# Heterogeneity in CDS Coverage *

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May 7, 2021

*We thank the 'Hanlon Financial Systems Center', Stevens Institute of Technology for providing financial support to obtain the required data. We are grateful to the AFA 2021 participants for their valuable comments. We also thank Xavier Giroud, Alexander Rodivilov, Filippo Pavesi, Fang Mai and Anand Goel for helpful comments. We are also grateful to seminar participants at Stevens Institute of Technology. The ideas expressed in this paper are those of the authors and do not necessarily reflect the position of the authors' respective institutions. Any errors are our responsibility.

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# Heterogeneity in CDS Coverage

**Abstract**

The total long-term liabilities for S&P 500 companies increased threefold in the past 18 years. However, the Credit Default Swap (CDS) market, did not follow this pattern and about 30% of the S&P 500 companies never had a CDS. In this paper, we study the cause of this puzzling heterogeneity in CDS coverage and show that the demand for CDS is causally related to the structure of bond ownership. In particular the number of investors holding the underlying bond (*breadth*) and the concentration of ownership (*institutional depth*) affect the demand for CDS. We test two rival hypotheses (*limited diversification* and *governance influence*) on a unique, partially hand-collected sample that includes CDS issued on S&P 500 companies and over 180,000 bond ownership observations obtained from Lipper eMAXX. Controlling for a number of covariates and adopting a regression discontinuity design approach, our results support the governance influence hypothesis suggesting that high breadth and low depth increases the demand for a CDS. Our results have important normative implications in the regulation of CDS markets and naked CDS strategies.

**JEL Classification Code**: G01, G12, G30, G39
**Keywords**: CDS, Bond Ownership, Risk Management, Financial market regulation

# 1 Introduction

In this paper, we study the cause of disparity in CDS coverage by focusing on a unique sample of CDS contracts issued on S&P 500 companies and bond ownership. The total liabilities held by S&P 500 companies during the period 2001-2018 increased three-fold, despite that, about 30% of the S&P 500 companies never had a CDS issued on their long term debt and only about 60% of the S&P 500 companies had CDS contracts on their bonds by the end of 2018. This puzzling evidence also includes well-known entities such as Bed Bath & Beyond Inc., Moody's Corp, Netapp Inc., Ross stores Inc. and others that never had a CDS on their outstanding debt differently from their direct peers and despite having significant outstanding obligations.

We argue that the number of unique institutional investors (breadth of bond ownership) holding the underlying bond and the concentration (depth) of bond ownership determines the demand for a CDS. We formulate two opposing hypotheses, the *limited diversification hypothesis* and the *governance influence hypothesis* to support our argument that bond ownership structure governs CDS demand. Our analysis shows that high numerosity and diversified bond ownership with diluted bond holdings stimulate the demand for a CDS supporting the 'governance influence hypothesis'.

We establish a connection between bond ownership and CDS demand by running a set of probit regressions on the sample of S&P 500 companies. A regression discontinuity design framework is used to determine a breakpoint where the switch is observed, with companies moving from no CDS to having a CDS. This approach yields a breakpoint at a breadth of 60 for our full sample. We next explore how corporate governance plays a role in regulating the demand for CDS. The evidence supports our assumption that poor governance enhances the demand for a CDS with our primary variables of bond ownership (breadth and depth) maintaining their significance and direction. Our results also suggest that a liquid bond market is a precursor to CDS market existing with the demand for a CDS going down with an increase in bond liquidity. These results add to the literature by providing important normative implications for the regulation of the CDS market and naked CDS strategies.

One of the relevant concerns is that the relationship between the ownership structure of a bond and the demand for the referred CDS is really a relationship between the credit quality of the bond and the CDS demand. We allay the concern by explicitly controlling for credit quality in our regression analysis. We find that our results are robust to controlling for credit quality.

Using a difference-in-difference estimation framework, we find a reduction in the breadth of ownership leads to loss of referred CDS. This further helps us establish a causal relationship between the existence of a CDS and the breadth of bond ownership. We use a variety of robustness measures and note that our results are consistent with our primary governance influence hypothesis.

There is a rich literature on many aspects of CDS with its pricing, relationship with corporate governance, and corporate finance being analyzed in depth.[1]. Prior studies have noted the differences and similarities of CDS pricing with corporate bonds, equity stocks, and other equity options [2]. The

[1] See Duffie (1999) , Arora et al. (2012), Morrison (2005)
[2] See Longstaff et al. (2005), Blanco et al. (2005)

literature has also identified the impact of a CDS on these markets and the information flow between CDS and various categories of markets [3]. A recent study by Oehmke and Zawadowski (2017) discusses the motivations for trading in CDS markets and the economic functions of this market. Through their analysis of data on notional CDS amount and volume, they suggest that CDS markets act as an alternative marketplace to the underlying bonds.

Our paper contributes to the recent strand of research that explores the initiation of a CDS. For example, Hao et al. (2020) examine the effect on CEO compensation by the onset of a CDS. The authors hypothesize and prove that CEOs of firms protected by a CDS have a greater long-term compensation to compensate for their reduced incentives to monitor borrowers.[4] Danis and Gamba (2018) study the real effects of CDS introduction on firm value. They weigh the negative and positive impacts of CDS on the firm value simultaneously. Even though the introduction of a CDS reduces the firm value due to increased bankruptcy costs following high firm liquidations, the bondholders' ability to hedge risk reduces the probability of costly debt renegotiation which increases the firm value[5].

However, despite the growing importance of a CDS, relatively little is known about this disparity in the CDS coverage and the motivations that drive the demand for a CDS. Banerjee and Kong (2019) partially tries to establish the cause for this CDS coverage disparity from the perspective of

[3] Acharya and Johnson (2007), (2010) study the information flow between CDS and equity markets

[4] Also, Banerjee et al. (2018) link CDS initiation to CEO compensation and find that the initiation of a CDS for a reference entity increases the CEO's financial protection by increasing cash compensation and ex-ante cash severance pay.

[5] The paper empirically proves that for public corporations in the United States the introduction of CDS contracts increases the firm value by 2.9%

pricing of credit risk. They model the reason for both demand and supply side initiation of CDS contracts and theoretically show that the market for CDS exists if the creditor's offer price is at least slightly greater than the issuer's reservation price. The root cause of this puzzle about the heterogeneity in the CDS coverage remains unsolved. In this paper, we address the existing gap in the CDS literature by identifying the reason for the heterogeneity in CDS coverage.

Our paper also contributes to a large literature that studies the relationship between a CDS and corporate bonds. Much of the literature tries to explore the effect of how the initiation of CDS has affected the characteristics of the bond market. Nashikkar et al. (2011) find that CDS liquidity has explanatory power for the bond prices, over and above the bond's liquidity variables. They expect the CDS-bond basis to reduce as the liquidity in the CDS market increases. Massa and Zhang (2012) also provides evidence on the improvement of bond liquidity post-issuance of CDS contracts by positing a reduction in fire-sale risk when liquidity lowers due to credit downgrades. Zhu (2006) compares the pricing of credit risk in the bond market and the rapidly growing CDS markets. Their paper documents that the CDS market leads the bond market in terms of price discovery. Our paper differs from these studies and thus contributes to the literature by identifying the effect of bond market and bond ownership structure on CDS initiation or demand.

The remainder of this paper is organized as follows. Section 2 discusses the CDS market. Section 3 describes our theoretical motivation. We discuss the data and our sample in Section 4. Section 5 describes our research methodology. Section 6 presents the empirical analysis and results. Section

7 conducts robustness analysis. Section 8 concludes.

## 2 CDS market

A Credit Default Swap (CDS) is a fixed income instrument that works like an insurance contract protecting against the loss caused by a credit event. A CDS is issued on bonds, loans, and structured investment vehicles such as ABS, MBS, and CDO securities. The protection buyer pays a premium referred to as the credit spread to protect against a contingent credit event of the reference entity (company, nation, etc.). The premium is determined against the total notional amount insured and is paid as annual, semi-annual, or quarterly payments. A CDS is primarily used to *trade credit risk* (Bolton and Oehmke (2013)). Banks leverage CDS contracts as an additional tool for risk management which help them *maintain regulatory capital ratios* (Shan et al. (2014b)). Although CDS acts as insurance, it is in fact a derivative instrument closer to an option that bets on the occurrence of a credit event.

The CDS market which began in the early nineties[6] did not experience a growth in corporate CDS till the beginning of the next decade. By the end of 2008 about 1400 companies in the U.S. market had a CDS contract issued on their bonds as we see in Figure 1, this was a very small fraction of the total U.S. market having about eleven thousand firms. We saw a decline in the corporate CDS market with the percentage of U.S. firms covered by CDS dropping down by 30% by the end of 2018. We see a similar trend for CDS coverage for the largest five hundred U.S. public companies. We observe that

[6] There is some ambiguity about the exact date, but as noted by Tett (2009), J.P. Morgan was the first underwriter of a CDS contract in 1994.

the CDS contracts issued on the S&P 500 companies have increased steadily from 3 in 2001 to around 413 in the first quarter of 2008. There has been a decline thereafter and this number stands at about 300 as of December 2018.

INSERT FIGURE 1 HERE

The CDS market grew to a modest gross notional amount outstanding of $180 billion by 1997. (Augustin et al. (2014)). It grew by around 30 times in the next seven years to a gross notional outstanding of about $6 trillion by the end of 2004. The market experienced a three-digit growth to reach an outstanding of $61.2 trillion just before the onset of financial crisis followed by a substantial decline , with a comparatively smaller outstanding value of about $20 trillion in 2013. The downward trend continued and the CDS market size declined to a notional outstanding of $8.1 trillion by end of 2018. According to the data reported by the Bank for International Settlements, CDS contracts represent 96% of the total credit derivatives by notional amount outstanding and are about 2% of the $544 trillion global derivatives market (notional outstanding) as of December 2018.

When the CDS market first began, insurance companies played the role of major contract sellers/underwriters with banks acting as main buyers. The CDS contracts were originally used by banks to transfer the credit risk of their loan portfolios. Over time, hedge funds entered the market and have increased their participation. Blue Mountain Capital, DE Shaw, Saba Capital Management and Citadel are few of the major hedge funds operating in this space. Over a period of two decades, it has been observed that insurance companies have had a role reversal from being net sellers to net buyers of

CDS protection while the hedge funds have become the net contract sellers. As discussed by Peltonen et al. (2014), the CDS market is fairly concentrated with around 13 dealers and about 75% of gross sale being done by the 10 most active ones. They have also found that majority, around 80% of the participants in the CDS market act as net contract buyers.

Statistics published by BIS at the end of 2018 reported that about 70% of the total CDS outstanding transactions globally were carried out through central clearing processes. Table 1 represents this while also providing the breakup of CDS users by entity types and contract positions. We see that the banks and the securities firms are the primary traders of CDS contracts followed by the hedge funds. This table conforms to the literature that states that a large part of active CDS market participants act as net protection buyers.

INSERT TABLE 1 HERE

## 3 Theoretical motivation

The market for corporate CDS includes three entities:

1. The reference entity: The institution who is the primary borrower on whose debt a CDS contract is written.

2. The buyer of the contract: The creditor of the reference entity. This includes the institutional investors, hedge funds, insurance companies and individuals ideally holding the debt of the reference entity.

3. The seller of the CDS contract: The underwriter/seller who designs the terms of a CDS contract and guarantees the underlying debt between the

issuer and the buyer. This is a third party seller, usually large banks or insurance companies.

While the reference entities may have multiple securities, a CDS contract is structured such that it is issued only on the senior portion of the company's debt. Thus to model the demand for a CDS contract, we consider the reference firms to be uniformly distributed in terms of their financial characteristics.

A CDS is considered to be a risk neutral instrument that mechanically responds to demand. The seller has a distinct cost function for CDS issued on each company which decides his reservation price ($\underline{P_S}$). $\underline{P_S}$ sets the lower bound below which the underwriter is unwilling to sell. At the same time, a CDS buyer will have a value function that will determine the buyer's reservation price for a CDS contract ($\overline{P_B}$). This is the upper bound above which the buyer will not buy the CDS contract. Sale of a CDS contract happens in the region of overlap between the two reservation prices with equilibrium existing only if $\underline{P_S}$ is less than $\overline{P_B}$. The overlap region is depicted in Figure 2.

INSERT FIGURE 2 HERE

A bondholder or bond owner has three choices :

1. Hold the bonds
2. Sell the bonds
3. Buy insurance via a CDS contract

The decision of the bondholders depend on their perception of financial risk from holding the bond. The bond owners consider buying a CDS to protect themselves of the risk of not getting paid back and thus would like to get protected against the exposure to the risk of the reference entity.

