS and non-CDS matched sample. We also use the instrumental variable (IV) method to address endogeneity concerns. Our instrument is past lenders' foreign exchange hedging positions. Minton, Stulz, and Williamson (2009) find that lenders with larger foreign exchange hedging positions are more likely to trade CDSs to hedge their borrowers' credit risk. Past lenders' foreign exchange hedging decision should not directly affect firms'

current choice between public and bank debt. We further restrict our analysis in the sample of CDS firms and use CDS liquidity measures to capture the CDS effect. Finally, we exclude the global financial crisis period from the analysis. Our results are statistically significant, even after controlling for the selection and endogeneity of CDS trading.

To shed further light on the underlying mechanism of the observed CDS effect, we examine how the relationship between CDSs and debt choice varies in the cross-section. Although the overall positive effect of CDSs on public debt and negative effect on bank debt exclude the dominant role of the *monitoring avoidance channel*, the results are consistent with both the *information channel* and the *tougher creditor channel*. Cross-sectional tests not only provide insights on the channels through which the documented relationship operates but also strengthen identification because this relationship is unlikely to arise if our measure of CDS trading simply reflects unobserved economic forces. More specifically, the positive effect of CDS trading on the reliance on public debt should be more pronounced in the presence of factors that strengthen the *information* or the *tougher creditor channel*. Firms with greater asymmetric information might rely more heavily on bank debt due to bank lenders' superior information production and the signaling role of bank debt. If CDS trading reveals private information to the market about the reference firm, we can expect that information improvement is particularly valuable for informationally opaque firms. Therefore, the *information channel* predicts that the effect of CDS trading on firms' debt choice is stronger for informationally opaque firms, which is exactly what we find in the data.

Additionally, we find that the CDS effect on debt structure does not vary with financial distress risk measures. Because the tougher creditor concern is more severe for firms with greater distress risk, firms in financial distress should have greater incentives to avoid the tougher CDS-protected bank lenders and switch to public debt financing. Thus, this finding

suggests that the *tougher creditor channel* might not be the dominant channel for the CDS effect on debt structure choices.

We further explore the role of equity options on the documented relationship. Equity options are alternative tools to hedge firm risk. Although there are notable differences between equity options and CDSs, both derivatives are based on the same corporate fundamentals. The existence of equity options in the investor's opportunity set provides an alternative trading venue for informed traders and might positively affect the corporate equity market quality and price discovery,[5] which could negatively affect the effect of CDSs on corporate debt structure choices through the information channel. Consistent with this prediction, we find that CDS affects corporate choices between public debt and bank debt less significantly for firms with liquid equity options. This finding provides additional support for the information channel of the CDS effect.

In addition to analyzing the choice between public and bank debt, we also examine the effect of CDS trading on detailed debt composition within each debt category. The results suggest that CDS firms use fewer term loans, whereas the changes in other types of bank debt are not significant. Furthermore, although firms generally use a greater amount of public debt when there is CDS trading on their debt, these changes differ for different public debt types. Although there is a significant increase in *senior bonds and notes*, *subordinated bonds and notes* decrease with CDS trading. This finding indicates that the increase in public debt financing for CDS firms is concentrated in the category of *senior bonds and notes*, which is intuitive, given that senior bonds are the most commonly used underlying reference assets for CDSs.

[5] See, for example, DeTemple and Jorion (1990), Kumar, Sarin, and Shastri (1998), Easley, O'Hara and Srinivas (1998), Chan, Chung and Fong (2002), Cao, Chen and Griffin (2005), Pan and Poteshman (2006), and Muravyev, Pearson, and Broussard (2013).

Finally, we examine firm debt issuance decisions to determine whether firms prefer public bonds to bank loans when they decide to issue new debt. The results show that firms are more likely to issue public bonds than to issue bank loans when there is CDS trading on their debt. The finding suggests that an approach CDS firms use to adjust their public debt ratio is to increase their new bond issuance when they need debt financing.

Our paper contributes to the literature in the following ways. First, we add to the ongoing discussions about the real effects of credit derivatives, particularly CDSs. CDSs can affect the debtor-creditor relationship (Hu and Black, 2008; Bolton and Oehmke, 2011), which further increases corporate bankruptcy risk (Subrahmanyam, Tang and Wang, 2014), precautionary cash holdings (Subrahmanyam, Tang and Wang, 2017) and risk-taking activities, such as innovations (Chang et al., 2017). In particular, previous papers document the effect of CDSs on corporate credit supply and find evidence of an increase in leverage after CDS introduction (Shan, Tang, and Yan, 2016; Saretto and Tookes, 2013; Ashcraft and Santos, 2009). Our paper complements these studies by showing that CDSs can change firms' choices among different debt types.

Second, we contribute to the emerging literature on the determinants of corporate debt structure. Recent studies provide empirical evidence of the effect of corporate ownership structure on their choices between public and bank debt (Lin, Ma, Malatesta, and Xuan, 2013; Boubaker, Rouatbi, and Saffar, 2017; Boubakri and Saffar, 2018). Using brokerage closures and mergers as exogenous variations in a corporate information environment, Li, Lin, and Zhan (2018) find evidence that firms substitute away from public debt toward bank debt following an increase in information asymmetry. We extend this literature by showing that the introduction of credit derivatives, such as CDS contracts on corporate debt, can change corporate debt structure by improving the corporate information environment.

The reminder of the paper proceeds as follows. Section 2 discusses the data, variables and summary statistics. Then, Section 3 presents the empirical results from the baseline regressions and the robustness tests for endogeneity issues. Section 4 conducts tests to understand the channels and mechanisms, while Section 5 presents additional tests based on corporate characteristics. Section 6 concludes the paper.

2. Data and variables

2.1. Data and sample

To investigate the effect of CDS trading on corporate debt choices, we use a large sample of U.S. public firms over the 2002–2015 period. We obtain CDS trading data from GFI and CreditTrade. The overlapping feature of the two data sources allows us to crosscheck the data accuracy for the period before 2006. We further validate the list of CDS firms using Markit data. In our dataset, the first firm started to be referenced with CDSs occurred in 1997, which is the broad inception year of the CDS market for corporate debt (Tett, 2009). We obtain corporate debt financing data from Standard and Poor's (S&P) Capital IQ database, which provides comprehensive corporate debt structure data from 2002 onwards (Colla et al. 2013). We further obtain firm financial information and debt rating data from Compustat annual files and stock market data from the Center for Research in Security Prices (CRSP). We exclude financial firms (firms with SIC codes between 6000 and 6999) and observations with missing variables from the analysis. To mitigate the effect of outliers, all variables (except for indicator variables) are winsorized at the upper and lower one-percentile levels. The final sample contains 34,700 firm-year observations and 5,424 unique firms, of which 591 firms are CDS-referenced firms (i.e., firms that ever had CDS trading during our sample period).

2.2. Variable construction

Following Lin et al. (2013), Boubaker et al. (2017; 2018) and Boubakri and Saffar (2018), we consider two dependent variables, *Public debt* and *Bank debt*, as our proxy for corporate debt structure. *Public debt* is defined as the ratio of public bonds to total debt measured in the same year. *Bank debt* is defined as the ratio of bank loans to total debt measured as of the same year. Public debt is measured as the sum of senior bonds and notes, subordinated bonds and notes, and commercial paper. Bank debt is measured as the sum of revolving credit and term loans. Because there exist other types of debt, such as capital leases and private non-bank loans, total debt is measured as the sum of public debt, bank debt, and other debt. Thus, the sum of *Public debt* and *Bank debt* is not equal to one, suggesting that a positive relationship with public debt does not necessarily imply a negative relationship with bank debt, and vice versa.

