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Working Paper

Do Empty Creditors Matter? Evidence from Distressed Exchange Offers

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DISCUSSION PAPERS

MT-DP – 2013/34

Do Empty Creditors Matter?

Evidence from Distressed Exchange Offers

ANDRÁS DANIS

Discussion papers
MT-DP – 2013/34

Institute of Economics, Centre for Economic and Regional Studies,
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Do Empty Creditors Matter?
Evidence from Distressed Exchange Offers

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Do Empty Creditors Matter?

Evidence from Distressed Exchange Offers

Andras Danis

Abstract

I examine the effect of credit default swaps (CDSs) on the restructuring of distressed firms. Theoretically, I show that if bondholders are insured with CDSs, the participation rate in a restructuring decreases. Using a sample of distressed exchange offers, I estimate that the participation rate is 29% lower if the firm has CDSs traded on its debt, compared to an unconditional mean of 54%. I use the introduction of the Big Bang protocol as a natural experiment. The results suggest that firms with CDSs find it difficult to reduce debt out-of-court, which is inefficient because it increases the likelihood of future bankruptcy.

Keywords: credit default swaps, CDS, empty creditor, restructuring, bankruptcy

JEL classification: G33, G34

Érdek nélküli hitelezők a kötvénypiacon: mennyire befolyásolják a vállalatok hitelcsökkentését?

Danis András

Összefoglaló

A kötvénypiacon léteznek olyan befektetők, akik be vannak biztosítva a kötvényt kibocsátó vállalat csődje ellen úgynevezett credit default swap-okkal (cds). Ezeknek a hitelezőknek egyes elméletek szerint (Hu/Black 2008; Bolton/Oehmke 2011) nem érdeke egy vállalatot a csődtől megmenteni egy esetleges hitelcsökkentéssel. Ebben a tanulmányban ezt a feltevést empirikusan vizsgálom. Amerikai kötvények csődeljáráson kívüli restrukturálásaiból álló mintát gyűjtök. Ezen belül vannak vállalatok, amelyek kötvényeire léteznek credit default swap-ok. Ilyen vállalatok kötvénytulajdonosai ritkábban vesznek részt restrukturálásban, mint az olyan vállalatok kötvénytulajdonosai, amelyekre nem léteznek cds-ek. A teljes mintában átlagosan a kötvények 54 százalékát restrukturálják. Ez az arány 29 ponttal csökken, ha léteznek cds-ek. Ezek az eredmények arra utalnak, hogy cds-el rendelkező vállalatok nehezebben tudják eladósodottságukat csökkenteni. Ennek az a hátránya, hogy növelheti a jövőbeni csőd valószínűségét.

Tárgyszavak: csőd, restrukturálás, credit default swap, érdek nélküli hitelező

JEL kódok: G33, G34

Do Empty Creditors Matter? Evidence from Distressed Exchange Offers

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April 24, 2013

Abstract

I examine the effect of credit default swaps (CDSs) on the restructuring of distressed firms. Theoretically, I show that if bondholders are insured with CDSs, the participation rate in a restructuring decreases. Using a sample of distressed exchange offers, I estimate that the participation rate is 29% lower if the firm has CDSs traded on its debt, compared to an unconditional mean of 54%. I use the introduction of the Big Bang protocol as a natural experiment. The results suggest that firms with CDSs find it difficult to reduce debt out-of-court, which is inefficient because it increases the likelihood of future bankruptcy.

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How do credit default swaps (CDSs) affect the restructuring of financially distressed companies? Intuitively, if a firm's creditors are insured against the firm's default via CDS contracts, they have little incentive to agree to a restructuring that would avoid bankruptcy. For example, if the CDS insures the face value of debt, creditors will reject any offers by a financially distressed company for payments below face value. Thus, if a firm's lenders are empty creditors, i.e. insured with CDSs, the firm cannot easily reduce its debt in an out-of-court restructuring prior to bankruptcy. I present evidence consistent with this hypothesis.