These reference entities differ in their bond ownership structure. We measure the bond ownership structure along two dimensions, *breadth* and *depth*. We call the number of institutional investors holding the bonds of a company as the *breadth* of bond ownership. Concentration of institutional ownership defined as the *depth*, is the fraction of total bond outstanding amount held by each institution. Such bond ownership structure may potentially explain the observed heterogeneity: in fact, we argue that the CDS demand is causally related to the breadth and the depth of bond ownership. For any bond issuer, the intersection between these two attributes changes the financial risk borne by the investors, which in turn determines the need for protection. In figure 3 we graphically represent the demand for a CDS as a 2x2 matrix of breadth and depth.

INSERT FIGURE 3 HERE

Each quadrant is characterized by a different combination of breadth and depth that allows us to frame our two hypotheses to determine the testable empirical predictions.

The first *limited diversification hypothesis* suggests that the demand of a CDS is increasing in the concentration of bond ownership and decreasing in the number of investors holding the bond. Consider a reference entity whose bonds are owned by a large number of buyers and each buyer holds a very small percentage of the company's bond (quadrant HL). Due to the distributed ownership and the small size of each position, the loss to each individual bondholder caused by the default of a reference entity is reduced. The demand for a CDS on the bonds of such a reference entity therefore is modest suggesting that atomistic bond ownership with high numerosity reduces the demand for a CDS. Differently, a few bond owners having a high proportion of the company liabilities (quadrant LH) would face significant capital losses in case of default of the reference entity and therefore may have a preference for buying protection increasing the demand for a CDS. Consider an entity 'A' having few buyers and highly concentrated bond ownership compared to another entity 'B'. We expect the demand for a CDS on company 'A' to be higher and the seller to have a lower $\overline{P_S}$ for company A when compared to company 'B'. At the same time, buyers have a higher reservation price for the company 'A'. At the institutional level, the institutions holding a high percentage of a single company bonds face a high risk in the case of default by the company. They may thus have a high buying reservation price ($\overline{P_B}$) and a greater demand for CDS protection. Such demand in turn provides an incentive for protection sellers to structure insurance products.

We accordingly formulate the following:

**H1a.** The probability of having a CDS is negatively affected by the breadth of bond ownership and positively affected by the depth of bond ownership.

A rival *governance influence hypothesis* suggests that atomistic and diversified bond ownership (quadrant HL) increases the demand for a CDS. In fact when ownership is atomistic and fragmented individual investors are too small to individually influence the governance of the bond issuing firm and coordination costs make collective influence on the company's management ineffective. As a consequence, demand for protection through a credit derivative increases. On the contrary when ownership is concentrated, investors have more leverage on managers to control risk taking and managerial discretion. This in turn reduces the need for external insurance.

To illustrate, let us consider two companies 'A' and 'B'. Company 'A' has only 2 bondholders each holding 50% of the total bond outstanding amount. The large proportion of bonds owned by each investor allows them to individually (and *a fortiori* jointly) exert influence on the management to protect their financial investment. With such ownership the need for external protection through a CDS is reduced which determines a lower incentive on protection sellers to structure insurance products. Differently, in company 'B' ownership is distributed over $N$ bond owners each holding $1/N$ bonds. The dispersion in ownership and the high cost of coordination among investors limit the possibility of curbing managerial discretion leading to a higher risk and a related demand for protection.

These arguments lead to the following:

**H1b.** High breadth and low depth in bond ownership increase the probability of having a CDS.

# 4 Data

## *4.1* Data construction

The data used in this paper are derived from multiple sources with non-homogeneous identifier that required careful matching.

S&P 500 companies are large, well established and typically have an outstanding debt with an unconditional liquidity making them ideal candidates for a CDS issuance. The presence of outstanding debt in S&P 500 companies is represented in Figure 4. Companies outside S&P 500 might have an endogenous lack of CDS due to their financial condition. We also show in Table 2 that the probability of having a CDS contract increases for companies in S&P 500. The table presents a set of probit regressions performed on a propensity score matched (PSM) panel data of companies listed in the U.S. market for the period between 2001-2018. The dependent variable is a binary variable (CDS) taking a value of 1 if a company has a CDS contract in that quarter. The primary predictor variable is again a binary variable (SP) taking a value of 1 for companies that are constituents of S&P 500 and 0 otherwise. We find that being a part of S&P 500 has a strong positive significance on the probability of having a CDS.

INSERT TABLE 2 HERE

We thus focus on S&P 500 companies and observe them over a period of 18 years from 2001-2018 to empirically test the heterogeneity in CDS coverage.

We collect quarterly data on CDS contracts over our sample period from the 'IHS Markit' database. The database contains contract level information like the company name, the seniority tier of the debt on which the CDS is priced, the currency of the contract and the restructuring type. It also has details about the industry, location and country of headquarter for the reference entity. The database provides information on data quality rating, composite recovery rate and the par spread of the CDS as well.

We start with collecting quarterly data on CDS for the 72 quarters in our sample. IHS Markit database reports data on a daily basis and to obtain quarterly data the last 3 market open days of each quarter are considered to produce 72 data files.

This data is then merged with S&P 500 constituents data obtained from 'Compustat-Capital IQ' for each quarter in our sample period. Because of the absence of a homogeneous identifier in the two datasets and the fact that Compustat updates the names of S&P constituents on a real time basis, while IHS Markit keeps the historical names, the majority of the merging has to be carried out manually. Additionally in case of mergers, acquisitions, name changes, delisting of companies, the names in the two databases will not match, further slowing down the process of merging.

The database is then merged with bond ownership data obtained from 'Lipper eMAXX'. We obtain the quarterly data on bond ownership for a period between 2006-2008 and the first two quarters of 2017. This database contains detailed fixed-income holdings for around 20,000 American and European firms. eMAXX reports its data based on regulatory disclosure to the National Association of Insurance Commissioners(NAIC), the Securities and Exchange Commission(SEC) and voluntary disclosures by few private pension funds. The database reports this data on quarterly basis at both institutional and individual levels and has data for almost all firms in the North American market, with each quarter having about 1.5 million observations. Merging this data to S&P 500 company dataset is challenging as well. The eMAXX database has the same parent company with varying CUSIP (unique identification number for each company) codes thus requiring manual intervention at each quarter for these files as well.

We then merge the database with variables from the 'Institutional Shareholder Services (ISS)' database to compute the quality of corporate governance index (E-index). We use the six provisions (variables): staggered boards, limits to shareholder bylaw amendments, poison pills, golden parachutes, and supermajority requirements for mergers and charter amendments chosen by Bebchuk et al. (2004) to compute the E-index.

Next, we use the 'TRACE' database to obtain the bond transactions and thus the bond liquidity data for S&P 500 companies in our sample. Our final dataset is obtained by adding financials of each company for each quarter from 'Compustat-Capital IQ' to the merged database.

After this extensive process of data collection we have a partially hand-collected sample of around 6,000 observations. Our sample is a panel data with cross-section of S&P 500 companies.

## 4.2 Summary Statistics

CDS coverage over the period between 2001-2018 is presented in Figure 1. Panel A of Figure 1 has two line plots. The red line indicates the number of companies in the U.S. market between 2001-2018 plotted on a quarterly basis. The blue line represents the number of companies in the U.S. market having CDS in each quarter. While the number of companies in the U.S. market has remained almost constant at about 11,000 companies per quarter, CDS contracts show a humped pattern growing from inception up to a maximum of 1,400 contracts around 2008 and dipping thereafter. Panel B of Figure 1 plots the subsample of CDS written on S&P 500 companies. We observe a similar pattern with contracts growing from an initial count of 4 at inception to 413 during the financial crisis but then dropping to 300 companies by the end of 2018.

INSERT FIGURE 1 HERE

The heterogeneity in the CDS coverage has existed since the beginning of the sample period. Table 3 provides statistics of the percentage of companies not covered by CDS on a yearly basis for the period under consideration. We see that this number began with 50% i.e. about half of the S&P 500 companies without CDS in 2001. The CDS coverage increased and reached a maximum by 2007, with about 80% of the companies having a CDS. The number of companies covered by a CDS began to drop after the financial crisis and we find that 40% i.e. around 300 companies did not have a CDS by the end of 2018. About 30% of the S&P 500 companies on an average do not have CDS contracts written on them each year.

INSERT TABLE 3 HERE

Further, we try to perform a broad examination to understand the cause for this disparity using the plot in Figure 4. In the graph, the bars represent the number of S&P 500 companies without CDS plotted quarterly between 2001-2018. The line plots the subsample of S&P 500 companies per quarter that have long term debt but do not have a CDS. The data show that about 99% of the companies that are not covered by a CDS have, however, long term debt outstanding which rules out the possibility that the drop in CDS might be due to a structural change in the capital structure of companies that led to much reduced or no leverage and therefore a mechanical absence of CDS contracts.

INSERT FIGURE 4 HERE

The graph in Figure 5 plots the CDS coverage with respect to outstanding debt in billion USD.

INSERT FIGURE 5 HERE

The total outstanding long term liabilities for the S&P 500 companies increased three fold from $1,700 billion to $5,300 billion in past 18 years. The CDS market, however, did not follow this pattern. In terms of debt covered by a CDS, about 99% of the total debt outstanding was not covered at the beginning of the sample period. As the CDS market grew, there was an increase in the coverage with about 98% ($1,862 billion) of long term debt being protected by a CDS during the period between 2004 and 2005. The ensuing decline in CDS contracts led to an increase in the proportion of debt uncovered by any CDS, with about $800 billions, or 15%, of the total long term liabilities unhedgeable by the end of 2018.

Our database includes 891 distinct companies that were included in the S&P 500 index at any point between 2001-2018. Figure 6 plots the count of companies by the percentage of times they had a CDS during our sample period. The numbers on the wedges represent the count of companies for a range when a company never had a CDS to the case when a company always had a CDS. We observe that 264 companies i.e. about 30% of the sample never had CDS during the sample period. Interestingly coverage is very heterogeneous across time with only about 10%, or 94, of 891 companies having had an uninterrupted CDS coverage during the period of observation.

INSERT FIGURE 6 HERE

The final dataset comprises of about 6,000 observations. The breadth of the companies ranges between 1 to 700 institutional investors with a mean of about 125 investors. The concentration of bond ownership has a mean of around 10%. The scatter plot for distribution of companies about their breadth and depth is presented in Figure 7. The 'Y' axis represents the natural log of the breadth and 'X' axis stands for the depth of bond ownership. We see that a high concentration of the companies in the sample have a breadth in the range of around 50 ($ln(4)$) to 400 ($ln(6)$) and a depth below 20%.

INSERT FIGURE 7 HERE

The summary statistics of bond ownership structure for companies with and without CDS is represented in Table 4. The table also provides the result of the two-tailed t-test conducted to test the equality of means for group of companies with and without a CDS across the parameters of breadth and depth. We see that the companies with a CDS have on an average double the number of institutional investors as compared to the companies without a CDS. Also, companies with a CDS appear to be less concentrated with their depth being almost half that of the companies without a CDS. Even the t-tests confirm that the companies with and without a CDS vary significantly in terms of their bond ownership structure.

INSERT TABLE 4 HERE

We report the summary statistics of the firm characteristics in Table 5. For the companies (bond issuing firms) in our sample during the period between 2006-2008 and the first two quarters of 2017 we find the mean asset size to be about $56 billion with a maximum of asset size of more than $256 billion. The sample has debt of about $18 billion and a market value of $28 billion. We see that the intangibles constitute about 10% of the total assets and represent 20% of the market value. We also find the average bond holding for each institutional investor to be about $12.25 million. The distribution of firms by industry is reported in Table 6. We use two digit standard industrial classification (SIC) code to define the industry of the firms in our sample. Firms in the 'Manufacturing' industry constitute about 40% of the sample. Intangibles heavy industries (Finance and Services) account for 30% of the sample. Agriculture, Forestry & Fishing is the most thinly represented industry with only one firm in S&P 500 being from that industry.