Following the literature on CDS (Ashcraft and Santos, 2009; Saretto and Tookes, 2013; Subramanyam, Tang, and Wang, 2014; Shan, Tang, and Winton, 2016), we measure *CDS trading* as a dummy variable equal to one if there is CDS trading on the firms' debt during the year, and zero otherwise. We treat the first year that a firm begins to have CDS contracts that reference its debt in GFI, CreditTrade, or Markit as its CDS initiation year and assume that it has CDS trading in all subsequent years. Therefore, the firm-years with CDS trading include all the years for firms that already have CDS trading on their debt before the start of our sample period and all the years during and after the CDS initiation year for firms that initiate CDS trading during our sample period. To address the omitted variable problems related to CDS trading, we control for *CDS firm*, defined as a dummy variable that equals one if the firm has CDS trading on its debt in any of the years in the sample period, and zero otherwise. Because CDS firms could be fundamentally different from non-CDS firms, including the CDS firm fixed effects can effectively control for the unobservable features that allow some firms to be CDS-referenced.

Based on prior studies on firm debt choice (e.g., Lin et al., 2013; Boubaker et al., 2018; Li, Lin, and Zhan, 2018), we control for a wide range of firm characteristics in our regression, including *Firm size*, *Tobin's Q*, *Leverage*, *Profitability*, *Tangibility*, *Debt rating*, and *Investment grade*. *Firm size* is defined as the natural logarithm of the book value of assets. We control for firm size because size captures the firm's level of information asymmetry and is related to the costs of debt security issuance (Blackwell and Kidwell, 1988; Houston and James, 1996). *Tobin's Q* is defined as the market value of assets minus deferred taxes over the book value of assets. We control for *Tobin's Q* because it is a proxy for firm growth and investment opportunities that could affect a firm's debt choice. Firms with more growth potential are more likely to rely on public debt to avoid stringent monitoring by banks (Diamond, 1991; Hoshi et al., 1993). *Leverage* is defined as the ratio of total liabilities to total assets. We include the leverage ratio to control for the effect of CDS trading on a firm's choice between debt and equity financing, as documented by Saretto and Tookes (2013). *Profitability* is defined as the ratio of income before extraordinary items to total assets. Profitable firms are likely to be those with better credit quality, which is critical to their debt choice (Diamond, 1991; Blackwell and Kidwell, 1998; Denis and Mihov, 2003). *Tangibility* is the ratio of property, plant, and equipment deflated by total assets. As a collateralization for debt, tangible assets can mitigate lenders' risk (Williamson, 1988). *Debt rating* is a dummy variable equal to one if the firm has a long-term debt rating from S&P, and zero otherwise. It measures a firm's information environment and credit risk. *Investment grade* is a dummy variable equal to one if the firm has an investment-grade long-term debt rating (i.e., debt rating of BBB and above) from S&P, and zero otherwise. Similar to *Debt rating*, *Investment grade* is a proxy for credit quality, which determines a firm's alternatives when making a debt choice (Diamond, 1991).

2.3. Descriptive statistics

Table 1 reports the summary statistics of the main variables used in the analysis. Panel A presents the summary statistics for all the firms in our sample. The panel shows that the mean value for *Public debt* is 0.458, and the median is 0.446. The mean value for *Bank debt* is 0.414, and the median is 0.268. Furthermore, the mean value for *CDS trading* is 0.159, indicating that 15.9% of our sample firms have CDS trading on their debt in a given year, similar to the findings of Li and Tang (2016). With respect to the control variables, the mean value of *CDS firm* is 0.176, indicating that approximately 17.6% of our sample firms have CDS trading on their debt at some time point in the sample period. The average firm size is 6.243. The mean value of *Tobin's Q* for the sample firms is 1.530, and the mean leverage ratio is 0.269. Furthermore, the mean profitability ratio is -0.062, and the median is 0.026, suggesting that the negative mean profitability ratio is driven by firms with large losses in certain years. The mean value of fixed assets to total assets (*Tangibility*) is 0.293. In our sample, 34.4% of the firms have debt ratings, and 15.4% have investment-grade ratings. Collectively, the summary statistics of our sample firms show that the sample we used is comparable with those of prior studies (Li, Lin, and Zhan, 2018).

<Insert Table 1 here>

In Panels B and C of Table 1, we report the summary statistics of CDS-referenced firms (i.e., firms that ever had CDS trading during our sample period) and non-CDS-referenced firms (i.e., firms that never had CDS trading during our sample period), respectively. The panels show that there are indeed differences in firm fundamentals between these two groups. Specifically, CDS-referenced firms use a larger proportion of public debt and smaller proportion of bank debt than non-CDS-referenced firms. CDS-referenced firms are also larger and have lower Tobin's Q. Furthermore, these firms have higher leverage ratios and greater proportions of tangible assets and are more profitable and more likely to have a debt rating,

particularly an investment-grade debt rating. The findings are consistent with prior studies (e.g., Ashcraft and Santos, 2009; Martin and Roychowdhury, 2015) that indicate that firm fundamentals such as the information environment, growth opportunities, and creditworthiness are closely related to the demand for and supply of CDS contracts on the firm's debt.

Table 2 presents the correlation matrix of the main variables in the analysis and shows that *CDS trading* is positively related to *Public debt* and negatively related to *Bank debt*. Both correlation coefficients are statistically significant at the 1% level, which provides univariate evidence that firms with CDS trading tend to use more public debt than bank debt. Additionally, *Public debt* is positively correlated with *CDS firm*, *Firm size*, *Leverage*, *Profitability*, *Tangibility*, *Debt rating*, and *Investment grade* and negatively correlated with *Tobin's Q*. *Bank debt* is negatively correlated with *CDS firm*, *Firm size*, *Tobin's Q*, *Leverage*, *Tangibility*, *Debt rating*, and *Investment grade* and positively correlated with *Profitability*.

<Insert Table 2 here>

3. Main results: The effect of CDS trading on firms' debt structure

In this section, we investigate the relationship between CDS trading and corporate choices between public debt and bank debt financing. We further address the potential endogeneity of CDS trading by using a matching approach, CDS liquidity measures and the instrumental variable approach.

3.1. Univariate analysis

To understand the relationship between CDS trading and corporate debt structure, we first examine the changes in firm public debt and bank debt ratios around CDS initiation. We focus on the subsample of firms with CDS initiation events during our sample period. Among the 591 CDS-referenced firms in the sample, 367 firms initiate CDS trading in our sample period.

We label their CDS initiation year as event year 0. Then, we calculate the average *Public debt* and *Bank debt* of these firms from the year immediately before CDS initiation (i.e., event year -1) to the year immediately after CDS initiation (i.e., event year 1). The results are presented in Figure 1. Panel A shows that the average *Public debt* is 0.747 in event year -1 and increases to 0.785 in event year 0. The difference is 0.038 and is statistically significant at the 5% level. Average *Public debt* further increases to 0.788 in event year 1. Panel B shows an opposite trend for bank debt. The average value of *Bank debt* is 0.188 in event year -1 and drops to 0.152 in event year 0. The difference is 0.036 and is statistically significant at the 5% level. Average *Bank debt* further decreases to 0.148 in event year 1. Overall, the results of the analysis provide univariate evidence of an increase in the use of public debt and a decrease in the use of bank debt by firms with CDS trading on their debt.

<Insert Figure 1 here>

3.2. Multivariate analysis

To mitigate the concern that firm debt structure is correlated with firm characteristics that are also related to the availability of CDS trading, we conduct a multivariate analysis that controls for a number of firm characteristics. We use the following regression model to examine the effect of CDS trading on firms' debt financing choices:

$$\begin{aligned} Debt\ financing\ choice_{it} &= ß_0 + ß_1 CDS\ trading_{i,t-1} + ß_2 CDS\ firm_i + ß_3 Firm\ size_{i,t-1} \\ &+ ß_4 Tobin's\ Q_{i,t-1} + ß_5 Leverage_{i,t-1} + ß_6 Profitability_{i,t-1} \\ &+ ß_7 Tangibility_{i,t-1} + ß_8 Debt\ rating_{i,t-1} + ß_9 Investment\ grade_{i,t-1} \\ &+ Year\ F.E. + Industry\ F.E. + Ɛ_{i,t} \end{aligned} \quad (1)$$

where i and t are indicators for the firm and year, respectively. Debt financing choices are proxied using either *Public debt* or *Bank debt*. The key coefficient of interest is $CDS\ trading_{i,t-1}$, which captures the impact of CDS trading on the choice of public or bank debt. We also add a dummy variable of $CDS\ firm_i$ to control for the unobservable differences between CDS-referenced firms and non-CDS-referenced firms. Furthermore, we include a set of controls based on firm characteristics, as discussed in Section 2.2. All independent variables are lagged by one year. Year and industry fixed effects based on two-digit SIC industry codes are included in the model to account for possible differences and changes in the reliance on a particular type of debt through time and across industries. The *t*-statistics are computed using standard errors robust to clustering at the firm level and heteroscedasticity.