Credit default swaps pose a problem because failure to renegotiate debt privately can increase the likelihood of future bankruptcy, which can incur deadweight losses. In addition, the existence of CDSs might also be relevant for firms that are not currently distressed. Their investment and financing decisions today can depend on the possibility that debt may be difficult to renegotiate if the firm encounters financial distress. Also, the question addressed in this paper relates to the broader topic of the net welfare effects of CDSs in the economy. Bolton and Oehmke (2011) argue that CDS contracts introduce certain inefficiencies, but that they also create benefits, and that which of the two dominates is an empirical question. In contrast, the popular press often argues that credit derivatives have a negative effect on welfare.¹ The present paper contributes to this important issue by focusing on the economic costs created by CDSs.

To measure the effect of CDSs on the restructuring of distressed firms, I construct a sample of recent U.S. distressed exchange offers. In these offers, firms with public debt try to reduce leverage by offering their bondholders a package of securities and cash in exchange for the existing bonds.² For each exchange offer and for each bond involved, I calculate the participation rate, defined as the face value of bonds tendered divided by the total face value of bonds outstanding. The participation rate is a good measure for the success of a restructuring, because a higher participation rate is usually associated with a larger debt

¹In an article in *The Wall Street Journal* on March 24, 2009, George Soros wrote that "CDS are toxic instruments whose use ought to be strictly regulated".

²This is the usual method for restructuring public debt in the United States (e.g. Asquith, Gertner, and Scharfstein 1994; or Altman and Karlin 2009).

reduction for the firm, other things equal. For each firm in the sample, I determine if there are CDS contracts traded on its debt. Controlling for other factors that might affect the success of a restructuring, I show that the average participation rate is 29% lower if a firm is a reference entity in the CDS market. Relative to the unconditional mean for the participation rate of 54%, this result is economically significant. To account for the endogeneity of the availability of CDS contracts, I use an institutional change in the CDS market as a natural experiment. The findings are consistent with the empty creditor hypothesis of Hu and Black (2008) and Bolton and Oehmke (2011).

To derive the main testable hypothesis in this paper, I construct a simple theoretical model that includes the key institutional features of a distressed exchange offer. The objective of the model is to establish a link between the amount of CDS insurance purchased by bondholders and the success of a financial restructuring. While the model builds on Bolton and Oehmke (2011), it differs from their model by linking the CDS insurance ratio to the participation rate in a distressed exchange offer, which is an observable measure for the success of a restructuring. The model predicts a negative relationship between an exogenous change in the insurance ratio of bondholders and the participation rate in a distressed exchange offer. This negative relationship is used as the basis for the empirical tests that follow.

In the empirical analysis, the base case regression treats the assignment of CDS contracts to firms as exogenous. This is a rather strong assumption, and it is relaxed later on. The dependent variable is the participation rate for 210 corporate bonds involved in 80 different exchange offers between 2006 and 2011. The main explanatory variable is a CDS dummy, which indicates if a CDS contract is traded on the firm's debt at the time of the offer. It is a noisy measure of the CDS insurance ratio of bondholders, and implicitly assumes that at least some CDS investors are bondholders. I support this assumption by drawing on the existing empirical evidence that certain bondholders have CDS contracts at the same time. Also, I present alternative measures of the CDS insurance ratio that might be more precise than the CDS dummy. Controlling for firm-specific and bond-specific characteristics that

might affect the participation rate, the results show that the average participation rate drops by 29 percentage points if there are CDS contracts outstanding.