INSERT TABLE 5 AND 6 HERE

# 5 Methodology

## *5.1* Research methodology

We test the two rival hypotheses (limited diversification and governance influence) on a quarterly sample of S&P 500 companies for a period between 2006-2008 and the first 2 quarters of 2017. We begin our econometric analysis by performing a set of regressions on our sample. The dependent variable is a binary variable named CDS, which takes the value of 1 for companies having a CDS contract and 0 for those who don't have a CDS. The dimensions of bond ownership structure are the primary explanatory variables. Breadth is the first primary variable which denotes the number of institutional investors holding the bonds of a company. The concentration of ownership, (depth) is the second independent variable. We measure depth as the Herfindahl-Hirschman Index(D) of bond ownership calculated as follows:

$$D = \sum_{i=1}^{n} s_i^2 \tag{1}$$

where:

$n$ = number of institutional investors

$s_i$ = percentage holding of an investor

$= \frac{\text{Amount of bond outstanding held by investor `i'}}{\text{Total institutional bond outstanding for the reference entity}}$

In our analysis we are interested in estimating the probability of having a CDS given the continuous explanatory variables of bond ownership, $P(CDS = 1|breadth, depth)$. Considering this probability to be linearly related to a continuous independent variable does not make sense conceptually. Estimating this relation using linear models might even make the predictions meaningless by driving them outside the range of (0,1). To address these problems of linear probability models (LPM) and thus the ordinary least square approach (OLS) we use *categorical models* in our regressions. The vector of independent variables that primarily define our underlying model include the breadth and the depth of bond ownership which are transformative normal. We thus use probit regressions in our analysis. To keep our results heteroskedasticity-consistent we use robust standard errors. The hypothesis is empirically tested through the following model:

$$CDS = \beta_0 + \beta_1 * B + \beta_2 * D + \gamma X + \epsilon \tag{2}$$

where:

CDS= $\begin{cases} 1, \text{if company with CDS} \\ 0, \text{otherwise} \end{cases}$ B = breadth of bond ownership

D = depth of bond ownership

X = vector of control variables

We augment our regressions using a set of control variables that may affect the CDS trading, drawn from prior CDS literature. Following Ashcraft and Santos (2009) and Martin and Roychowdhury (2015), we control for firm's fundamental attributes specifically size, leverage and credit risks. We also control for a firm's Tobin Q or Peters and Taylor's Q (total Q) to capture firm's investment opportunities (see, e.g., Fu et al. (2016), Kogan and Papanikolaou (2014)), suggested to affect CDS initiation (see, e.g., Ashcraft and Santos (2009)).

In particular, we use the following vector of control variables measuring firm characteristics : assets, debt, Tobin Q, total Q and credit rating. We calculate assets as the natural logarithm of total assets per quarter. Debt is measured as the natural logarithm of sum of long term debt and debt in current liabilities for each quarter. Tobin Q is calculated as market value of equity plus book value of short and long term debt divided by total assets. We obtain total Q from the Wharton Research Data Services' (WRDS) Peters and Taylor's Q database as an improvement over Tobin Q which takes into account both the physical and intangible capital. Total Q is calculated as the market value of capital divided by the sum of physical and intangible assets. Intangibles are the natural log of estimated replacement cost of the firm's intangible assets calculated on a quarterly basis. The regressions are also controlled for time fixed effects. We also control our regressions for industry fixed effects. Following CDS literature we use 2-digit 'Standard Industrial Classification (SIC)' code for specifying the industry.

# 6 Empirical analysis and results

## *6.1* Main results

Table 7 presents the results of our analysis. Columns (1) reports the result for univariate regression performed without any controls. Columns (2) includes the controls for firm size: total assets and debt. To account for the interaction of our exogenous variables (breadth and depth) we reestimate the specification of column (2) by adding an interaction term to the regression and present the result in column (3). Column (4) uses the specification of column (3) along with controlling for industry fixed effects. In columns (5)-(6) we test the impact of bond ownership on probability of having a CDS by varying the firm level controls of assets, debt, Tobin Q and Peters and Taylor's total Q. We see that the coefficients for breadth and depth are statistically highly significant. We find that the breadth is positively related and the depth is negatively related to the CDS demand. The breadth and depth maintain their direction and significance even in the presence of interaction term (column (3)). An interesting thing to note is that the interaction term of breadth and depth is also highly significant and positively related to the probability of having a CDS suggesting the importance of both the dimensions taken together.

The results confirm the effect of the bond ownership structure on the probability of having a CDS. We find our model to be significant in all the specifications with a pseudo R-squared of about 25%. The pseudo R-squared increases substantially to 38% after controlling for industry fixed effects suggesting heterogeneity across industries.

INSERT TABLE 7

In the set of our control variables, total assets seem to have a significant positive impact on the dependent variable. Also, Tobin Q and Total Q have a negative influence on CDS demand i.e. more the firm is undervalued, higher is its probability of having a CDS. Interestingly, we find that the total debt outstanding as an independent variable does not have an impact on the CDS variable.

The results presented in Table 7 confirm the *governance influence hypothesis*, suggesting that a highly fragmented and an atomistic bond ownership spurs demand for a CDS.

## *6.2* Economic interpretation of the probit regressions

The probit regressions are less straightforward to interpret as compared to the OLS regressions. Being non-linear in nature, probit regressions cannot use the conventional approach of associating the economic interpretation of change in the dependent variable to the coefficients of the independent variables. The marginal effect of the primary independent variables on the probability of having a CDS is presented in Figure 8.

INSERT FIGURE 8 HERE

The Figure 8, Panel A provides predicted probabilities for breadth and depth by change in each independent variable individually. We observe that an increase in the number of institutional investors from 1 by 50 increases the demand for a CDS contract by 10%. At the same time an increase in concentration of investors from 10% to 50% reduces the probability of having a CDS by 4%. We see that the demand for CDS is more elastic to the change in breadth vis-à-vis a change in depth.

## *6.3* Auxiliary evidence

### *6.3.1* Interaction with corporate governance

Our results support the 'governance influence hypothesis' suggesting that the inability of the bond holders to exercise influence over the governance of the bond issuing firm to protect their financial investment initiates the demand for a CDS. The difficulty in exerting control over the management collectively can be attributed to the increased coordination cost as the number of bond holders increases. We conjecture that poor governance would further increase these coordination costs and we expect the demand for CDS to be higher for firms with poor governance. We perform a set of regressions including the corporate governance variable to confirm this conjecture.

We use E-index (Bebchuck, Choen, and Ferrell index) as a proxy for quality of corporate governance following prior literature[7]. The regression results including corporate governance are presented in Table 8. The index is constructed from IRRC data using six provisions as described in Bebchuk et al. (2004). The index ranges from a feasible low of 0 to a high of 6; a high score is associated with weak shareholder rights and thus a signal of poor governance. Columns (1) - (3) use the continuous measure of the index as a control. In columns (4) - (6) we define 'BCF' as a binary measure for governance. We code the BCF variable to be 1 for companies with poor governance (E-index greater than 3: the median) and 0 for companies with good governance (E-index less than or equal to 3). We find in columns (1) - (3) that the governance index is significant and positively related to the demand for a CDS as we hypothesized. Also, from columns (4) - (6) we observe that the binary variable and interaction of governance with breadth is highly significant and loads positively. This suggests that poor governance increases the demand for CDS. In all our regressions breadth remains a significant determinant of CDS demand and depth is significant and loads negatively using binary measure of the governance index supporting our hypothesis. The predicted probabilities of CDS for changes in breadth and depth for subsamples of companies with good and poor governance is presented in Figure 9.

INSERT TABLE 8 AND FIGURE 9 HERE

#### *6.3.2* Interaction with bond liquidity

A bond holder as mentioned earlier in 'Section 3' has three choices: (a) hold the bonds, (b) sell the bonds, and (c) buy a CDS contract. Ideally, we would

[7] For example: Bhagat and Bolton (2008); Fatima et al. (2012); Vincent et al. (2012)

expect a bond holder whose bonds have a highly liquid secondary market to prefer selling a bond over paying a cost and buying a CDS contract. This relationship between bond liquidity and CDS demand is studied and results are presented in Table 9.

INSERT TABLE 9 HERE

We measure bond liquidity as the percentage of days in a quarter the senior unsecured bonds of a firm are traded. All the probit regressions in Table 9 add bond liquidity as one of the covariates. In columns (3) and (4) we interact bond liquidity with the breadth and depth of the firm. We find liquidity to be positively associated with CDS demand suggesting the need of a market for existence of a CDS. We observe that the interaction of breadth and depth with liquidity loads negatively on CDS demand. Thus, a high bond liquidity has an offsetting effect on CDS demand but when bond liquidity is low there is no unconditional supply of CDS. The results hold with the inclusion of industry fixed effects.

## *6.4* Further findings

We further investigate the data to look for discontinuity in the regression design. We try to determine a particular level of investors that causes a flip in the CDS pattern and thus triggers the economic viability of having a CDS. The histogram in Figure 10 plots the fraction of companies with and without CDS by bins of breadth. Each bin considers 10 investors and measures the fraction of companies with (without) CDS over total companies with (without) CDS in the sample. We see a coordination vs diversification flip at a breadth of 60 where the fraction of companies having a CDS becomes more than the fraction of companies without a CDS. This can be thought of as a flip from coordination (limited diversification) to diversification (governance influence) hypothesis suggesting better coordination of bond holders with the management of reference entity for a breadth below 60. As the number of investors increases, coordinated influence over the managers becomes difficult and the demand for a CDS rises.

INSERT FIGURE 10

We confirm this discontinuity or breakpoint at a breadth of 60 by the line plot in Figure 11. The plot shows the fraction of companies with CDS over the total companies by bins (10 investors per bin) of breadth. We observe that beyond a breadth of 400, all the companies in the sample have a CDS.

INSERT FIGURE 11

#### *6.4.1* Border discontinuity and probability of CDS

We run regression discontinuity design (RDD) approach to observe the border discontinuity at a breadth of 60. Figure 12 presents the RDD plot for our full sample. The solid line represents the global polynomial fit of CDS on breadth. The polynomial fit is a smooth approximation to the unknown regression function based on a second order polynomial regression fit of CDS on breadth. The dots in the plot represent the local sample means of CDS at intervals of breadth. We observe a jump is the solid line from red to blue around the breadth of 60 confirming a discontinuity at that point.

INSERT FIGURE 12

Having identified the border discontinuity from the data, we now verify that the companies above and below the border are comparable, except in their probability of having a CDS. This step is necessary to assert that we have identified a quasi-exogenous component to determining the demand for a CDS that does not merely reflect the underlying fundamental differences among the firms.

INSERT TABLE 10 HERE

Table 10 provides the comparison of companies above and below the breadth of 60. Our border sample comprises of about 300 companies having between 55 to 65 institutional investors. The border sample has about 150 observations on both sides of the border. We run a two-tailed t-test for equality of means across parameters of assets, debt, market value and Tobin Q. Our results show that the t-test cannot be rejected for any of these characteristics confirming that the border sample comprises of comparable firms. At the same time, the t-test is significantly rejected for the probability of having a CDS. Our results establish a discontinuity at a breadth of 60 and confirm the role of breadth in determining the demand for CDS.

#### *6.4.2* Border discontinuity for governance subsamples

We perform the RDD analysis for sub sample of firms with good and poor governance. Figure 13 Panel A plots the histogram showing the fraction of companies with or without CDS by bins of breadth for the sub samples of firms with good and bad governance. We find that a breakpoint where we see a switch in companies moving from no CDS to having a CDS occurs at around 40 for poorly governed companies and at a breadth of about 90 for firms with good governance. Using a piece-wise regression (results not reported in the paper) we identify and confirm these breakpoint to be at a breadth 40 and 90 for firms with poor and good corporate governance respectively.

INSERT FIGURE 13 HERE

Having identified the discontinuity for the subsamples we plot the RDD plot and present them in Figure 13 Panel B. The jumps in the solid line from red to blue confirms the discontinuities at the breakpoints for both the samples. We also perform t-test to compare the breakpoints of the two subsamples samples and find the two breakpoints to be statistically significantly different.

## *6.5* Economic interpretation of discontinuity breakpoint

The economic interpretation for the breakpoint for the regression discontinuity design (RDD) of our sample can be understood from the literature on 'threshold strategy' Nash equilibrium[8]. As we illustrated in 'Section 3' a rational customer (a bondholder in our study) has a three choices of holding, selling or buying a CDS contract to protect himself of the risk of default by the bond issuer. We have also shown that the institutional bond holders are

[8] see: Viswanathan and Tse (1989); Hassin and Haviv (1997); Laurens and Senthil (2014)

large and it is non-trivial for them to have the need to seek protection for their bond holding.[9]. Further in Table 9, we observe that the demand for a CDS increases with a decrease in bond liquidity. This result suggests that investors holding bonds of less liquidity avail the last protection choice of buying a CDS contract or influencing the management.

The bond holder's objective is to minimize his expected costs and thus maximize his expected utility. The expected cost for a bond holder can be given by: *E(C) = min[cost of buying a CDS, coordination costs]*. We define coordination cost as the cost of coordination amongst bond holders to collectively influence the company's management. Following from the literature on consumer queues (Hassin and Haviv (2003)), we can say that bond holders follow a threshold strategy when there are coordination costs. In other words, a bond holder buys a CDS contract if the number of bond holders (length of queue) is above a threshold. Above the threshold, congestion effects dominates and cost of coordination becomes very high. As the coordination cost rises with the increase in the number of bond holders, utility from buying a CDS outweighs the coordination costs and we observe a higher demand for CDS for firms with higher breadth. The reverse holds true as well, with a low breadth it buying a CDS costly vis-à-vis coordinating with a handful of investors. The RDD plot in Figure 12 shows the threshold/ breakpoint for our full sample to be at a breadth of 60.