Table 3 presents the baseline regression results of the effect of CDS trading on firms' debt financing choice. Column (1) presents the results using *Public debt* as the dependent variable, and column (2) presents the results using *Bank debt* as the dependent variable. When *Public debt* is the dependent variable, the coefficient on *CDS trading* is significantly positive (coefficient=0.067, *t*-statistics=2.856). When *Bank debt* is the dependent variable, the coefficient on *CDS trading* is significantly negative (coefficient=-0.1, *t*-statistics=-4.172). Therefore, our baseline results suggest that firms with CDS trading use more public bond debt and less bank debt. The effect of CDS trading is not only statistically significant but also economically important. The magnitude of the coefficients show that on average, firms with CDS trading have *Public debt* that is 0.067 percentage points higher than that of firms without CDS trading. Because the mean value of *Public debt* is 0.458, this difference constitutes an increase of 14.6% compared with the mean. Accordingly, firms with CDS trading have *Bank debt* that is 0.1 percentage points lower on average than that of firms without CDS trading, which constitutes a decrease of 24.2% compared with the mean of 0.414.

<Insert Table 3 here>

The coefficients of the control variables are generally consistent with prior studies (e.g., Lin et al. 2013; Li, Lin, and Zhan, 2018; Boubaker et al., 2018). More specifically, *Public debt* is significantly positively associated with *Firm size*, *Tobin's Q*, *Leverage*, *Debt rating*, and *Investment grade* and significantly negatively associated with *Profitability*. Moreover, consistent with our expectation, *Bank debt* is significantly negatively associated with *Firm size*, *Tobin's Q*, *Debt rating* and *Investment grade* and significantly positively associated with *Leverage* and *Profitability*.

Collectively, the results in Figure 1 and Table 3 show that firms use more public debt and less bank debt after CDSs that reference their debt begin trading, and this finding is robust to controlling for firm characteristics and year/industry fixed effects. In other words, CDS-referenced firms prefer public debt to bank debt in their debt structure. This result is consistent with our information channel that the improved information environment after CDS introduction increases firms' preference for public debt and reduces the attractiveness of bank debt to corporations. In the following sections, we conduct further analysis to test whether the information channel plays a dominant role in explaining the increased use of public debt after the onset of CDS.

3.3. Endogeneity

Although the previous results demonstrate a strong effect of CDS on corporate public and bank debt ratios, the findings are subject to endogeneity concerns. There are two possible types of endogeneity in our setting. First, firms can be selected into CDS trading based on both observable and unobservable factors. These factors can also affect corporate debt structure choices. Although we have controlled for a number of factors that affect corporate debt structure, there might be omitted factors that affect both corporate debt structure and CDS

trading on corporate debt. In addition to the selection issue and omitted variable concerns, there might also be a reverse causality problem. For example, bonds are usually the proxy for hedging needs (Oehmke and Zawadowski, 2017) and can be used for delivering a CDS settlement. Therefore, having a public bond market can increase the likelihood of the firm being referenced with CDS. In the baseline analysis, we have added a *CDS Firm* dummy to control for the time-invariant unobservable differences between CDS-referenced firms and non-CDS-referenced firms. In this sub-section, we conduct additional tests to address these endogeneity concerns.

3.3.1 Matching approach

The first approach we use to address endogeneity is the matching approach. As discussed above, firms can be selected into CDS trading based on various factors. Li and Tang (2016) find that large firms are more likely to have CDS trading on their debt. When constructing the matched sample, we first match firms with CDS trading and firms without CDS trading from the same one-digit SIC industry based on firm size measured as of the year prior to CDS initiation. Second, we match firms with CDS trading and firms without CDS trading based on multiple dimensions that are drastically different between these two groups of firms and that have a significant effect on firms' choice of debt structure (Li and Tang, 2016). These variables include *Firm size*, *Leverage*, *Current ratio*, *Return on assets*, *Market-to-book*, *Z-score*, and *Cash-to-assets*. *Firm size* and *Leverage* are defined in Section 2.2. *Current ratio* is defined as the ratio of current assets over total assets. *Return on assets* is defined as the ratio of operating profit over total assets. *Market-to-book* is defined as the ratio of market value of assets over total assets. *Z-score* is calculated following Altman (1968), while *Cash-to-assets* is defined as the ratio of cash and cash equivalents over total assets.

Different from the baseline analysis with all non-referenced CDS firms as the control group, we repeat the debt structure analysis in Equation (1) for the size- and multiple-dimension-matched samples. The results are presented in Panel A of Table 4. For the size-matched sample, the coefficient of *CDS trading* is significantly positive (coefficient=0.086, *t*-statistics=3.435) when *Public debt* is the dependent variable. When the dependent variable is *Bank debt*, the coefficient of *CDS trading* is significantly negative (coefficient=-0.087, *t*-statistics=-3.513). The results are qualitatively similar when using the matching approach based on multiple dimensions. Therefore, our baseline results are not driven by omitted observable or time-invariant unobservable factors that are missing from the relationship between CDS trading and corporate debt choice.

3.3.2 CDS liquidity measures

To further alleviate the concern that our findings are driven by the potential selection of firms into CDS trading, we exclude firm-years without CDS trading and conduct the debt structure analysis with the sample comprising firm-years with CDS trading only. We then replace the *CDS Trading* dummy with CDS liquidity measures, including *Number of Contracts Outstanding* and *Number of Trades*. Specifically, *Number of Contracts Outstanding* is defined as the natural logarithm of one plus the number of CDS contracts outstanding during the year. *Number of Trades* is defined as the natural logarithm of one plus the number of CDS trades during the year. We expect that the effect of CDSs on debt structure is greater for firms with a more-liquid CDS market because investors' access to a CDS market is easier when the market is more liquid; thus, the effect of a liquid CDS market could be more pronounced. The results are presented in Panel B of Table 4. We find significant coefficients for both CDS liquidity measures. The coefficient of *Number of Contracts Outstanding* is significantly positive when *Public debt* is the dependent variable (coefficient = 0.006, *t*-statistics=1.832) and significantly

negative when *Bank debt* is the dependent variable (coefficient=-0.007, *t*-statistics=-2.49). The coefficient on *Number of Trades* is significantly positive when *Public debt* is the dependent variable (coefficient=0.09, *t*-statistics=-2.248) and significantly negative when *Bank debt* is the dependent variable (coefficient=-0.009, *t*-statistics=-2.379). Hence, our previous results remain unchanged when focusing on the CDS sample and using alternative CDS variables.

3.3.3 Firm fixed effects

In addition to the matching approach and the CDS liquidity measures, we include firm fixed effects in the model to control for time-invariant unobservable differences among firms. We further control for the omitted variable problem by including firm fixed effects in the model. The results are reported in Panel C of Table 4. The coefficient on *CDS trading* remains significantly positive when *Public debt* is the dependent variable (coefficient=0.048, *t*-statistics=3.014) and significantly negative when *Bank debt* is the dependent variable (coefficient=-0.05, *t*-statistics=-2.368). Therefore, the relationship between CDS trading and firm debt choice still holds when firm fixed effects are included.

3.3.4 Instrumental variable approach

The final approach we adopt to address endogeneity concerns is the instrumental variable method. Specifically, following prior papers (Saretto and Tookes, 2013; Subrahmanyam, Tang, and Wang, 2014), we use lenders' foreign exchange hedging positions (*Lender FX usage*) as the instrumental variable in the first-stage regression. *Lender FX usage* is defined as the average of the notional volume of FX derivatives used for hedging purposes, relative to total assets, across the banks that have served as either lenders or bond underwriters for the firm over the previous five years. A detailed discussion about the construction of the instrument can be found in Saretto and Tookes (2013). We expect that lenders with larger foreign exchange hedging positions are more likely to trade CDSs to hedge their borrowers' credit risk. However,

past lenders' foreign exchange hedging decision should not directly affect firms' current choice between public debt and bank debt except through CDS trading.