To address the endogeneity problem in the assignment of CDS contracts to firms, I use the introduction of the Big Bang protocol in April 2009 as a natural experiment. This institutional change in the CDS market led to a standardization of several contractual features, among which I exploit a change in restructuring clauses. After April 2009, the restructuring clause for Standard North American Corporate contracts was set to *No Restructuring*. In other words, out-of-court restructurings like a distressed exchange offer do not trigger a payment by the CDS protection seller. This corresponds to the situation described above, where a bondholder insured with CDS contracts has no incentive to agree to a debt restructuring, because he can obtain a higher payoff by holding out for bankruptcy. Before the Big Bang protocol, however, another popular clause was *Modified Restructuring*. Under this contract, a debt restructuring is a credit event, and the protection buyer is entitled to a payment from the protection seller. In this case, an insured bondholder has no incentive to reject a distressed exchange offer. Before the Big Bang protocol, both types of contracts were common in the CDS market. After 2009, *No Restructuring* was the standard contract. Therefore, if the difference in the participation rates of CDS firms and non-CDS firms is driven by empty creditors, the difference should increase after the introduction of the Big Bang protocol. I test this prediction using a difference-in-differences estimation and find evidence consistent with the empty creditor hypothesis.

Further, I address the noisy measurement of the CDS insurance ratio by using an alternative measure. As econometricians, we only observe if a firm has CDS contracts traded on its debt. This contains two sources of noise: First, some CDS investors might not be among the bondholders of the firm. Second, the CDS dummy does not distinguish a firm with a high insurance ratio from a firm with a low one. By removing the second noise source, a better measure for the insurance ratio might be obtained. Data from the

Depository Trust and Clearing Corporation allows to define a new measure for the insurance ratio as the total amount of CDS outstanding for a firm, divided by the total amount of its debt. While this measure still assumes that at least some CDS investors are bondholders, it removes the second source of noise inherent in the CDS dummy. The results described above are robust to this alternative measure of the bondholder insurance ratio.

This paper is related to several areas of research. First, to the literature on the costs and benefits of the CDS market. Duffee and Zhou (2001) show that while CDSs are attractive hedging instruments for banks, they can hurt banks through the market for loan sales. From the perspective of a borrower, Ashcraft and Santos (2009) find no evidence that CDS trading reduces the cost of debt financing for the average borrower, whereas Saretto and Tookes (2012) find that CDSs allow firms to borrow at longer maturities and to maintain higher leverage ratios. Bolton and Oehmke (2011) develop a theoretical model to analyze the costs and benefits of CDS from the perspective of an entrepreneur. They show how CDSs lead to inefficient liquidations *ex post*, although they might have positive effects *ex ante*. While the first effect is exactly the empty creditor problem, the second occurs because CDSs increase the firm's pledgeable income when the initial debt contract is written, thus more investment projects obtain financing. Finally, in direct tests of the empty creditor hypothesis, there is mixed evidence in the literature. Bedendo, Cathcart, and El-Jahel (2011) find no significant effect of CDS contracts on the probability of bankruptcy, while Subrahmanyam, Tang, and Wang (2012) find a positive effect. In a simulation study, I am able to reconcile these conflicting results. I show that there is a weak statistical relationship between realized bankruptcy and empty creditors. Instead, the outcome of an out-of-court restructuring allows a more efficient estimation of the empty creditor hypothesis. This explains why it is more likely to identify the empty creditor problem in distressed exchange offers, even in a small sample. It also explains why Subrahmanyam, Tang, and Wang (2012), who use a larger sample than Bedendo, Cathcart, and El-Jahel (2011), find that CDS contracts have a significant effect on the probability of

bankruptcy. Also, Subrahmanyam, Tang, and Wang (2012) argue that the higher bankruptcy risk is due to the empty creditor problem. While it is difficult to identify the channel through which CDSs lead to bankruptcy, the present paper suggests that it might be via the failure of out-of-court restructurings.