To illustrate, let us consider two companies 'A' and 'B'. Firm 'A' has two bond holders each holding 50% of the bond outstanding. Only two investors makes it easy for them to coordinate and then the large proportion of bonds

[9] see Table 5 for the summary statistics

held by them individually helps them exert influence on the management to protect their bond investment. On the contrary firm 'B' has 100 investors an each holding 1% of the total bond outstanding. An individual bond holder in this case is atomistic to influence the management. At the same time the coordination with 99 other bond holders is costly and thus they will be unable to exert influence as a single unit (of all bond holders). This initiates the demand for a CDS contract as the breadth of bond ownership increases.

We also find from Figure 13 that the breakpoint shifts for subsamples of companies with poor and good governance. Breakpoint for firms with poor governance is observed at a lower number of 40 suggesting the coordination is probably more difficult for them. For companies with good governance we find a higher breakpoint at a breadth of 90. The two breakpoints are statistically significantly different and conditioning on the quality of governance we show that this breakpoint also shifts. Thus we can say that the threshold varies depending on the sample under consideration.

# 7 Robustness Analysis

## *7.1* Subsampling by total assets and intangibles

In all our regressions we control for issuers size. However, size may have non linear effects for large vs small companies. As a first robustness check we perform a set of alternative regression analyses on several size clusters. In particular, we break our sample in quartiles based on total assets and the results are presented in Table 11, Panel A. Panel A presents results for regressions on top and bottom quartiles of S&P 500 companies in our sample divided on the basis of the asset size. Columns (1) - (3) in both the panels have subsample of companies in the first or bottom quartile i.e. companies having smaller asset size. Columns (4) - (6) presents the regression results for the fourth or top quartile. We find the breadth and depth retains their sign and significance.

INSERT TABLE 11 HERE

Intangible assets on an average account for about 10% of the the total assets for S&P 500 companies in our sample as presented in Table 5. The distribution, however, is not uniform with companies in finance, insurance and services industries (comprising about 30% of our sample)[10] having a higher proportion of intangible assets. The impact of bond ownership may not be the same for companies at two ends of the spectrum. To account for this disparity we also divide our sample on intangible assets. We augment our regressions with a dummy called 'high intangibles' which takes the value of 1 for companies having intangible assets above the median. Companies with low values of intangible assets get a value of 0 for this dummy. We use the Peters and Taylor method Ryan and Lucian (2017) for calculation of intangible assets. The results are presented in Table 11, Panel B. We find the demand for CDS to be high for firms with high intangibles as conjectured. Also, our main results hold supporting our 'governance influence hypothesis'.

[10] see Table 6.

## *7.2* Credit quality

An obvious candidate as a determinant of CDS coverage is the quality of the outstanding liabilities. Underwriters of high-quality bonds may feel unnecessary to buy protection given the limited downside risk whereas investors in riskier securities may have a preference for bonds that can be hedged through insurance. We control for this possible confounder in Table 12 that tabulates the result of regressions including the issuer's credit rating. Canonically, we define the companies with credit ratings of AAA, AA, A, BBB on their senior secured bonds as *Investment Grade* and those with credit ratings of BB, B as *Speculative Grade*. Columns (1) - (3) control for the grade or rating fixed effect along with the time fixed effects. Columns (4) - (6) presents regression results including the interaction of breadth and depth with the investment grade and using only the time fixed effects. We also include industry fixed effects in columns (3) and (6). The results obtained are similar to our main results with demand for a CDS being positively related to the breadth and being negatively related to the depth, thus supporting the 'governance influence hypothesis'.

INSERT TABLE 12 HERE

## *7.3* Subsampling by constituents

Companies in S&P 500 are ideal candidates for CDS issuance as we infer from Table 2. To establish the causality between bond ownership structure and CDS demand we perform a quasi-natural experiment on our sample. We consider subsamples of firms that were added to and removed from the S&P

500 during our sample period. We have about 90 distinct firms in each subsample. For each firm in the subsample we consider 5 observation, two prior to and two post the addition/deletion. The results of probit regressions performed on the two subsamples are reported in Table 13. Panel A reports the regression results for companies added to the S&P 500 list and panel B reports the results for subsample removed from S&P 500 constituents. Column (1) reports the unconditional regressions. Column (2) reports the regressions after controlling for firm size (assets and debt). Column (3) includes the interaction of breadth and depth. We include interaction of both breadth and depth with SP (equal to 1 if a company is in S&P 500, otherwise) in column (4). We find that CDS positively loads on breadth with breadth retaining its significance. The results in both the panels are similar to those presented in our main results table, suggesting a role of bond ownership structure in determination of CDS demand.

INSERT TABLE 13 HERE

## *7.4* Difference-in-Difference (DID)

We further establish the connection between breadth and existence of a CDS by performing DID analysis on the subsample of companies in S&P 500 in the first quarter of 2008. First quarter of 2008 saw a peak in the CDS coverage with 413 S&P 500 companies being covered (see Figure 1). The minimum coverage in our sample is observed in the second quarter of 2017. We thus study the companies in these two quarters (Q1, 2008 and Q2, 2017) to manifest the connection between breadth and existence of a CDS. Table

14 reports the results of DID regressions and the marginal effects. The dependent variable (breadth) is a continuous variable defined as the number of institutional investors holding the bonds of a company. Time is a dummy variable indicating the time when the treatment started. We assume that the treatment started post 2008 and code the time dummy as 1 for observations in 2017. Treatment is our dummy variable to identify the group exposed to the treatment. We split our subsample into three groups. The control group takes a value of 0 and includes companies take were a part of S&P 500 and had a CDS contract in both the quarter. Group 1 is the treated group, companies which had a CDS in the first quarter of 2008 and lost CDS by second quarter of 2017. Group 2 includes companies not having a CDS in 2008 and continued without a CDS by the second quarter of 2017. Panel A presents the results of DID and Panel B reports the marginal effects. In columns (1) - (3) DID is performed with groups 0 and 1. We perform a triple DID to include group 2 and the results are presented in columns (4) - (5). Columns (1) and (4) report the unconditional results with firm controls added in regression results presented in columns (2) , (3) and (4). Assets are defined as the total assets per quarter. Debt is the sum of long-term debt and debt in current liabilities calculated every quarter.

INSERT TABLE 14 HERE

We find that time loads positively and is significant for all the regressions in Panel A, suggesting a cross-sectional increase in breadth from 2008 to 2017. The connection between having a CDS and breadth is found to be statistically significant for all the group with an unconditional average breadth of 133.70.

To understand the average pre (2008) and post (2017) difference in each group we calculate the marginal effect, results are represented in Panel B. We see that there is a significant impact in each group with breadth increasing over time. The increase is, however, lower for group 1 suggesting a reduction in breadth as the company looses its CDS. While we are able to establish a strong connection between the existence of CDS and the breadth of bond ownership, this is yet not enough to fully support the causality. In order to conclusively establish the causality we need to observe the pattern of breadth prior to and after loosing a CDS. We have been unable to do the causality analysis because of unavailability of data and plan to do it in the next draft of this paper.

Finally, in unreported tests, we run all our regressions with different levels of fixed effects and standard errors. Results are robust and qualitatively unchanged.

# 8 Conclusion

This paper investigates the disparity in CDS coverage. We provide a novel evidence that the demand for CDS is governed by the bond ownership structure of the reference entity. Our analysis, based on partially hand-collected data of CDS on S&P 500 companies and their bond ownership structure obtained from Lipper eMAXX, suggests that the financial risk borne by the investors regulates the demand for CDS contracts. We propose a causal relation between bond ownership structure and need for a CDS. In particular the *breadth* and the *institutional depth* increases or decreases the likelihood of having CDS. The reason for the disparity in CDS coverage is identified and two opposing hypotheses (*limited diversification* and *governance influence*) are formulated to explain this puzzling heterogeneity. Our empirical results support the governance influence hypothesis and we find statistically significant results suggesting that a high breadth and a low depth initiates the need for a CDS. Highly concentrated bond ownership reduces the need for a CDS by providing the investors with the ability to exercise control over the company. A fragmented and diversified ownership leads to problems of coordination with the management, causing difficulty in exercising control and thereby stimulating the need for protection or a CDS.

The preliminary results could be strongly affected by the quality of governance and the liquidity of the underlying assets. To address these concerns we control for corporate governance and bond liquidity individually in our regressions and find the demand for CDS to be higher for firms with poor governance. It is also interesting to note that a liquid bond market is needed for the existence of a CDS market with the bond liquidity negatively impacting the demand for a CDS as expected.

Following our results we run a regression discontinuity design (RDD) to identify a breakpoint in the likelihood of the demand for a CDS and find the discontinuity to be at a breadth of 60. This suggests that as the number of institutional investors increases beyond 60, the ownership gets small, collective coordination with the company's management becomes difficult raising the coordination cost and increasing the demand for a CDS. Consistent with our previous results, the companies with good and poor governance exhibit different breakpoints at 40 for poor and 90 for firm with good governance, respectively. The economic interpretation of such breakpoints is that of threshold equilibrium cutoffs, similar in spirit to the results in Laurens and Senthil (2014).

Overall, our novel evidence shed light on the functioning of CDS markets and has important normative implications for the design of financial markets regulation.

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# 9 Figures

## **Figure 1:** CDS Coverage

This plot provides the quarterly count of companies with and without CDS over a period of 18 years beginning 2001. Panel A reports statistics for companies in the U.S. market. The blue line indicates the total count of companies in U.S. market and red represents the count of U.S. companies having a CDS. Panel B plots the count of companies in S&P 500 having a CDS.

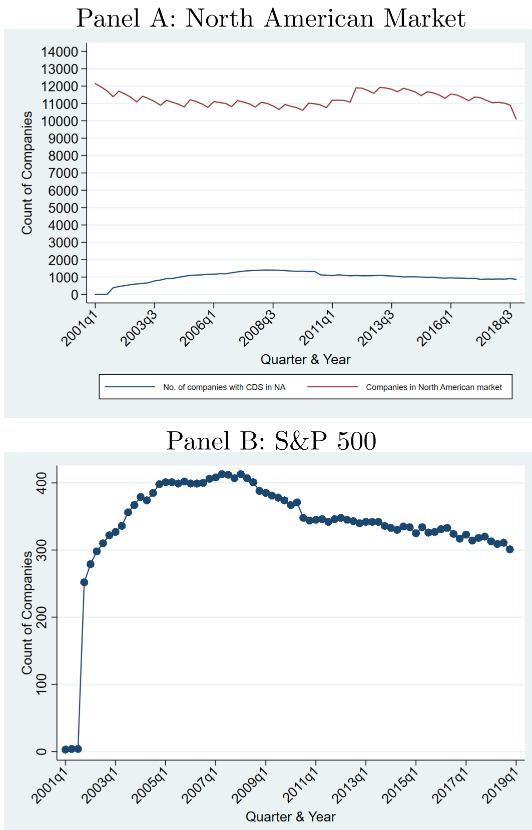


**Figure 2:** Region of trade of a CDS contract

The figure depicts the region within which trade of a CDS occurs in market. Transaction region is the set of CDS prices which are higher that the seller's reservation price ($\underline{P_S}$) and lower than buyer's reservation price ($\overline{P_B}$).

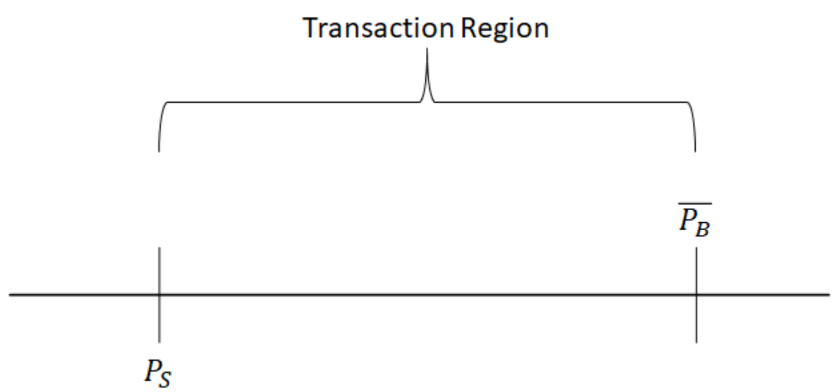


**Figure 3:** Requirement pattern of CDS

This is a 2X2 matrix formed by the intersection of the two bond ownership attributes - breadth & depth. The 'HH' quadrant represents the companies with high breadth and high depth. Second quadrant (LH) consists of companies with less number of bond holders and each holding high concentration of bond outstanding. Similarly 'LL' has companies with low breadth and low depth and 'HL' comprises of companies with large number of bonds owners and low concentration of ownership.