In the unreported first-stage regression, we find that in line with Saretto and Tookes (2013), *Lender FX usage* is significantly positively related to *CDS trading*, which suggests that the lenders' foreign exchange hedging position is a good predictor of *CDS trading*. To check the validity of our instrument, we conduct two tests. We first run an *F*-test of the excluded exogenous variable. The results reject the null hypothesis that the instrument does not explain state ownership. We also conduct a Kleibergen-Paap *rk* LM test, which rejects the null hypothesis that the model is under-identified at the 1% level. We then use the *Instrumented CDS trading* in the second-stage regression analyses for the determinants of *Public debt* or *Bank debt*. The results, reported in Panel D of Table 4, remain qualitatively similar. There is a positive relationship between instrumented *CDS trading* and *public debt* (coefficient=0.358, *t*-statistics=2.325) and a negative relationship between instrumented *CDS trading* and *bank debt* (coefficient=-0.497, *t*-statistics=-3.269). Collectively, the results in Table 4 show that our previous results are not driven by the endogeneity problem.

3.3.5 Excluding the financial crisis period

In the last test, we exclude the financial crisis period of 2007–2009. Firms' financing behaviors could have been different during this financial crisis period because of the limited supply of capital. The market's decision to initiate CDS trading could have also been affected by the financial crisis due to the rise of market-wide default risk. Therefore, our findings are likely driven by the financial crisis period. To mitigate this concern, we exclude the 2007–2009 period from our analysis, and the results are reported in Panel E of Table 4. The panel shows that the coefficient of *CDS trading* remains significantly positive when *Public debt* is the dependent variable (coefficient=0.067, *t*-statistics=2.469) and significantly negative when

Bank debt is the dependent variable (coefficient=-0.104, *t*-statistics=-4.274), suggesting that excluding the crisis period from our sample has no material effect on our findings.

<Insert Table 4 here>

4. Channels and mechanisms

4.1 Role of information uncertainty

Lack of information prohibits firms from borrowing in the public debt market because bondholders are less involved in information collection and monitoring (Colla, Ippolito, and Li, 2013). Conceivably, firms might begin to use an additional amount of public debt when their information environment is improved. Additionally, firms with a more opaque information environment would benefit more from an improvement in that environment. Additionally, when there is CDS trading on firm debt, the advantages of superior information production and signaling effects from bank debt on opaque firms decrease. Therefore, we predict that the effect of CDS trading on firm debt choices, i.e., both public debt and bank debt, would increase with an increased level of information uncertainty.

We use three measures of information uncertainty. The first measure is *Cash flow volatility*, which is defined as the standard deviation of quarterly cash flow over the past 12 quarters. A higher value of *Cash flow volatility* indicates greater risk in firms' business operations and, hence, higher information uncertainty from investors' point of view. The second measure is *Accounting opacity*, which is estimated following the accruals quality model in Dechow and Dichev (2002). The measure is calculated as the standard deviation of the residuals from the firm-specific regression of working capital accruals on past, present and future cash flows from operations. Because *Accounting opacity* measures the extent to which

accruals map cash flow realizations, a higher value indicates more imprecise or erroneous mapping and, hence, lower accruals quality and higher information uncertainty. The third measure is *Bid-ask spread*, which is defined as the natural logarithm of the ratio of the absolute value of the difference between the trade price and the midpoint of the bid-ask quote over the trade price. A higher *Bid-ask spread* indicates greater information risk in the stock market. The three measures capture firms' level of information uncertainty in business operations, financial reporting, and capital markets, respectively.

We augment Equation (1) by including the three information uncertainty measures and their interaction terms with CDS trading. The interaction terms between the three measures and CDS trading capture how the average relationship between CDS trading and corporate debt choices varies across firms with different information uncertainty levels. The regression results are reported in Table 5. Information uncertainty in column (1) and column (2) is measured by *Cash flow opacity*. When the dependent variable is *Public debt*, the coefficient of the interaction term, *CDS trading*Cash flow volatility*, is significantly positive (coefficient=1.614, *t*-statistics=3.276), indicating that the positive relationship is more pronounced when firms have high cash flow volatility. When the dependent variable is *Bank debt*, the coefficient of the interaction term is significantly negative (coefficient=-0.982, *t*-statistics=-2.326), indicating that the negative relationship is more pronounced when firms have high cash flow volatility. The results are similar when information uncertainty is measured by *Accounting opacity* and *Bid-ask spread* in columns (3)-(6). Therefore, the evidence is consistent with the information channel prediction that the effect of CDS trading affects the firm information environment and increases when the firm has higher information uncertainty. Thus, the positive relationship between CDS trading and public debt and the negative relationship between CDS trading and bank debt are stronger with an increased information uncertainty level.

<Insert Table 5 here>

4.2. Test of the tougher creditor channel

One of the reasons why firms may prefer bank debt to public debt is the efficiency of bank lenders in making the optimal liquidation or renegotiation decision when the firm is in financial distress. Nevertheless, CDS contracts separate the firm's cash flow rights and control rights, turning CDS-protected bank lenders into tougher negotiators (Hu and Black, 2008; Bolton and Oehmke, 2011; Subrahmanyam, Tang and Wang, 2014). The tougher creditor effect reduces the attractiveness of bank debt but is much less relevant for public debt because public bondholders are massive and less involved in monitoring and debt renegotiation in the first place. Because the tougher creditor concern is more severe when the firm has higher financial distress risk, firms might have greater incentives to avoid the tougher CDS-protected bank lenders and switch to public debt financing in such cases. To test this channel, we examine how the relationship between CDS trading and firm debt choices varies across firms with different levels of financial distress risk.

We use three measures for financial distress risk. The first measure we use is *Z-score*, which is calculated following Altman (1968). A higher *Z-score* indicates more financial solvency and, hence, lower financial distress risk. The second measure we use is *Probability of default*, which is a market-based measure of financial distress risk calculated following Bharath and Shumway (2008). A higher *Probability of default* indicates greater likelihood of default and, hence, higher financial distress risk. The third measure we use is the *Distress dummy*, which equals one if the firm is financially distressed, and zero otherwise. Following Gilson, John, and Lang (1990) and Demiroglu and James (2015), we identify a firm year as financially distressed if its stock return is in the bottom 5% of the market for two consecutive years.

We include the three financial distress measures and their interaction terms with CDS trading in Equation (1). The coefficients on the interaction terms between financial distress risk and CDS trading thus capture the effect of financial distress risk on the relationship between CDS trading and firm debt choice. The results are reported in Table 6. The results using the *Z-score* to measure financial distress risk are presented in column (1) and column (2). When the dependent variable is *Public debt*, the coefficient of *CDS trading*Z-score* is positive but not significant (coefficient=0.011, *t*-statistics=1.181). When the dependent variable is *Bank debt*, the coefficient on *CDS trading*Z-score* is negative but not significant (coefficient=-0.006, *t*-statistics=-1.25). Therefore, we do not find a significant effect of financial distress risk on the relationship between CDS trading and firm debt choice. The results remain unchanged when financial distress risk is measured by either *Probability of default* or *Distress dummy*. Hence, our results suggest that neither the positive relationship between CDS trading and public debt nor the negative relationship between CDS trading and bank debt varies across firms with different financial distress risk levels. This finding suggests that the *tougher creditor channel* might not be the dominant channel for the effect of CDSs on firm debt-structure choices.

<Insert Table 6 here>

5. Additional tests

5.1. Effect of options trading

Stock options are important derivative securities in the financial market. Prior studies (e.g., Cao, 1999; Cao, Chen, and Griffin, 2005; Roll, Schwartz, and Subrahmanyam, 2009) show that informed trading in the options market and the enhanced information supply associated with options trading improve the informational efficiency of the underlying stock. Because both CDS trading and options trading reduce the information asymmetry faced by

investors, we examine in this section whether there is any substitution effect between these two derivative securities in terms of firm debt structure.