The second strand of literature concerns out-of-court debt restructurings. Theoretical contributions show how different frictions, notably asymmetric information and free-rider problems, impede the success of restructurings (e.g., Giammarino 1989; Coffee and Klein 1991; Gertner and Scharfstein 1991; Bernardo and Talley 1996; Hege 2003; or Hennessy and Zechner 2011). In the empirical literature, some authors compare different types of debt restructurings (e.g., Gilson, John, and Lang 1990; Asquith, Gertner, and Scharfstein 1994; Franks and Torous 1994; Chatterjee, Dhillon, and Ramírez 1996). These restructurings range from bank workouts, distressed exchange offers, and pre-packaged bankruptcies to traditional bankruptcy procedures. Existing empirical tests are based on the assumption that firms have a choice between these different forms of restructuring, while in my model a distressed firm prefers to restructure out-of-court and will file for bankruptcy only if necessary. The theoretical predictions of the present paper suggest that recovery rates from distressed exchange offers are higher than recovery rates in bankruptcy, which is consistent with the findings of the papers mentioned above. In a different study, Betker (1997) provides evidence that out-of-court restructurings are less costly than formal bankruptcy, which supports the claim that a shift towards more frequent bankruptcies is inefficient. More closely related is Narayanan and Uzmanoglu (2012), who show that if distressed firms have multiple classes of debt, they try to reduce debt within a class that is less affected by empty creditors.

The third strand of literature examines credit risk in general, which is more developed than the two other strands discussed above. Lando (2004) and Duffie (2011) provide excellent reviews of the field. Many contributions in this literature focus on developing better models to predict the probability of default of a particular issuer (e.g., Altman 1968; Chava and Jarrow 2004; Giesecke, Longstaff, Schaefer, and Strebulaev 2011). Most authors use a combination

of firm characteristics and macroeconomic variables to predict defaults. The present paper suggests that, in addition to these variables, the amount of CDS protection purchased by bondholders is an important predictive variable for bankruptcy. Also, while the existing literature focuses corporate credit risk, the recent debt restructuring in Greece draws public attention to the default risk of sovereign issuers. There are certain similarities between corporate and sovereign credit risk, and any lessons learned from corporate restructurings might be valuable for understanding their sovereign counterparts.

1 A Model of Distressed Exchange Offers

There is one firm with a single bond outstanding. The total face value of the bond is $F > 0$ units of consumption and there is a single risk-neutral bondholder. Risk neutrality is not an essential assumption but simplifies the analysis. Also, Appendix A shows that the framework can be extended to n bondholders. The firm is characterized by a random cash flow y , with distribution function $G(y)$, density $g(y)$, and support $[0, \bar{y}]$. It is assumed that $E[y] \leq F$, which can be interpreted as financial distress, and that $F < \bar{y}$. Equity holders are risk neutral, and firm management is assumed to maximize their expected payoff. The firm has the option to start a cash tender offer, a special form of a distressed exchange offer, to buy back its outstanding bond.³ There are no cash holdings, which implies that the tender offer is financed with new equity. The firm chooses an unconditional bid $b \in \mathbf{R}$ per unit of face value. Following the offer, the bondholder decides how much face value to tender, $x \in [0, F]$. After the tender offer, the cash flow realizes, and the firm may go into bankruptcy. This is assumed to happen if the cash flow is less than the new face value of the bond, or $y \leq F - x$. In bankruptcy, equity holders receive a zero payoff, i.e. the absolute priority rule is always

³In reality, there are many different distressed exchange offers. Sometimes the firm offers a new bond or equity to the bondholders. However, cash tender offers are frequently used empirically. Chatterjee, Dhillon, and Ramírez (1995) report that 35% of distressed exchange offers are cash tender offers, which is similar to the 31% in my sample. Economically, these offers are very similar in the sense that the firm offers a security or cash to the bondholders in order to reduce its leverage.

enforced.⁴ The recovery rate in bankruptcy is denoted by $\rho \in [0, 1]$. The rationale behind the less than full recovery are direct and indirect bankruptcy costs, which are exogenous to the model. Also there is no distinction between Chapter 7 (liquidation) and Chapter 11 (reorganization), as the main focus of the paper is out-of-court debt restructurings.