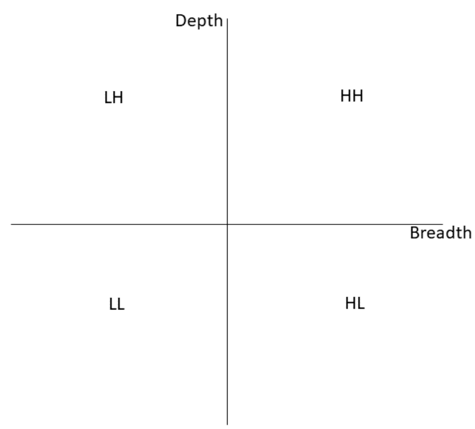


**Figure 4:** S&P 500 Companies with long term liabilities and no CDS

In this figure the bars show the number of S&P 500 companies without CDS plotted quarterly between 2001-2018. The line corresponds to the count of S&P 500 companies that have debt but do not have CDS contract on them. For example, for the first quarter of 2001, 496 companies did not have CDS and 490 of the S&P 500 had long term debt outstanding.

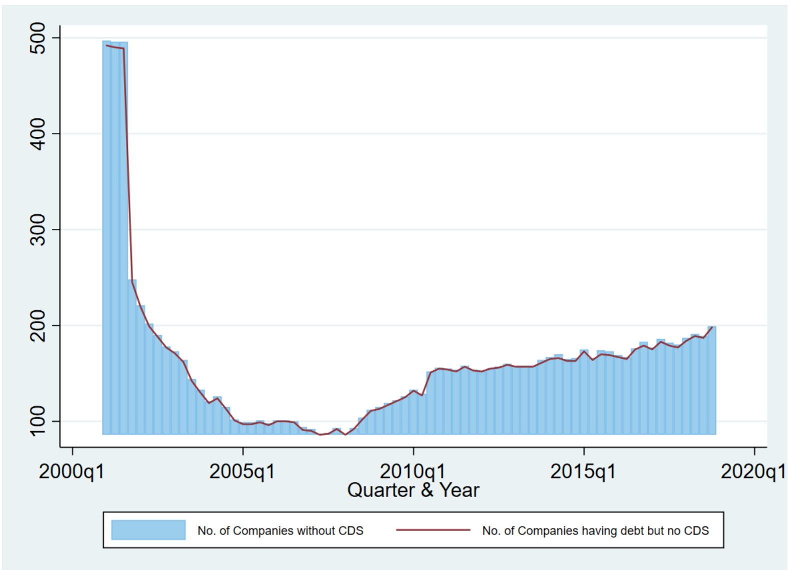


**Figure 5:** Comparison of Debt and CDS market

In this plot we represent the disparity in debt and CDS market. The bars show the long term liabilities in billion dollars combined for all S&P 500 companies not covered by a CDS each quarter. The line corresponds to the percentage of the total long term liabilities not covered by CDS. For example, for the last quarter of 2018 about 14% of the total long term liabilities are not covered by a CDS. This 14% corresponds to around 800 billion USD as denoted by the blue bar. The long term liabilities are represented in billion USD.

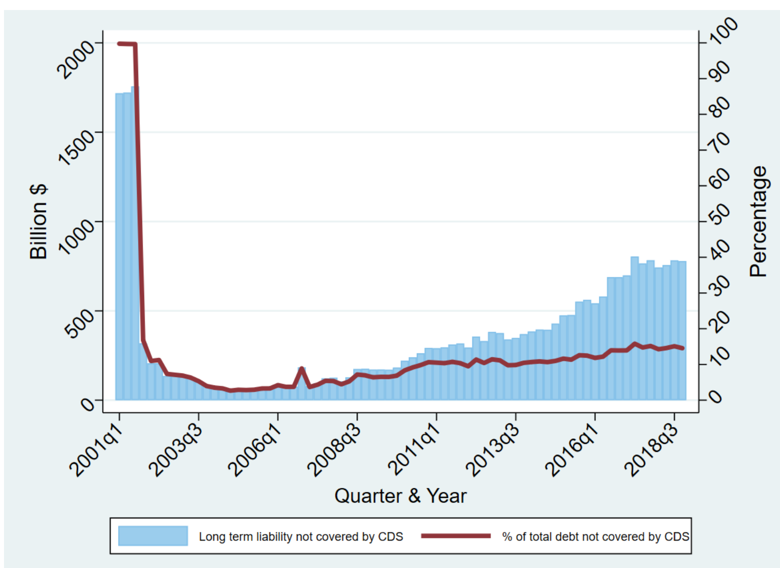


**Figure 6:** Distribution of companies in terms of their CDS coverage

In this figure the number on each wedge shows the count of companies not having a CDS, segregated based on the percentage of times a company did not have a CDS during the 18 years. For eg. the brown wedge shows that 264 of the 891 unique companies never had CDS in those 18 years. In the same way the slice with 'Always' shows that 94 companies always had CDS. The data set has 891 unique S&P 500 companies in the sample period.

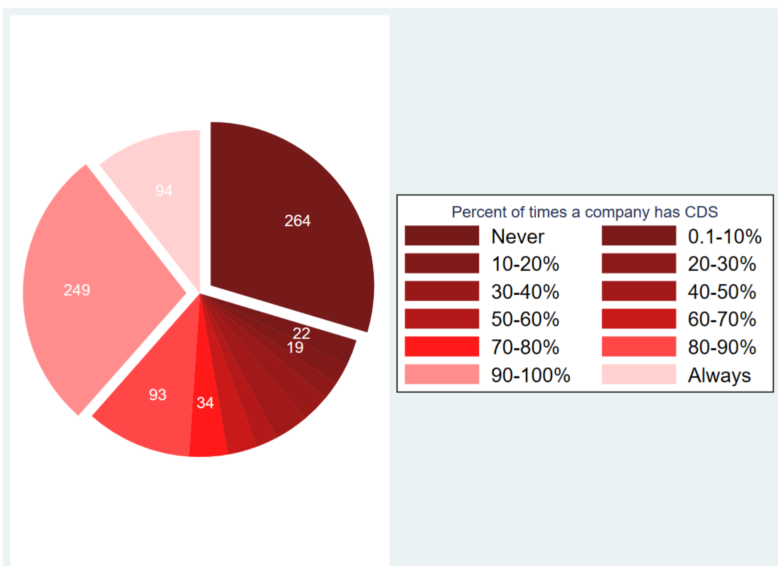
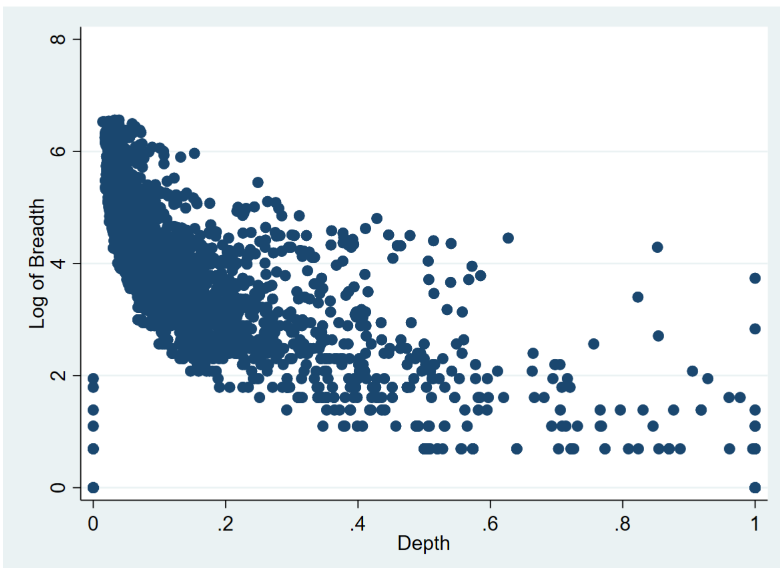


**Figure 7:** Distribution of companies by bond ownership structure

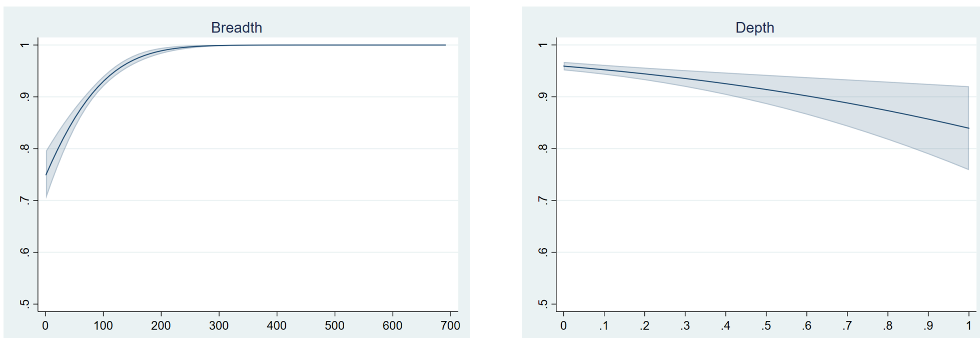
This is a scatter plot of companies by bond ownership structure. The 'X' axis reports the depth of a company's bond ownership and the natural log of the breadth is recorded by the 'Y' axis.



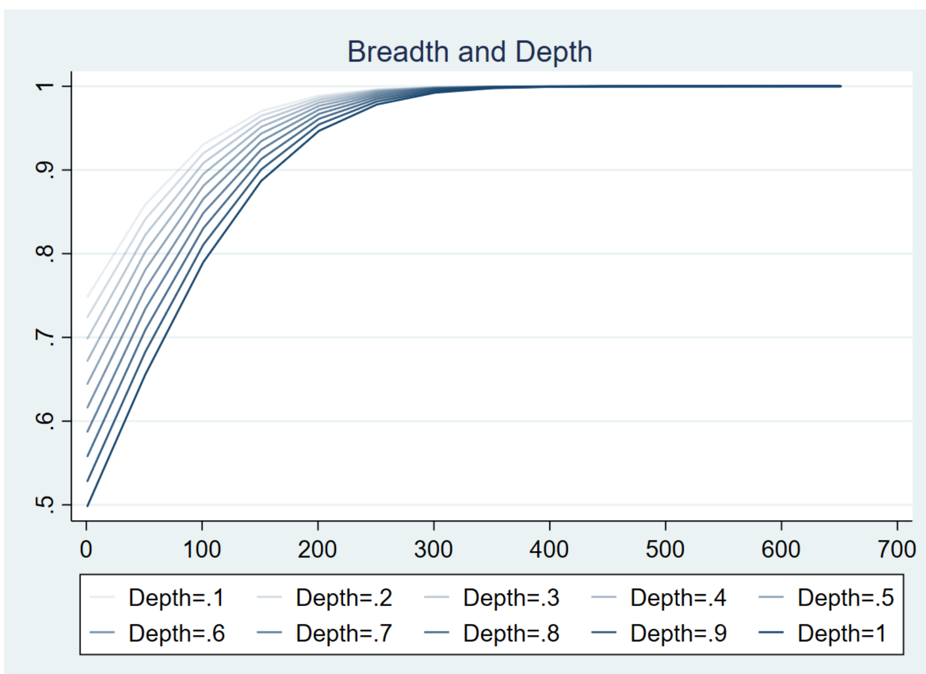
## **Figure 8:** Marginal effects and predicted probabilities

These figures represent predicted probabilities for changes in the two explanatory variables in our model (equation (2)). Panel A provides the change in probability of having a CDS for changes in breadth and depth keeping one of the variable constant at all times. The shaded area provides the confidence interval. Panel B presents the marginal effects for interaction of breadth and depth.

PANEL A



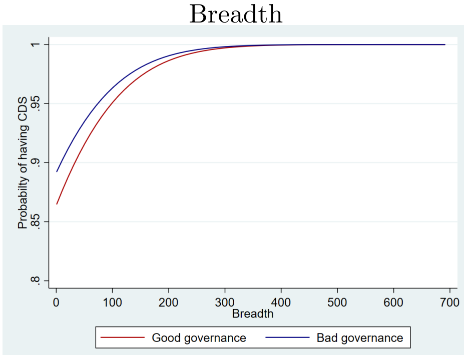

PANEL B



## **Figure 9:** Marginal Effect for subsamples of companies with good and bad governance

These figures represent predicted probabilities for changes in the two explanatory variables in our model for the subsamples of companies with good and bad/poor governance.