We obtain options trading data from the Ivy DB OptionMetrics database, which contains information on each individual put and call stock option on a daily basis. We follow Roll, Schwartz, and Subrahmanyam's (2009) definition of the options trading volume (*Options volume*) as the aggregate dollar trading volume of all option contracts for each firm during each year. The annual dollar trading volume is the product of daily volume and the midpoint of the end-of-day bid-ask spread for each options contract on a stock, aggregated across all trading days in a year and across all listed options contracts on the stock. Thus, in the analysis, we set the trading volume of firm-years without options trading to zero and use the natural logarithm of one plus the dollar trading volume (in tens of thousands of dollars).

We interact the CDS trading dummy with the options trading volume and include the interaction term in Equation (1). The results are presented in Table 7 and show that when the dependent variable is *Public debt*, the coefficient of the interaction term, *CDS trading*Options volume*, is significantly negative (coefficient=-0.079, *t*-statistics=-4.663). When the dependent variable is *Bank debt*, the coefficient of the interaction term, *CDS trading*Options volume*, is significantly positive (coefficient=0.082, *t*-statistics=5.469). The findings suggest that the effect of CDS trading on the firm's debt structure is weaker when the firm has an active options market. This finding is consistent with the substitution effect between CDS trading and options trading in terms of the role of providing firm information, which is indirect evidence that corroborates the role of the information revelation of CDS trading in determining firm debt structure.

<Insert Table 7 here>

5.2. CDS trading and debt instruments

To further investigate the effect of CDS trading on firm debt structure, we examine how components of public debt and bank debt change with CDS trading. We decompose bank debt into term loans and revolving credit. Strahan (1999) shows that there are significant differences between credit lines and term loans in terms of borrower size, pricing, loan size, and maturity. While term loans are typically used to finance long-term investments, revolving lines of credit are a popular tool for corporate liquidity management in which firms pay a commitment fee and can draw as needed. We further decompose public debt into senior bonds and notes, subordinated bonds and notes, and commercial paper. In addition to the popular senior bonds and notes and subordinated bonds and notes, commercial paper is a form of short-term market financing.[6] We use these separate debt instruments as dependent variables in the regression analyses.

The results are reported in Columns (1)-(5) of Table 8 and show that the coefficient of *CDS trading* is significantly negative (coefficient=-0.051, *t*-statistic=-2.773) in the term loans regression, but the coefficient of *CDS trading* is not significant in the revolving credit regression (coefficient=-0.049, *t*-statistic=-1.425). We also find that the coefficient of *CDS trading* is significantly positive (coefficient=0.141, *t*-statistic=5.259) in the senior bonds and notes regression, significantly negative (coefficient=-0.066, *t*-statistic=-3.337) in the subordinated bonds and notes regression, and insignificant in the commercial paper regression (coefficient=-0.008, *t*-statistic=-0.985). The results suggest that CDS trading does not significantly affect the corporate use of short-term debt instruments such as revolving credit and commercial paper. More importantly, the findings show that with CDS trading, firms shift their debt from term loans and subordinated bonds and notes to senior bonds and notes. Such

[6] Collar, Ippolito, and Li (2013) find that approximately two-thirds of firms rely on senior bonds and notes for financing. However, approximately one-fifth of the firms use subordinated bonds and notes. Very few firms use commercial paper for financing in their sample. Kahl, Shivdasani, and Wang (2015) find that firms use commercial paper to provide start-up financing for capital investment.

a shift suggests that the increase in public debt financing for CDS firms is concentrated in the category of *Senior bonds and notes*, which is intuitive considering that senior bonds are the most commonly used CDSs underlying reference assets.

<Insert Table 7 here>

5.3. CDS trading and loan-bond issuance choice

Thus far, we have used public debt and bank debt ratios and found that firms increase public debt reliance after CDSs begin trading. In this section, we further examine firms' debt issuance decisions to determine whether firms prefer public bonds to bank loans when they decide to issue new debt.

We follow the approach adopted by Becker and Ivashina (2014) to construct two alternative samples: one includes the firm-years in which the firm has at least one type of debt issuance (either bonds or loans, or both) in a given year. The other includes firm-years in which the firm has only one type of debt issuance (either bond or loan issuance) in a given year. Thus, we can ensure that we focus on a sample of firms that have positive debt financing demand, which helps us rule out the financing-demand explanation. We obtain bond issuance data from Mergent Fixed Income Securities Database (FISD) and bank loan-issuance data from Dealscan. In the choice model, the independent variable of interest is the *CDS Trading* indicator, and the dependent variable is the bond issue dummy (*Bond issue*), which equals one if the firm issues a bond in a given year, and zero otherwise. Specifically, we estimate the following logistic debt choice model:

$$\begin{aligned} Bond\ issue_{it} = {} & ß_0 + ß_1 CDS\ trading_{i,t-1} + ß_2 CDS\ firm_i + ß_3 Firm\ size_{i,t-1} \\ & + ß_4 Tobin's\ Q_{i,t-1} + ß_5 Leverage_{i,t-1} + ß_6 Profitability_{i,t-1} \\ & + ß_7 Tangibility_{i,t-1} + ß_8 Debt\ rating_{i,t-1} + ß_9 Investment\ grade_{i,t-1} \\ & + Year\ F.E. + Industry\ F.E. + Ɛ_{i,t} \end{aligned} \quad (2)$$

where *i* and *t* are indicators for the firm and year, respectively. The control variables are the same as those in Equation (1).

Table 9 presents the regression results. The coefficients of *CDS Trading* are significantly positive in both column (1) (coefficient=0.269, *z*-statistic=2.273) and column (2) (coefficient=0.219, *z*-statistic=2.071), suggesting that firms tend to substitute bond issuance for bank loan financing after the inception of CDS trading. The marginal effect of CDS trading on the choice of bond financing (evaluated at the mean of all covariates) is 3.5% in column (1) and 4% in column (2). Note that in column (1), the bond issuance indicator captures both the case in which the firm issues bonds only and the case in which the firm issues both loans and bonds. Our second sample allows a finer analysis by limiting the situations that the bond indicator represents. By construction, in column (2), the bond issuance indicator equals one if the firm issues bonds only in a given year and zero if the firm issues loans only.

Overall, the regression results demonstrate that firms increase their public debt issuance when there is CDS trading on their debt, which is consistent with our previous findings. The analyses help us to quantitatively understand the changes in the likelihood of choosing a particular debt financing channel.

<Insert Table 9 here>

6. Conclusion

In this paper, we investigate the effect of CDSs on corporate debt structures by using a comprehensive database of U.S. corporate CDS trading and debt structures between 2002 and 2015. We find that firms increase the proportion of public debt but lower the proportion of bank debt in their debt structure after they become CDS referenced. This effect is both statistically and economically important. On average, the ratio of public debt to total debt is

0.067 percentage points higher for firms with CDS trading, which is an increase of 14.6% compared with the mean value. Accordingly, the ratio of bank debt to total debt is 0.1 percentage points lower for firms with CDS trading, which constitutes a decrease of 24.2% compared with the mean value.

We further find that the effect of CDS trading on firms' debt choice is stronger for firms with greater information asymmetry but does not vary for firms with different levels of bankruptcy risk. The findings are consistent with the information channel (i.e., CDS trading reduces firm information asymmetry, which enables the firm to issue more public debt) but are inconsistent with the tougher creditor channel (i.e., CDSs make bank lenders tougher creditors in the case of bankruptcy, deterring the firm from using bank debt). Finally, we find that the effect of CDS trading on firm debt choice is weaker if the firm has a liquid equity option market, suggesting that the two derivative securities are substitutes in information production. We also find that the effect of CDS trading varies among different debt instruments within public debt and bank debt and affects not only firms' level of public debt and bank debt but also their issuance decisions when in need of debt financing.