The bondholder is partially insured with a CDS contract. A fraction $\beta \in \mathbf{R}$ of his exposure F can be hedged this way. If β is positive, the bondholder is a protection buyer, otherwise he is a protection seller. Note that it is not assumed that he is a protection buyer, although it will turn out that he is in equilibrium. Also, the contract is not subject to counter-party risk and is provided by a risk-neutral and competitive market maker.⁵ The market maker has rational expectations in the sense that he anticipates the actions of both the bondholder and the firm. In particular, he understands that the amount of CDS protection purchased or sold by the bondholder might change the probability that the firm files for bankruptcy. Finally, the firm has the option to file for bankruptcy at any time in the model. It turns out that it is never optimal to do so, except in the final period and only in some states of nature. Figure 1 summarizes the timeline of events of the model.

The bondholder's expected payoff is:

$$U_B(\beta, x) = -p(\beta) + bx + \int_0^{F-x} \left[\rho y + \left(1 - \frac{\rho y}{F-x} \right) \beta F \right] dG(y) + \int_{F-x}^{\bar{y}} (F-x) dG(y).$$

The first term is the premium that he pays to the protection seller in the initial period. The premium depends on β , the fraction of the face value F that he insures. The second term is the payment the bondholder receives from the firm in a distressed exchange offer. The firm offers a bid b and the bondholder tenders a face value $x \in [0, F]$. The third term contains the terminal payoff to the bondholder in the states of nature where the firm bankrupts because its cash flow is lower than the final face value of bonds $F - x$. This payoff has two components:

⁴Empirically there are deviations from the absolute priority rule. The present model can be extended to account for these deviations, without affecting the main predictions of the model.

⁵This assumption was introduced by Glosten and Milgrom (1985) and Kyle (1985), and is also used by Bolton and Oehmke (2011), among others.

one for the bond and one for the CDS contract. The fourth term captures the bondholder's payoff in the states of nature where the firm has enough cash flow to service the debt payment.

The equity holders understand that their bid b affects the total tendering amount, which in equilibrium is a function $x(b)$. The expected payoff to equity holders can then be written as:

$$U_E(b) = -bx(b) + \int_{F-x(b)}^{\bar{y}} [y - (F - x(b))] dG(y).$$

The bondholder can purchase or sell CDS protection from a risk-neutral market maker at an actuarially fair price. To solve the game explicitly, assume that the final cash flow is uniformly distributed,

$$y \sim U(0, \bar{y}).$$

The game is solved by backwards induction. Given a bid b , the bondholder decides how much face value to tender. His optimal tendering strategy at an interior solution is determined by the first-order condition with respect to x . Under the assumption of a uniformly distributed cash flow y , the optimal amount tendered can be found in closed form,

$$x(b) = F - \frac{\bar{y}(1-b)}{2-\rho} - \frac{\beta F}{2}. \tag{1}$$

If $b < 1$ and $\beta \geq 0$, which will be the case in equilibrium, the amount tendered x is indeed strictly smaller than F . Also, it will be shown later that the equilibrium value of x given by the first-order condition is positive. Hence, it is not necessary to examine corner solutions in this simple model. The formal proof of this statement is provided in Appendix B. Note that the amount tendered is an increasing function of the bid, as expected. Also, the parameter β shifts the function $x(b)$ downwards. Figure 2 shows that if a larger fraction of the bond is hedged by a CDS contract, then for the same bid b fewer bonds are tendered by the bondholder. Equivalently, to obtain the same amount of bonds, the firm has to offer a higher bid to the bondholder.