Breadth




Depth

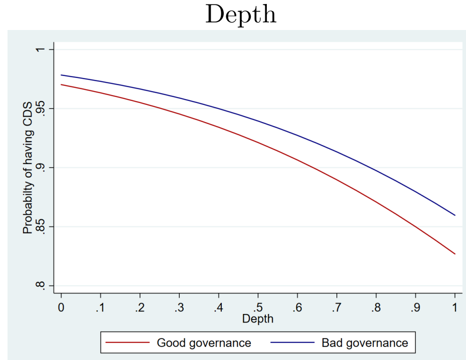
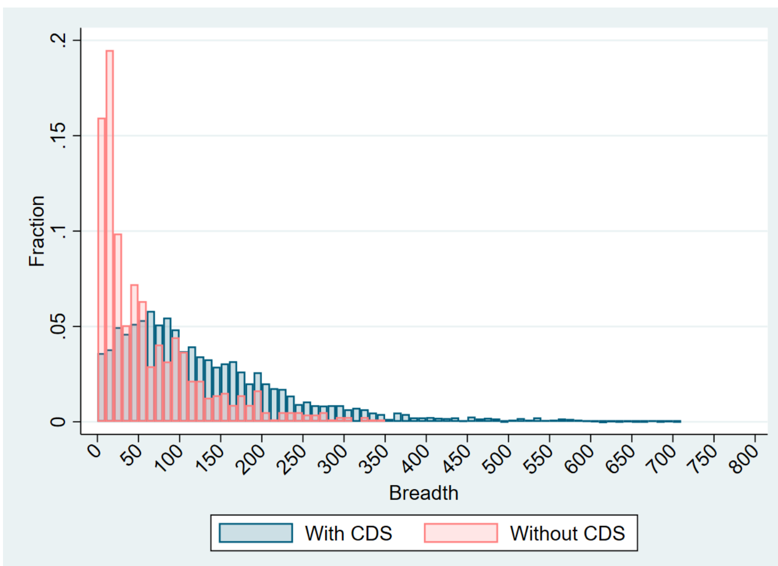


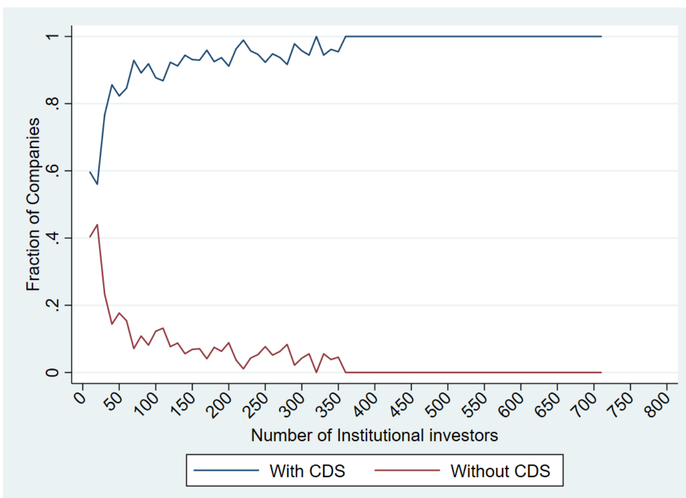
**Figure 10:** Histogram of Companies with and without CDS on breadth

This figure plots the histogram showing the fraction of companies with/without CDS by bins of breadth. Each bin has a width of 10. For example, the first bin represents the fraction of companies having 1-10 institutional investors. About 0.16% of the total companies without a CDS have less than 11 investors, and 0.04% of companies having a CDS lie in the first bin. We observe a flip in this fraction at a breadth of 60.



## **Figure 11:** Histogram of Companies with and without CDS on breadth

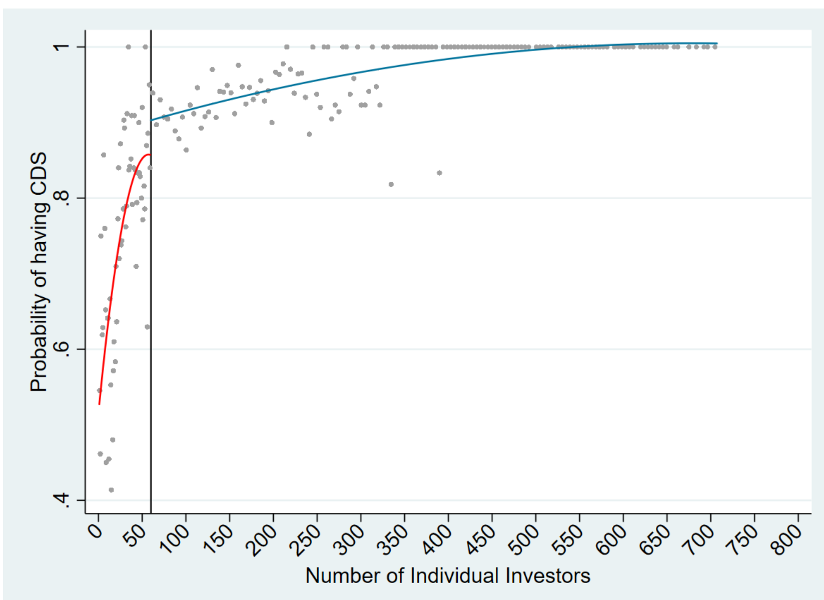
The plot shows the fraction of companies with/without CDS over the total companies by bins (10 investors per bin) of breadth. The blue line shows the line plot for companies having a CDS and red is for the ones not having a CDS.



## **Figure 12:** Regression discontinuity design (RDD) plot at breadth of 60

This is the RDD plot at a breadth of 60 for the full sample. The solid line represents the global polynomial fit of CDS on breadth, dots represent the local sample means of CDS at intervals of breadth. The red line fits the polynomial for sample below the breakpoint of 60. The blue line shows the quadratic fit for the subsample above the breadth of 60.

PANEL A

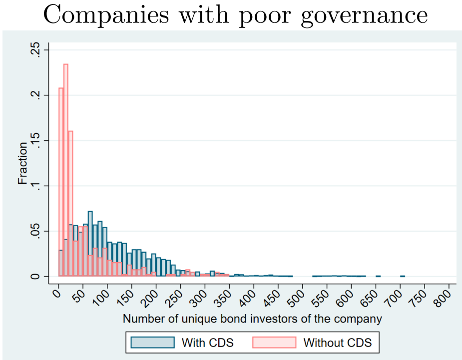


# **Figure 13:** Border discontinuity for governance subsamples

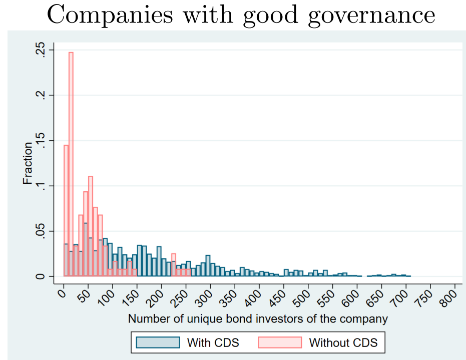
This figure plots the discontinuities for subsample of companies with poor and good governance. Panel A plot the histogram showing the fraction of companies with/without CDS by bins of breadth. Panel B plots the regression discontinuity design plot.

PANEL A: HISTOGRAM

Companies with poor governance

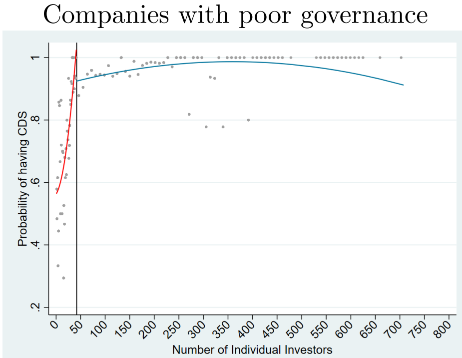



Companies with good governance

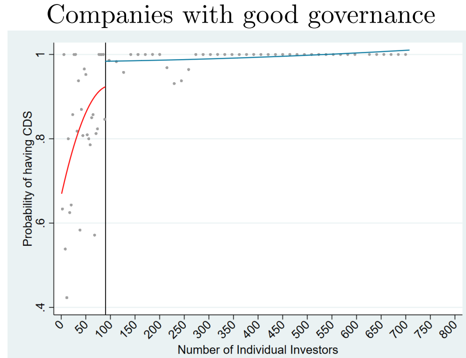



PANEL B: RDD

Companies with poor governance




Companies with good governance



# 10 Tables

## Table 1: Credit Default Swaps, by type of position

This data table from BIS,2018 shows dis-aggregation of CDS users by entity types and contract positions.

| OTC, Credit Default Swaps, by type of position | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| In billions of US dollars | **Total** | **Reporting dealers** | **Other financial institutions** | | | | | | | **Non Financial Institutions** |
| | | | Total | CCPs | Banks and securities firms | Insurance and financial guarantee firms | SPVs,SPCs and SPEs | Hedge funds | Other | |
| | H2 18 | H2 18 | H2 18 | H2 18 | H2 18 | H2 18 | H2 18 | H2 18 | H2 18 | H2 18 |
| **Total CDS Contracts** | | | | | | | | | | |
| Notional amounts outstanding | 8,143 | 1,809 | 6,063 | 4,445 | 402 | 127 | 48 | 383 | 659 | 270 |
| Bought(gross basis) | 5,101 | 1,821 | 3,133 | 2,183 | 238 | 72 | 37 | 206 | 396 | 148 |
| Sold(gross basis) | 4,851 | 1,798 | 2,930 | 2,262 | 164 | 55 | 11 | 177 | 263 | 122 |

**Table 2**

Impact of being in S&P 500 on having a CDS

The table presents results for a set of probit regressions performed on a PSM matched panel data of companies listed in the U.S. market for a period of 18 years or 72 quarters. The dependent variable is the binary variable (CDS) taking a value of 1 if the company has a CDS contract on its bond in that quarter. The primary predictor variable is SP = 1/0 for company being a S&P 500 company or not. In Columns (1)-(3) the independent variables have been lagged by 1 year. Column (1) presents result of unconditional regressions. Columns (2)-(3) control for firm size. In Column (4)-(6) we reestimate the specification of columns (1)-(3) with independent variables being lagged by 2 years. All the regressions have time fixed effects. Assets are defined as natural log of total assets. Long term debt is defined as the natural log of total long term debt. Natural log of change in total long term debt per year is termed as the change in leverage. Market value is the natural log of market value of the firm per quarter. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | CDS | CDS | CDS | CDS | CDS | CDS |
| SP | 1.266*** | 1.490*** | 0.846*** | 1.239*** | 1.446*** | 0.776*** |
| | (0.011) | (0.012) | (0.020) | (0.011) | (0.012) | (0.021) |
| Assets | | -0.004 | 0.081*** | | 0.004 | 0.063*** |
| | | (0.008) | (0.012) | | (0.007) | (0.012) |
| Long term debt | | 0.309*** | 0.314*** | | 0.279*** | 0.297*** |
| | | (0.007) | (0.009) | | (0.007) | (0.009) |
| Change in leverage | | | -0.000*** | | | -0.000*** |
| | | | (0.000) | | | (0.000) |
| Market value | | | 0.224*** | | | 0.255*** |
| | | | (0.010) | | | (0.010) |
| Constant | -1.008*** | -3.274*** | -4.927*** | -0.749*** | -2.834*** | -4.935*** |
| | (0.023) | (0.051) | (0.188) | (0.023) | (0.051) | (0.192) |
| Observations | 63,990 | 61,176 | 34,337 | 60,182 | 57,478 | 31,410 |
| Time FE | YES | YES | YES | YES | YES | YES |
| Wald $chi^2$ | 14376 | 18232 | 8764 | 12913 | 16454 | 8009 |
| Prob $>chi^2$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.17 | 0.28 | 0.30 | 0.16 | 0.26 | 0.29 |

**Table 3**
Sample descriptive statistics

This table presents summary statistics for percentage of S&P 500 companies not covered by a CDS each year during the sample period between 2001-2018. For example in 2009, 25.20% of the S&P 500 companies did not have a CDS contract on their debt.

| Year | Percentage | Year | Percentage |
|---|---|---|---|
| 2001 | 49.60 | 2010 | 31.20 |
| 2002 | 35.60 | 2011 | 30.80 |
| 2003 | 26.60 | 2012 | 32.00 |
| 2004 | 20.40 | 2013 | 32.80 |
| 2005 | 19.60 | 2014 | 33.20 |
| 2006 | 19.80 | 2015 | 34.60 |
| 2007 | 18.60 | 2016 | 36.60 |
| 2008 | 22.40 | 2017 | 36.00 |
| 2009 | 25.20 | 2018 | 39.80 |
| | | **Total** | 30.20 |

**Table 4**
Summary statistics of bond ownership by CDS

The table presents the summary statistics of breadth and depth for companies with and without CDS. Breadth is defined as the number of institutional owners. Depth is defined as the concentration of ownership. The table also provides the results for the t-test on equality of means conducted across group of companies with and without CDS.

| | Without CDS | With CDS | Difference | p-Value |
|---|---|---|---|---|
| **Breadth** | | | | |
| Mean | 61.52 | 134.08 | 72.56*** | 0.00 |
| Median | 39.00 | 103.00 | | |
| Standard Deviation | 65.43 | 113.77 | | |
| **Depth** | | | | |
| Mean | 0.18 | 0.09 | 0.09*** | 0.00 |
| Median | 0.09 | 0.05 | | |
| Standard Deviation | 0.23 | 0.13 | | |

## Table 5

Summary statistics of firms

This table reports the summary statistics of firm characteristics for the companies (bond issuing fimrs) and institutional investors (bond holding firms) in our sample during the period between 2006-2008 and the first two quarters of 2017. Assets are defined total assets per quarter. Debt is defined as the sum of long term debt and debt in current liabilities for each quarter. Intangibles include the total intangible assets of a firm per quarter. Tobin Q is calculated as the market value of equity plus book value of short and long term debt by total assets. Market value, net income and total revenue are obtained from 'Compustat-Capital IQ' on a quarterly basis. The values are presented in million USD.