Our paper contributes to the ongoing discussions about the real effects of credit derivatives. Extant studies provide preliminary evidence on how CDS trading affects the credit supply and focus on hedging-related lending incentives. We complement the literature by documenting the informational role of CDS trading in the credit market, which has been much less studied. Our study can deepen the understanding of the determinants of corporate debt structures by showing how the introduction of credit derivatives affects firms' choices between different debt instruments.

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APPENDIX. Variable Definitions

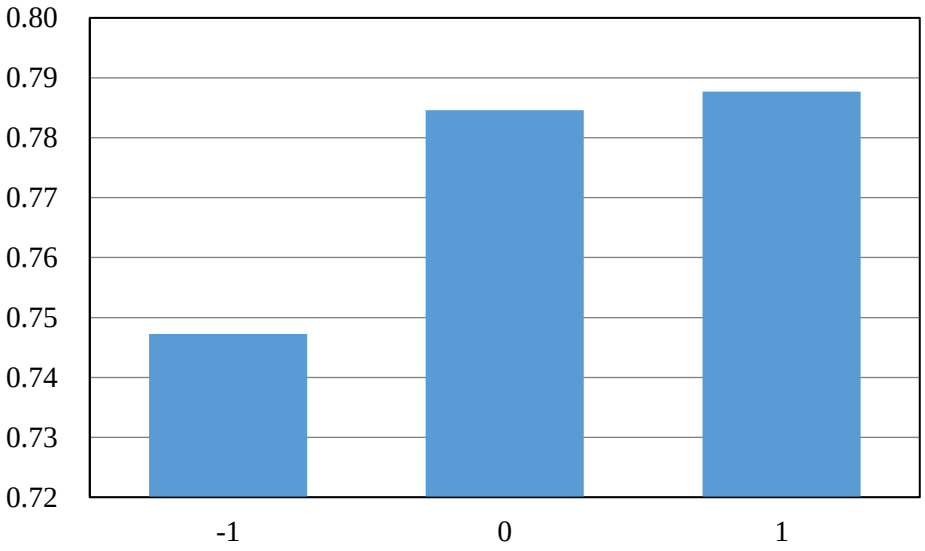
Variable	Definition
Public debt	Ratio of public bonds over total debt. Public bonds is the sum of senior bonds and notes, and subordinated bonds and notes. Total debt is the sum of term loans, revolving credit, senior bonds and notes, subordinated bonds and notes, commercial paper, capital leases, and other debt.
Bank debt	Ratio of bank loans over total debt. Bank loans is the sum of revolving credit, term loans, and commercial paper. Total debt is the sum of term loans, revolving credit, senior bonds and notes, subordinated bonds and notes, commercial paper, capital leases, and other debt.
CDS trading	Dummy variable equal to one if there is CDS trading on the firm's debt during the year, and zero otherwise.
CDS firm	Dummy variable equal to one if the firm has CDS trading on its debt in any year during the sample period, and zero otherwise.
Firm size	Natural logarithm of the book value of assets (*AT*).
Tobin's Q	Ratio of the market value of assets minus deferred taxes (*TXDB*) over the book value of assets (*AT*). Market value of assets is sum of long-term debt (*DLTT*), short-term debt (*DLC*) and the product of stock price (*PRCC_F*) and the number of shares outstanding (*CSHPRI*).
Leverage	Ratio of long-term debt (*DLTT*) plus short-term debt (*DLC*) over the book value of total assets (*AT*).
Profitability	Ratio of income before extraordinary items (*IB*) over book value of total assets (*AT*).
Tangibility	Ratio of property, plant and equipment (*PPENT*) over the book value of total assets (*AT*).
Debt rating	Dummy variable equal to one if the firm has long-term debt rating from S&P, and zero otherwise.
Investment grade	Dummy variable equal to one if the firm has investment-grade (BBB- and above) long-term debt rating from S&P, and zero otherwise.
Cash flow volatility	Standard deviation of quarterly cash flow over the past 12 quarters. Quarterly cash flow is the ratio of operating income before depreciation (*OIBDPQ*) over book value of total assets (*ATQ*).
Accounting opacity	Accruals quality measure constructed following Dechow and Dichev (2002) and calculated as the standard deviation of the residuals from firm-specific regression of working capital accruals on past, present and future cash flows from operations.
Bid-ask spread	Natural logarithm of the ratio of the absolute value of the difference between the trade price and the midpoint of the bid-ask quote over the trade price.
Altman's Z-score	(3.3*Operating income (*IOADP*) + Sales (*SALE*) +1.4*Retained earnings (*RE*)+1.2*(Current assets (*ACT*)-Current Liability (*LCT*)))/Book Assets (*AT*)
Distance-to-default	A market-based measure of financial distress risk, constructed following Bharath and Shumway (2008). We take the arithmetic mean of the daily measure to obtain the annual measure for each stock.
Distress dummy	A dummy variable equals one in the distress year and zero otherwise. Following Gilson, John, and Lang (1990) and Demiroglu and James (2015), we identify a firm year as financially distressed if its stock return is in the bottom 5% of the market for two consecutive years.
Options volume	Natural logarithm of one plus the aggregate dollar trading volume of all option contracts for the firm during the year
Term loan	Ratio of term loan over total debt.

Revolving credit	Ratio of revolving credit over total debt.
Senior bonds and notes	Ratio of senior bonds and notes over total debt.
Subordinated bonds and notes	Ratio of subordinated bonds and notes over total debt.
Commercial paper	Ratio of commercial paper over total debt.
Bond issue	Dummy variable equal to one if the firm issues a bond in a given year and zero otherwise

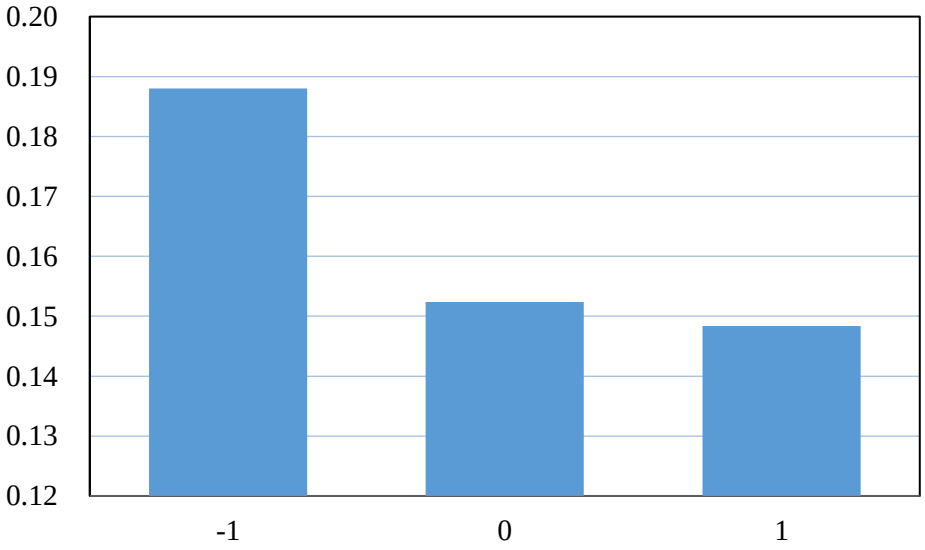
Notes. Variable names in parentheses in the right column refer to the names of the data items in the merged Compustat/CRSP database.

FIGURE 1. Public Debt and Bank Debt around CDS Introduction

Panel A. Public Debt



Panel B. Bank Debt



Notes. The figure presents the mean values of public debt and bank debt for event years -1 to 1, where event year 0 is the year of CDS introduction.