Finally, the firm chooses a bid b by taking into account the relationship $x(b)$. In other

words, it realizes that by offering a higher bid it can induce the bondholder to tender more bonds. On the other hand, it takes into account the costs associated with a tender offer. The optimal bid is found by maximizing:

$$\begin{aligned} U_E(b) &= -bx(b) + \int_{F-x(b)}^{\bar{y}} [y - (F - x(b))] \frac{1}{\bar{y}} dy \\ &= -b \left[F - \frac{\bar{y}(1-b)}{2-\rho} - \frac{\beta F}{2} \right] + \int_{\frac{\bar{y}(1-b)}{2-\rho} + \frac{\beta F}{2}}^{\bar{y}} \left[y - \frac{\bar{y}(1-b)}{2-\rho} - \frac{\beta F}{2} \right] \frac{1}{\bar{y}} dy. \end{aligned}$$

By applying Leibnitz' rule and solving the first-order condition, the optimal bid is:

$$b = 1 - \frac{F}{\bar{y}} \frac{[4 - \beta(1 - \rho) - 2\rho](2 - \rho)}{2(3 - 2\rho)}. \quad (2)$$

It is shown below that in equilibrium β is smaller than 1, and by assumption $\rho \in [0, 1]$, so the optimal bid is less than one per unit of face value. In other words, the firm is able to repurchase the bond at a discount, which is consistent with empirical observations. The optimal bid is increasing with β , the fraction of face value that is insured through a CDS contract. The intuition for this result is illustrated by Figure 2. A higher value of β leads to fewer bonds tendered, for a fixed value of b . Therefore, the reduction in debt is smaller. But the firm wants to reduce its debt, because equity holders only receive a terminal payoff if the cash flow is above $F - x$. Therefore, they offer a higher bid to the bondholder, to induce him to tender more bonds. Another observation is that F/\bar{y} , a measure of leverage, is negatively related to the optimal bid. The reason is that with a high leverage ratio the firm is likely to go bankrupt in the terminal period. Due to bankruptcy costs, this leads to a low expected payoff for the bondholder. He is willing to reduce debt, even at a low price b , because he receives more in the terminal period in the states of nature where the firm is solvent.

The corresponding face value tendered in equilibrium is:

$$x = \frac{2(1 - \rho) - \beta(2 - \rho)}{2(3 - 2\rho)} F. \quad (3)$$

The effect of a higher β is a lower face value tendered. This result is composed of two effects. On the one hand, a higher β shifts the bondholder's supply function downward (i.e., for a given bid he tenders less). This can be seen in Figure 2. Thus, the direct effect of a higher β is a decrease in x . On the other hand, the firm tries to compensate for this and increases the bid. This means that there is an indirect effect of β on x , which increases the amount tendered. But the second effect is not large enough, as it turns out, and in equilibrium the direct effect dominates. This is why an increase in β leads to a lower amount tendered. This result is analogous to the analysis of the empty creditor problem in Bolton and Oehmke (2011) in the sense that it shows how partly insured bondholders make debt reductions more difficult for a firm.

Equation (3) shows in closed form how the bondholder's insurance ratio affects debt reductions, which cannot be determined in the model of Bolton and Oehmke (2011). Unfortunately, it is not easy for an econometrician to observe b . This is because many offers are not pure cash tender offers, but the firm offers a package of new securities. However, the variable x/F is observable in practice. The so-called participation rate in a distressed exchange offer is an important measure for the success of the offer. Therefore, the news announcements of distressed firms often contain information about this measure. Note that the present model yields a very simple expression for the participation rate,

$$\frac{x}{F} = \frac{2(1 - \rho) - \beta(2 - \rho)}{2(3 - 2\rho)}. \quad (4)$$

The participation rate does not depend on the firm's leverage ratio or the distribution of its cash flow. The following hypothesis summarizes the main testable prediction of the theoretical model.

Hypothesis. *The participation rate x/F in a distressed exchange offer decreases with β (the fraction of the bond that is insured with CDS contracts).*

The model developed here is very stylized, and there might be several other factors

influencing the outcome of a distressed exchange offer. Therefore, the empirical tests below contain control variables in addition to a measure of β . Also, it is important to note that β is not likely to be exogenous. In fact, the next section shows how the insurance ratio can depend on the recovery rate ρ , which also affects the participation rate. In an empirical test it is therefore important to use *exogenous* variation in β and examine how it affects the participation rate. Section 3 presents a natural experiment as a source of exogenous variation.