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| **Bond Issuing Firms** | | | | | |
| Assets | 6,694 | 56380.640 | 186522.600 | 757.369 | 2563174 |
| Debt | 6,292 | 17750.250 | 77773.870 | 0 | 916322 |
| Intangibles | 6,607 | 5624.498 | 13858.660 | 0 | 221871 |
| Market Value | 6,616 | 27635.940 | 48994.590 | 488.724 | 747867.4 |
| Net Income | 6,695 | 326.113 | 1507.826 | -61659 | 14830 |
| Total Revenue | 6,360 | 4683.277 | 8963.197 | -25623 | 130936 |
| Tobin Q | 6,214 | 1.642 | 1.240 | 0.0430 | 16.096 |
| Total Q | 6,072 | 1.391 | 5.444 | -47.041 | 106.447 |
| **Bond Holding Firms** | | | | | |
| Bond outstanding per investor | 5,948 | 12.259 | | | |

## Table 6

Distribution of firms by industry

This table presents the distribution of firms in our sample during the period between 2006-2008 and the first two quarters of 2017 by industry. We use 2 digit Standard Industrial Classification (SIC) code to define the industry of the 688 unique firm during our sample period.

| Industry | Frequency | Percent (%) |
|---|---|---|
| Agriculture, Forestry and Fishing | 1 | 0.15 |
| Construction | 7 | 1.02 |
| Finance, Insurance & Real Estate | 130 | 18.9 |
| Manufacturing | 279 | 40.55 |
| Mining | 37 | 5.38 |
| Non-classifiable items | 3 | 0.44 |
| Retail Trade | 50 | 7.27 |
| Services | 82 | 11.92 |
| Transportation & Public Utilities | 85 | 12.35 |
| Wholesale Trade | 14 | 2.03 |
| **Total** | 688 | 100 |

**Table 7**

Impact of bond ownership on CDS coverage

This table presents results for set of panel data probit regressions on our sample of S&P 500 companies for a period between 2006-2008 and the first two quarters of 2017. The dependent variable is the binary variable (CDS) taking a value of 1 if the company has a CDS contract on its bonds in that quarter. Indicators of bond ownership structure i.e. the breadth (number of institutional investors holding the bonds) and institutional depth (concentration of ownership) are the predictor variables. Two quarter moving average is taken for independent variables of breadth and depth. For a moving average of t and t-1 of the independent variables, CDS value of t+2 is considered. t here is time period quarter. Column (1) presents unconditional regression. Columns (2) includes the controls for firm size: total assets and debt. We add an interaction term of breadth and depth in column (3). In columns (4)-(6) we test the impact of bond ownership on probability of having a CDS by varying the firm level controls of assets, debt, Tobin Q and Peters and Taylor's total Q. Assets are defined as natural log of total assets per quarter. Debt is defined as the natural log of the sum of long term debt and debt in current liabilities for each quarter. Tobin Q is calculated as market value of equity plus book value of short and long term debt by total assets. Total Q is the 'Peters and Taylor's Q obtained from WRDS. All our regressions control for time fixed effects. Column (4) also includes industry fixed effects. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

| | (1)<br>CDS | (2)<br>CDS | (3)<br>CDS | (4)<br>CDS | (5)<br>CDS | (6)<br>CDS |
|---|---|---|---|---|---|---|
| Breadth | 0.010*** | 0.008*** | 0.006*** | 0.006*** | 0.007*** | 0.006*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Depth | -0.654*** | -0.729*** | -0.838*** | -0.846*** | -0.787*** | -0.785*** |
| | (0.156) | (0.167) | (0.170) | (0.192) | (0.171) | (0.186) |
| Breadth*Depth | | | 0.067*** | 0.065*** | 0.068*** | 0.048*** |
| | | | (0.015) | (0.016) | (0.015) | (0.014) |
| Assets | | 0.200*** | 0.201*** | 0.492*** | 0.141*** | 0.367*** |
| | | (0.039) | (0.040) | (0.055) | (0.040) | (0.050) |
| Debt | | -0.036 | -0.053 | -0.005 | -0.047 | -0.030 |
| | | (0.035) | (0.036) | (0.045) | (0.036) | (0.042) |
| Tobin Q | | | | | -0.088*** | |
| | | | | | (0.021) | |
| Total Q | | | | | | -0.013*** |
| | | | | | | (0.004) |
| Constant | 0.729*** | -0.719** | -0.782*** | -2.558*** | -0.143 | -2.222*** |
| | (0.105) | (0.280) | (0.280) | (0.513) | (0.308) | (0.375) |
| Observations | 5,740 | 5,213 | 5,213 | 4,595 | 5,164 | 4,690 |
| Time FE | YES | YES | YES | YES | YES | YES |
| Industry FE | NO | NO | NO | YES | NO | NO |
| Wald $chi^2$ | 649.40 | 592.60 | 629.20 | 682.80 | 645.10 | 478.10 |
| Prob $>chi^2$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.24 | 0.24 | 0.25 | 0.38 | 0.25 | 0.26 |

**Table 8**

Auxiliary evidence: interaction with corporate governance

This table presents the results for set of panel data probit regressions on our sample of S&P 500 companies. The dependent variable is the binary variable (CDS) taking a value of 1 if the company has a CDS contract on its bonds in that quarter. Indicators of bond ownership structure i.e. the breadth (number of institutional investors holding the bonds) and institutional depth (concentration of ownership) are the predictor variables. Two quarter moving average is taken for independent variables of breadth and depth. For a moving average of t and t-1 of the independent variables, CDS value of t+2 is considered. t here is time period quarter. We augment all our regressions with an extra control for corporate governance. We use E-index as a proxy for governance. Columns (1) - (3) use the continuous measure of the index as a control. In columns (4) - (6) we define 'BCF' as a binary measure for governance. We code the BCF variable to be 1 for companies with poor governance and 0 for companies with good governance. Assets are defined as natural log of total assets per quarter. Debt is defined as the natural log of the sum of long term debt and debt in current liabilities for each quarter. We include time fixed effects in all our regressions and column (5) also includes industry fixed effects. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

| | (1)<br>CDS | (2)<br>CDS | (3)<br>CDS | (4)<br>CDS | (5)<br>CDS | (6)<br>CDS |
|---|---|---|---|---|---|---|
| Breadth | 0.016*** | 0.012*** | 0.010*** | 0.006*** | 0.003** | 0.006*** |
| | (0.002) | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) |
| Depth | -0.006 | -0.109 | -0.219 | -0.943*** | -1.038*** | -1.227*** |
| | (0.230) | (0.239) | (0.237) | (0.224) | (0.269) | (0.344) |
| Breadth *Depth | | | 0.092*** | 0.122*** | 0.105*** | 0.119*** |
| | | | (0.024) | (0.022) | (0.025) | (0.022) |
| Assets | | 0.330*** | 0.334*** | 0.264*** | 0.802*** | 0.265*** |
| | | (0.054) | (0.056) | (0.051) | (0.087) | (0.051) |
| Debt | | -0.087* | -0.110** | -0.060 | -0.023 | -0.061 |
| | | (0.045) | (0.047) | (0.044) | (0.058) | (0.044) |
| E Index | 0.112*** | 0.119*** | 0.128*** | | | |
| | (0.024) | (0.027) | (0.027) | | | |
| 1.BCF | | | | 0.137* | 0.273*** | |
| | | | | (0.074) | (0.094) | |
| Breadth * BCF | | | | | | -0.000 |
| | | | | | | (0.001) |
| Depth * BCF | | | | | | 0.337 |
| | | | | | | (0.332) |
| Constant | -0.105 | -2.259*** | -2.387*** | -1.501*** | -6.308*** | -1.383*** |
| | (0.160) | (0.438) | (0.441) | (0.377) | (0.653) | (0.360) |
| Observations | 4,116 | 3,792 | 3,792 | 4,503 | 3,629 | 4,503 |
| Time FE | YES | YES | YES | YES | YES | YES |
| Industry FE | NO | NO | NO | NO | YES | NO |
| Wald $chi^2$ | 208.90 | 193.40 | 246.50 | 379.80 | 479.20 | 400.40 |
| Prob $>chi^2$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.24 | 0.26 | 0.27 | 0.24 | 0.41 | 0.24 |

**Table 9**

Auxiliary evidence: interaction with bond liquidity

This table presents the results for set of panel data probit regressions on our sample of S&P 500 companies for a period between 2006-2008 and the first two quarters of 2017. The dependent variable is the binary variable (CDS) taking a value of 1 if the company has a CDS contract on its bonds in that quarter. Indicators of bond ownership structure i.e. the breadth (number of institutional investors holding the bonds) and institutional depth (concentration of ownership) are the predictor variables. Two quarter moving average is taken for independent variables of breadth and depth. For a moving average of t and t-1 of the independent variables, CDS value of t+2 is considered. t here is time period quarter. We augment all our regressions with an extra control of bond liquidity. Columns (1) - (4) add bond liquidity as control in the regression equations. In columns (3)-(4) we present results where along with controlling for bond liquidity we interact it with our primary predictors of breadth and depth. Assets are defined as natural log of total assets per quarter. Debt is defined as the natural log of the sum of long term debt and debt in current liabilities for each quarter. All regressions are controlled for time fixed effects. Column (4) also includes industry fixed effects. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

| | (1)<br>CDS | (2)<br>CDS | (3)<br>CDS | (4)<br>CDS |
|---|---|---|---|---|
| Breadth | 0.004*** | 0.003*** | 0.004*** | 0.003* |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Depth | 0.225 | -0.444 | -0.333 | -0.751 |
| | (0.732) | (0.725) | (0.743) | (0.748) |
| Breadth *Depth | | 0.049** | 0.346*** | 0.272** |
| | | (0.024) | (0.092) | (0.117) |
| Assets | 0.013 | 0.017 | 0.015 | 0.284*** |
| | (0.063) | (0.065) | (0.064) | (0.096) |
| Debt | 0.269*** | 0.263*** | 0.253*** | 0.363*** |
| | (0.075) | (0.076) | (0.075) | (0.100) |
| Bond Liquidity | 0.331* | 0.313 | 1.725*** | 1.363*** |
| | (0.200) | (0.202) | (0.414) | (0.500) |
| Breadth*Depth*Bond liquidity | | | -0.349*** | -0.274** |
| | | | (0.094) | (0.119) |
| Constant | -1.137** | -1.205** | -2.364*** | -4.524*** |
| | (0.543) | (0.547) | (0.665) | (0.935) |
| Observations | 2,531 | 2,531 | 2,531 | 2,115 |
| Time FE | YES | YES | YES | YES |
| Industry FE | NO | NO | NO | YES |
| Wald $chi^2$ | 324 | 337.4 | 324.9 | 315.8 |
| Prob $>chi^2$ | 0.00 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.30 | 0.30 | 0.31 | 0.43 |

**Table 10**

Comparison of groups above and below border discontinuity

This table compares traits of companies above and below border discontinuity. The border sample comprises of about 300 companies having a breadth between 55 to 65. The company characteristics are tested for equality of means using a two-tailed t test.

| | **Above Border Observations** | **Below Border Observations** | **Two-tailed t-test for equality of means** |
|---|---|---|---|
| **Basic Characterisitcs** | | | |
| Ln (Total Assets) | 9.22 | 9.21 | 0.94 |
| Ln (Total Debt) | 7.64 | 7.59 | 0.68 |
| Tobin Q | 1.38 | 1.51 | 0.16 |
| Market Value | 9.09 | 9.14 | 0.62 |
| | | | |
| Depth | 0.08 | 0.08 | 0.35 |
| CDS | 0.85 | 0.95 | 0.00 |
| Observations | 157 | 142 | |

**Table 11**

Robustness: size and tangibility

The table represents probit regression results for subsamples created on the basis of asset size of the firm. The full sample is divided based on total assets and intangible assets respectively. Two quarter moving average is taken for independent variables of breadth and depth. For a moving average of t and t-1 of the independent variables, CDS value of t+2 is considered. t here is time period quarter. Panel A presents results for quartile division on total assets. Columns (1) - (3) presents result for the first quartile and columns (3) - (6) regress on the fourth quartile (top 25% of the companies in terms of assets). In Panel B we perform the regressions on the full sample and augment them with a control of intangible assets. The dummy variable 'High Intangibles' takes a value of 1 for firms having above median values of total assets and 0 otherwise. Column (1) presents unconditional results. Columns (2) - (4) uses firm controls. Assets are defined as the natural log of total assets. Debt is the natural log of sum of long-term debt and debt in current liabilities. The panel results are controlled for time fixed effects. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