TABLE 1. Summary Statistics

	Mean	S.D.	25%	Median	75%
Panel A. All Firms (N=34,700)					
Public debt	0.458	0.419	0.000	0.446	0.924
Bank debt	0.414	0.414	0.000	0.268	0.915
CDS trading	0.159	0.366	0.000	0.000	0.000
CDS firm	0.176	0.381	0.000	0.000	0.000
Firm size	6.243	2.080	4.702	6.260	7.674
Tobin's Q	1.530	1.357	0.766	1.110	1.757
Leverage	0.269	0.230	0.095	0.233	0.381
Profitability	-0.062	0.310	-0.048	0.026	0.064
Tangibility	0.293	0.251	0.089	0.210	0.450
Debt rating	0.344	0.475	0.000	0.000	1.000
Investment grade	0.154	0.361	0.000	0.000	0.000
Panel B. CDS-Referenced Firms (N=6,099)					
Public debt	0.793	0.253	0.696	0.896	0.979
Bank debt	0.147	0.225	0.000	0.033	0.209
CDS trading	0.904	0.294	1.000	1.000	1.000
CDS firm	1.000	0.000	1.000	1.000	1.000
Firm size	9.080	1.161	8.181	9.001	9.940
Tobin's Q	1.263	0.833	0.746	1.031	1.494
Leverage	0.328	0.180	0.205	0.301	0.419
Profitability	0.038	0.091	0.016	0.042	0.075
Tangibility	0.360	0.238	0.154	0.314	0.549
Debt rating	0.957	0.202	1.000	1.000	1.000
Investment grade	0.652	0.477	0.000	1.000	1.000
Panel C. Non-CDS-Referenced Firms (N=28,601)					
Public debt	0.387	0.413	0.000	0.195	0.848
Bank debt	0.472	0.423	0.000	0.426	0.973
CDS trading	0.000	0.000	0.000	0.000	0.000
CDS firm	0.000	0.000	0.000	0.000	0.000
Firm size	5.638	1.697	4.386	5.756	6.904
Tobin's Q	1.587	1.438	0.773	1.131	1.822
Leverage	0.257	0.238	0.073	0.210	0.368
Profitability	-0.083	0.335	-0.079	0.021	0.061
Tangibility	0.279	0.251	0.079	0.190	0.416
Debt rating	0.214	0.410	0.000	0.000	0.000
Investment grade	0.048	0.213	0.000	0.000	0.000

Notes. The table presents the summary statistics of the variables in the analysis. Definitions of variables are in Appendix.

TABLE 2. Correlation Matrix

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
(1) Public debt	1.000										
(2) Bank debt	-0.763	1.000									
(3) CDS trading	0.358	-0.292	1.000								
(4) CDS firm	0.369	-0.299	0.941	1.000							
(5) Firm size	0.404	-0.280	0.610	0.630	1.000						
(6) Tobin's Q	-0.038	-0.054	-0.093	-0.091	-0.202	1.000					
(7) Leverage	0.232	-0.042	0.108	0.119	0.164	-0.001	1.000				
(8) Profitability	0.039	0.027	0.142	0.149	0.403	-0.242	-0.124	1.000			
(9) Tangibility	0.130	-0.048	0.111	0.122	0.228	-0.177	0.244	0.131	1.000		
(10) Debt rating	0.446	-0.316	0.570	0.596	0.689	-0.153	0.287	0.203	0.204	1.000	
(11) Investment grade	0.380	-0.311	0.614	0.637	0.575	-0.044	0.017	0.165	0.127	0.589	1.000

Notes. The table presents the correlation matrix of the variables in the analysis. Definitions of variables are in Appendix.

TABLE 3. Credit Default Swap Trading and Firm Debt Structure

Dependent Variable:	*Public debt*	*Bank debt*
	(1)	(2)
CDS trading	0.067	-0.100
	(2.856)***	(-4.172)***
CDS firm	-0.028	0.036
	(-0.912)	(1.330)
Firm size	0.048	-0.040
	(12.572)***	(-10.436)***
Tobin's Q	0.006	-0.027
	(1.728)*	(-7.854)***
Leverage	0.258	0.046
	(11.344)***	(1.992)**
Profitability	-0.130	0.180
	(-8.348)***	(11.249)***
Tangibility	-0.026	0.021
	(-0.956)	(0.754)
Debt rating	0.145	-0.131
	(10.097)***	(-9.490)***
Investment grade	0.151	-0.107
	(10.356)***	(-7.927)***
Obs.	28,231	28,231
Adj. R^2	0.304	0.210

Notes. The table presents regression results of the relation between CDS trading and firm debt structure. Constant and industry and year fixed effects are included in all the columns. All the independent variables are lagged by one year. The regression is performed by OLS, with the *t*-statistics (in parentheses) computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE 4. Tests for Endogeneity

Dependent Variable:	*Public debt* (1)	*Bank debt* (2)
Panel A. Matched Sample		
(1) Matching by Firm Size (N=6,891)		
CDS trading	0.086	-0.087
	(3.435)***	(-3.513)***
(2) Matching by Multiple Dimensions (N=7,377)		
CDS trading	0.147	-0.135
	(4.426)***	(-4.225)***
Panel B. Effect of CDS Liquidity		
(1) Number of Contracts Outstanding (N=3,197)		
	0.006	-0.007
	(1.832)*	(-2.490)**
(2) Number of Trades (N=3,197)		
	0.009	-0.009
	(2.248)**	(-2.379)**
Panel C. Controlling for Firm Fixed Effect (N=28,231)		
CDS trading	0.048	-0.050
	(3.014)***	(-2.368)**
Panel D. Instrumental Variable Approach (N=27,494)		
Instrumented CDS trading	0.358	-0.497
	(2.325)**	(-3.269)***
Panel E. Excluding the financial crisis period (N=21,590)		
CDS trading	0.067	-0.104
	(2.469)**	(-4.274)***

Notes. The table presents the endogeneity tests of the relation between CDS trading on firm debt structure. For the sake of brevity, the table only reports the coefficient of CDS-related variables. Other than stated, constant and industry and year fixed effects are included in all the tests. All the independent variables are lagged by one year. The regression is performed by OLS, with the *t*-statistics (in parentheses) computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE 5. The Effect of Information Uncertainty

Dependent Variable:	*Public debt*	*Bank debt*	*Public debt*	*Bank debt*	*Public debt*	*Bank debt*
	(1)	(2)	(3)	(4)	(5)	(6)
CDS trading	0.042	-0.085	0.050	-0.088	0.196	-0.189
	(1.574)	(-3.674)***	(1.595)	(-3.249)***	(2.006)**	(-2.268)**
*CDS trading*Cash flow volatility*	1.614	-0.982				
	(3.276)***	(-2.326)**				
Cash flow volatility	0.333	-0.647				
	(2.220)**	(-3.902)***				
*CDS trading*Accounting opacity*			0.489	-0.276		
			(2.341)**	(-2.288)**		
Accounting opacity			-0.051	-0.158		
			(-0.544)	(-1.559)		
CDS trading Bid-ask spread*					0.017	-0.012
					(2.364)**	(-2.127)**
Bid-ask spread					-0.028	0.026
					(-3.969)***	(3.686)***
CDS firm	-0.027	0.040	-0.036	0.040	-0.035	0.039
	(-0.920)	(1.528)	(-1.086)	(1.347)	(-1.156)	(1.450)
Firm size	0.051	-0.044	0.053	-0.046	0.040	-0.031
	(12.882)***	(-11.093)***	(12.148)***	(-10.575)***	(7.616)***	(-6.046)***
Tobin's Q	0.005	-0.026	0.009	-0.030	0.001	-0.025
	(1.252)	(-6.990)***	(2.142)**	(-7.042)***	(0.330)	(-6.468)***
Leverage	0.263	0.041	0.273	0.021	0.285	0.027
	(11.264)***	(1.730)*	(10.336)***	(0.789)	(11.475)***	(1.070)
Profitability	-0.111	0.151	-0.144	0.179	-0.120	0.176
	(-6.723)***	(8.713)***	(-6.765)***	(8.287)***	(-6.591)***	(9.082)***
Tangibility	-0.032	0.019	-0.036	0.014	-0.012	0.010
	(-1.137)	(0.676)	(-1.117)	(0.419)	(-0.426)	(0.333)
Debt rating	0.144	-0.130	0.140	-0.131	0.136	-0.124
	(9.830)***	(-9.341)***	(8.548)***	(-8.446)***	(9.208)***	(-8.767)***
Investment grade	0.149	-0.104	0.148	-0.100	0.148	-0.103
	(10.233)***	(-7.684)***	(9.283)***	(-6.789)***	(9.739)***	(-7.338)***
Obs.	27,011	27,011	22,606	22,606	25,794	25,794
Adj. R^2	0.311	0.218	0.323	0.230	0.322	0.222