PANEL A: SUBSAMPLE DIVISION ON ASSET SIZE

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | CDS | CDS | CDS | CDS | CDS | CDS |
| Breadth | 0.018*** | 0.014*** | 0.010*** | 0.006*** | 0.004*** | 0.002 |
| | (0.002) | (0.002) | (0.003) | (0.001) | (0.001) | (0.002) |
| Depth | -0.169 | -0.233 | -0.629** | -0.461 | -0.946* | -2.462*** |
| | (0.247) | (0.257) | (0.302) | (0.447) | (0.509) | (0.678) |
| Breadth *Depth | | 0.085*** | 0.128*** | | 0.111*** | 0.100** |
| | | (0.028) | (0.035) | | (0.033) | (0.040) |
| Assets | | 0.748*** | 1.152*** | | 0.121 | 0.889*** |
| | | (0.126) | (0.185) | | (0.087) | (0.185) |
| Debt | | -0.164** | -0.290*** | | -0.011 | 0.103 |
| | | (0.074) | (0.106) | | (0.060) | (0.121) |
| Constant | 0.127 | -4.972*** | -7.063*** | 0.692*** | -0.716 | -7.832*** |
| | (0.169) | (0.993) | (1.352) | (0.253) | (0.996) | (1.864) |
| Observations | 1,185 | 1,157 | 912 | 1,429 | 1,335 | 1,124 |
| Time FE | YES | YES | YES | YES | YES | YES |
| Industry FE | NO | NO | YES | NO | NO | YES |
| Wald $chi^2$ | 187.10 | 223.80 | 305.70 | 156.60 | 158.30 | 131.40 |
| Prob $>chi^2$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.16 | 0.20 | 0.32 | 0.24 | 0.26 | 0.49 |

| PANEL B: INTERACTION WITH INTANGIBLE ASSETS | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | CDS | CDS | CDS | CDS |
| Breadth | 0.009*** | 0.008*** | 0.006*** | 0.006*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Depth | -0.654*** | -0.701*** | -0.810*** | -0.803*** |
| | (0.154) | (0.167) | (0.170) | (0.194) |
| Breadth *Depth | | | 0.063*** | 0.062*** |
| | | | (0.014) | (0.016) |
| Assets | | 0.159*** | 0.164*** | 0.433*** |
| | | (0.039) | (0.040) | (0.057) |
| Debt | | -0.026 | -0.043 | -0.009 |
| | | (0.035) | (0.035) | (0.045) |
| 1.High Intangibles | 0.340*** | 0.256*** | 0.242*** | 0.236*** |
| | (0.050) | (0.054) | (0.054) | (0.076) |
| Constant | 0.646*** | -0.511* | -0.581** | -2.102*** |
| | (0.107) | (0.277) | (0.277) | (0.541) |
| Observations | 5,740 | 5,213 | 5,213 | 4,595 |
| Time FE | YES | YES | YES | YES |
| Industry FE | NO | NO | NO | YES |
| Wald $chi^2$ | 625.50 | 578.80 | 612.40 | 690.80 |
| Prob $>chi^2$ | 0.00 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.25 | 0.25 | 0.25 | 0.39 |

**Table 12**

Robustness: credit quality

The table represents probit regression results for full sample consisting of years 2006-2008 and first two quarters of 2017. Two quarter moving average is taken for independent variables of breadth and depth as well as for dependent variable (CDS). For a moving average of t and t-1 of the independent variables, CDS value of t+2 is considered. t here is time period quarter. W control for credit rating of the firms in regressions presented in columns (1) - (3). Columns (4) - (6) include the interaction term of breadth and depth with the investment grade along with other firm controls. We define the companys with credit ratings of AAA, AA, A, BBB as Investment Grade and BB, B as Speculative Grade. Assets are defined as the natural log of total assets. Debt is the natural log of sum of long-term debt and debt in current liabilities. All regressions control for time fixed effects. Columns (3) & (6) also control for the industry fixed effects. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | CDS | CDS | CDS | CDS | CDS | CDS |
| Breadth | 0.007*** | 0.006*** | 0.005*** | 0.007*** | 0.007*** | 0.006*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Depth | -0.621*** | -0.792*** | -1.037*** | -0.544* | -0.026 | -0.123 |
| | (0.188) | (0.209) | (0.247) | (0.280) | (0.311) | (0.356) |
| Breadth *Depth | | 0.045*** | 0.049*** | 0.051*** | 0.045*** | 0.050*** |
| | | (0.014) | (0.017) | (0.014) | (0.014) | (0.017) |
| Assets | | 0.153*** | 0.495*** | | 0.154*** | 0.492*** |
| | | (0.044) | (0.062) | | (0.045) | (0.062) |
| Debt | | -0.121*** | -0.053 | | -0.120*** | -0.052 |
| | | (0.040) | (0.051) | | (0.040) | (0.051) |
| Breadth * Grade | | | | -0.001 | -0.001 | -0.000 |
| | | | | (0.001) | (0.001) | (0.001) |
| Depth * Grade | | | | -0.152 | -0.979*** | -1.157*** |
| | | | | (0.293) | (0.325) | (0.359) |
| Constant | 1.100*** | 0.554* | -2.577*** | 0.838*** | 0.368 | -2.730*** |
| | (0.132) | (0.306) | (0.478) | (0.125) | (0.300) | (0.472) |
| Observations | 5,219 | 4,927 | 4,202 | 5,219 | 4,927 | 4,202 |
| Time FE | YES | YES | YES | YES | YES | YES |
| Industry FE | NO | NO | YES | NO | NO | YES |
| Credit Rating FE | NO | NO | NO | YES | YES | YES |
| Wald $chi^2$ | 497.00 | 477.40 | 500.70 | 522.90 | 480.50 | 504.50 |
| Prob $>chi^2$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.20 | 0.21 | 0.35 | 0.21 | 0.21 | 0.35 |

**Table 13**

Robustness: addition and removal from S&P 500

The table represents probit regression results for subsamples created on companies added to and deleted from the S&P 500 list during our sample period, presented in Panel A and B respectively. For each subsample we consider 5 observations per company, two before and two after the addition/deletion. For a moving average of t and t-1 of the independent variables, CDS value of t+2 is considered. t here is time period quarter. Assets are defined as the natural log of total assets. Debt is the natural log of sum of long-term debt and debt in current liabilities. Intangibles include the natural log of intangible assets of the firm per quarter. Tobin Q is calculated as market value of equity plus book value of short and long term debt by total assets. The panel results have controlled for time fixed effects. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

PANEL A: ANALYSIS WITH SUBSAMPLE ADDED TO S&P 500

| | CDS (1) | CDS (2) | CDS (3) | CDS (4) |
|---|---|---|---|---|
| Breadth | 0.019*** | 0.013** | 0.003 | 0.008 |
| | (0.005) | (0.006) | (0.006) | (0.006) |
| Depth | 0.557 | 1.014* | 0.420 | 1.085* |
| | (0.521) | (0.557) | (0.593) | (0.642) |
| Breadth *Depth | | | 0.252*** | |
| | | | (0.072) | |
| Breadth *SP | | | | 0.007 |
| | | | | (0.006) |
| Depth*SP | | | | -0.166 |
| | | | | (0.675) |
| Firm Control | YES | YES | YES | YES |
| Constant | -0.012 | -4.975*** | -4.224** | -5.016** |
| | (0.537) | (1.899) | (1.922) | (1.966) |
| Time FE | NO | YES | YES | YES |
| Wald $chi^2$ | 29.12 | 28.76 | 44.16 | 28.59 |
| Prob $>chi^2$ | 0.01 | 0.01 | 0.00 | 0.04 |
| Pseudo $R^2$ | 0.17 | 0.18 | 0.25 | 0.192 |

| PANEL B: ANALYSIS WITH SUBSAMPLE DELETED FROM S&P 500 | | | | |
|---|---|---|---|---|
| | CDS | CDS | CDS | CDS |
| | (1) | (2) | (3) | (4) |
| Breadth | 0.005** | 0.014** | -0.003 | 0.023** |
| | (0.002) | (0.007) | (0.005) | (0.011) |
| Depth | -0.413 | -0.372 | -3.187*** | -1.561 |
| | (0.529) | (0.660) | (1.054) | (0.972) |
| Breadth *Depth | | | 0.671*** | |
| | | | (0.203) | |
| Breadth *SP | | | | -0.009 |
| | | | | (0.011) |
| Depth*SP | | | | 1.575 |
| | | | | (0.975) |
| Firm Control | YES | YES | YES | YES |
| Constant | 0.280 | 1.376 | 0.909 | 1.381 |
| | (0.331) | (1.525) | (1.587) | (1.506) |
| | | | | |
| Time FE | NO | YES | YES | YES |
| Wald $chi^2$ | 16.85 | 21.88 | 46.54 | 26.57 |
| Prob $>chi^2$ | 0.11 | 0.057 | 0.00 | 0.03 |
| Pseudo $R^2$ | 0.08 | 0.22 | 0.41 | 0.23 |

**Table 14**

Robustness: difference-in-difference

The table in Panel A represents difference-in-difference (DID) results for subsamples created on companies in the first quarter of 2008 and the second quarter of 2017. Panel B presents the marginal effects by reporting the average pre to post (2008 to 2017) difference in each group. The dependent variable is 'Breadth' which is defined as the number of institutional investors holdings the bonds of a company. Treatment variable is a dummy that takes the value of 1 for companies which had a CDS in Q1, 2008 and lost there CDS by second quarter of 2017. The variable takes a value of 2 for companies that did not have CDS in Q1, 2008 and were without a CDS for Q2, 2017 as well. Treatment is 0 for our control group that includes subsample of companies that had a CDS in 2008 and continued to have it in Q2, 2017. All the companies in our subsample were a part of S&P 500 in the first quarter of 2008. Time is a dummy which takes value of 1 for observations in 2017 and 0 otherwise. Columns (1) - (3) presents results for the DID with groups 0 and 1. Columns (4) - (5) provides triple DID results. Columns (2), (3) & (4) use firm level controls. Assets are defined as the total assets per quarter. Debt is the sum of long-term debt and debt in current liabilities calculated every quarter. The panel results have controlled for time fixed effects. Column (3) also includes industry fixed effects. Significance at 10%,5% and 1% level is denoted by *, ** and *** respectively. Robust standard errors are represented in parentheses.

PANEL A: DIFF-IN-DIFF ESTIMATES

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Breadth | Breadth | Breadth | Breadth | Breadth |
| Treatment (group 1) | -28.700* | -28.960** | -40.774*** | -28.700* | -28.963** |
| | (16.874) | (11.266) | (12.682) | (16.892) | (11.277) |
| Treatment (group 2) | | | | -103.138*** | -80.119*** |
| | | | | (8.41) | (7.185) |
| Time | 99.941*** | 98.846*** | 98.098*** | 99.941*** | 90.888*** |
| | (10.623) | (8.56) | (8.046) | (10.635) | (7.969) |
| Group 1 * Time | -68.205*** | -18.659 | -21.124 | -68.205*** | -18.652 |
| | (23.035) | (21.964) | (22.759) | (23.059) | (21.988) |
| Group 2 * Time | | | | -54.619*** | -48.078*** |
| | | | | (13.731) | (13.428) |
| Assets | | 0.000*** | 0.000*** | | 0.000*** |
| | | (0.000) | (0.000) | | (0.000) |
| Debt | | 0.001*** | 0.001*** | | 0.001*** |
| | | (0.000) | (0.000) | | (0.000) |
| Constant | 133.700*** | 109.571*** | 110.259*** | 133.700*** | 109.567*** |
| | (7.010) | (5.499) | (21.971) | (7.017) | (5.505) |
| Observations | 609 | 541 | 533 | 693 | 647 |
| R-squared | 0.16 | 0.52 | 0.62 | 0.24 | 0.59 |
| Time FE | YES | YES | YES | YES | YES |
| Industry FE | NO | NO | YES | NO | NO |

| PANEL B: MARGINAL EFFECTS | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Breadth | Breadth | Breadth | Breadth |
| Group 0 | 99.941*** | 98.846*** | 99.941*** | 98.852*** |
| | (10.623) | (8.560) | (10.623) | (8.569) |
| Group 1 | 31.74 | 80.187*** | 31.74 | 81.199*** |
| | (20.439) | (20.203) | (20.460) | (20.225) |
| Group 2 | | | 45.322*** | 50.773*** |
| | | | (8.686) | (10.356) |