Notes. The table presents regression results of the effect of information uncertainty on the relation between CDS trading and firm debt structure. Constant and industry and year fixed effects are included in all the columns. All the independent variables are lagged by one year. The regression is performed by OLS, with the *t*-statistics (in parentheses) computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE 6. The Effect of Financial Distress Risk

Dependent Variable:	*Public debt*	*Bank debt*	*Public debt*	*Bank debt*	*Public debt*	*Bank debt*
	(1)	(2)	(3)	(4)	(5)	(6)
CDS trading	0.049	-0.088	0.052	-0.095	0.068	-0.100
	(1.727)*	(-3.382)***	(1.744)*	(-3.489)***	(2.498)**	(-4.194)***
*CDS trading*Z-score*	0.011	-0.006				
	(1.181)	(-1.250)				
Z-score	-0.009	0.011				
	(-5.582)***	(7.425)***				
*CDS trading*Probability of default*			-0.020	0.030		
			(-0.674)	(1.117)		
Probability of default			-0.021	-0.046		
			(-1.343)	(-2.819)***		
*CDS trading*Distress dummy*					-0.154	0.118
					(-1.415)	(1.360)
Distress dummy					0.080	-0.112
					(3.036)***	(-4.300)***
CDS firm	-0.030	0.040	-0.003	0.027	-0.028	0.036
	(-0.925)	(1.421)	(-0.103)	(0.875)	(-0.898)	(1.309)
Firm size	0.051	-0.044	0.050	-0.042	0.048	-0.040
	(12.963)***	(-11.152)***	(11.972)***	(-10.113)***	(12.573)***	(-10.437)***
Tobin's Q	0.002	-0.022	0.005	-0.033	0.007	-0.028
	(0.528)	(-6.258)***	(1.360)	(-8.097)***	(1.929)*	(-8.145)***
Leverage	0.248	0.066	0.294	0.045	0.257	0.048
	(10.650)***	(2.765)***	(11.841)***	(1.778)*	(11.307)***	(2.093)**
Profitability	-0.042	0.069	-0.138	0.166	-0.123	0.170
	(-2.382)**	(3.913)***	(-7.985)***	(9.393)***	(-7.822)***	(10.509)***
Tangibility	-0.024	0.017	-0.040	0.027	-0.025	0.019
	(-0.850)	(0.620)	(-1.300)	(0.874)	(-0.918)	(0.698)
Debt rating	0.138	-0.124	0.138	-0.126	0.146	-0.131
	(9.376)***	(-8.783)***	(8.811)***	(-8.428)***	(10.151)***	(-9.564)***
Investment grade	0.147	-0.103	0.157	-0.108	0.150	-0.106
	(9.525)***	(-7.381)***	(9.261)***	(-6.847)***	(10.265)***	(-7.833)***
Obs.	27,502	27,502	23,995	23,995	28,231	28,231
Adj. R^2	0.307	0.213	0.286	0.191	0.304	0.211

Notes. The table presents regression results of the effect of financial distress risk on the relation between CDS trading and firm debt structure. Constant and industry and year fixed effects are included in all the columns. All the independent variables are lagged by one year. The regression is performed by OLS, with the *t*-statistics (in parentheses) computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE 7. The Effect of Options Trading

Dependent Variable:	*Public debt*	*Bank debt*
	(1)	(2)
CDS trading	0.090	-0.120
	(3.274)***	(-4.865)***
*CDS trading*Options volume*	-0.079	0.082
	(-4.663)***	(5.469)***
Options volume	0.080	-0.092
	(4.428)***	(-6.267)***
CDS firm	-0.029	0.036
	(-0.944)	(1.315)
Firm size	0.042	-0.033
	(10.410)***	(-7.995)***
Tobin's Q	0.002	-0.022
	(0.505)	(-6.290)***
Leverage	0.264	0.038
	(11.633)***	(1.647)*
Profitability	-0.128	0.177
	(-8.223)***	(11.072)***
Tangibility	-0.025	0.020
	(-0.922)	(0.726)
Debt rating	0.144	-0.130
	(9.977)***	(-9.400)***
Investment grade	0.153	-0.108
	(10.553)***	(-8.023)***
Obs.	28,231	28,231
Adj. R^2	0.306	0.213

Notes. The table presents regression results of the effect of options trading on the relation between CDS trading and firm debt structure. Constant and industry and year fixed effects are included in all the columns. All the independent variables are lagged by one year. The regression is performed by OLS, with the *t*-statistics (in parentheses) computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE 8. Credit Default Swap Trading and Debt Instruments

	Bank debt types		Public debt types		
Dependent Variable:	*Term loan*	*Revolving credit*	*Senior bonds and notes*	*Subordinated bonds and notes*	*Commercial paper*
	(1)	(2)	(3)	(4)	(5)
CDS trading	-0.051	-0.049	0.141	-0.066	-0.008
	(-2.773)***	(-1.425)	(5.259)***	(-3.337)***	(-0.985)
CDS firm	0.039	-0.003	-0.028	-0.006	0.006
	(1.837)*	(-0.152)	(-0.935)	(-0.288)	(0.730)
Firm size	-0.028	-0.011	0.031	0.014	0.003
	(-9.164)***	(-3.621)***	(8.183)***	(7.202)***	(4.445)***
Tobin's Q	-0.008	-0.019	0.008	-0.005	0.002
	(-2.781)***	(-7.873)***	(2.364)**	(-3.088)***	(3.865)***
Leverage	0.076	-0.029	0.120	0.140	-0.002
	(3.881)***	(-2.018)**	(5.342)***	(9.994)***	(-0.926)
Profitability	0.065	0.115	-0.117	-0.016	0.003
	(4.857)***	(10.788)***	(-7.624)***	(-2.041)**	(2.265)**
Tangibility	-0.004	0.025	0.080	-0.109	0.003
	(-0.189)	(1.072)	(2.857)***	(-7.904)***	(1.057)
Debt rating	0.018	-0.148	0.064	0.086	-0.005
	(1.510)	(-15.075)***	(4.124)***	(8.390)***	(-2.788)***
Investment grade	-0.118	0.011	0.216	-0.102	0.037
	(-10.575)***	(1.183)	(13.292)***	(-11.581)***	(9.091)***
Obs.	28,231	28,231	28,231	28,231	28,231
Adj. R^2	0.104	0.152	0.271	0.122	0.106

Notes. The table presents regression results of the relation between CDS trading and debt instruments. Constant and industry and year fixed effects are included in all the columns. All the independent variables are lagged by one year. The regression is performed by OLS, with the *t*-statistics (in parentheses) computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE 9. Credit Default Swap Trading and Debt Issuance Choice

	Sample of firms that issue either bond or loan, or both	Sample of firms that issue either bond or loan
Dependent Variable:	*Bond issue*	*Bond issue*
	(1)	(2)
CDS trading	0.269	0.219
	(2.273)**	(2.071)**
CDS firm	0.050	-0.044
	(0.182)	(-0.156)
Firm size	-0.164	-0.250
	(-4.217)***	(-5.799)***
Tobin's Q	-0.281	-0.292
	(-7.110)***	(-6.847)***
Leverage	-0.809	-1.039
	(-4.081)***	(-4.788)***
Profitability	1.177	1.258
	(5.898)***	(5.783)***
Tangibility	0.614	0.507
	(2.448)**	(1.865)*
Debt rating	-0.620	-0.749
	(-5.522)***	(-6.338)***
Investment grade	0.176	0.283
	(1.491)	(2.129)**
Obs.	9,197	7,369
Pseudo R^2	0.250	0.185

Notes. The table presents regression results of the relation between CDS trading and firm debt issuance. The regression is performed by the Logit model in which the dependent variable is equal to one if the firm issues public bond and zero if the firm issues private bank debt in a given year. *Z*-statistics (in parentheses) are computed using standard errors robust to both clustering at the firm level and heteroskedasticity. Constant and industry and year fixed effects are included in all the columns. All the independent variables are lagged by one year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.