1.1 Do bondholders purchase or sell CDS?

Empirically, there are many reasons why bondholders trade in the CDS market. A study of the British Bankers Association (2006) shows that the participants of the CDS market are very heterogeneous. According to the study, the main protection buyers in 2006 were banks - trading activities (39%), hedge funds (28%), banks - loan portfolio (20%), insurance companies (6%), pension funds (2%), mutual funds (2%), and corporates (2%). Of course, many of these investors are not bondholders of the reference entities. The heterogeneity of the CDS participants suggests that there are many possible reasons why bondholders enter a CDS contract.

Three possible reasons are presented here. First, regulatory requirements might force them to hedge credit risk in their portfolios. Both banks and insurance companies are usually required to hold more regulatory capital for bonds that have been downgraded. Hedging credit risk through CDS contracts can relax binding capital constraints.

Second, speculation on credit risk could be a reason to trade in the CDS market. If an existing bondholder changes his belief about the issuer's probability of default, he might reduce the credit risk exposure by purchasing CDS protection. This might be cheaper than selling the bond if the bond market is illiquid.

Third, there might be a purely strategic reason for a bondholder to purchase CDS protection. If he expects the issuer to make a distressed exchange offer, a CDS position can

increase the bondholder's expected payoff. In the model, CDS contracts allow the bondholder to commit himself to tender less in a distressed exchange offer. The benefit of this strategy is that the equity holders offer a higher bid to the bondholder.

It is not feasible to endogenize all possible motives for a bondholder to participate in the CDS market. Therefore, this section focuses on the strategic motive, and abstracts from the other two motives. The strategic motive is also most likely to cause endogeneity problems in empirical tests of the effect of CDS on out-of-court restructurings.

For a given face value insured, βF , the market maker who is the counter party to the bondholder calculates the CDS premium by determining the expected payment to the protection buyer, which is given by:

$$p = \int_0^{F-x} \left(1 - \frac{\rho y}{F-x}\right) \beta F \frac{1}{\bar{y}} dy.$$

This expected value can be decomposed into a probability of default and a loss given default. The probability of default is given by:

$$PD = \int_0^{F-x} \frac{1}{\bar{y}} dy = \frac{F}{\bar{y}} \left(1 - \frac{2(1-\rho) - \beta(2-\rho)}{2(3-2\rho)}\right), \quad (5)$$

where x refers to the optimal face value tendered, given β , and $F-x$ is the face value outstanding after the distressed exchange offer. The fraction F/\bar{y} measures the firm's leverage. It is not surprising that the leverage ratio increases the probability of default. Interestingly, however, the level of CDS protection chosen by the bondholder also affects the probability of default. The formula shows that a higher insurance ratio β translates to a higher default probability. The loss given default in dollars is:

$$LGD = \left(1 - \frac{\rho}{2}\right) \beta F,$$

which implies that the fair CDS premium is:

$$p = PD \cdot LGD = \frac{F}{\bar{y}} \left(1 - \frac{2(1 - \rho) - \beta(2 - \rho)}{2(3 - 2\rho)} \right) \left(1 - \frac{\rho}{2} \right) \beta F.$$

This expression shows that p is increasing in β , even after normalizing by βF . In simple terms, the more CDS protection the bondholder purchases, the more expensive the insurance becomes per unit of face value insured. This is because a highly insured bondholder will tender less in a distressed exchange offer, therefore the firm cannot reduce its debt and the firm is more likely to file for bankruptcy.

To find the optimal level of CDS protection, the bondholder trades off the costs and benefits of CDS contracts. On the one hand, buying too much CDS protection is expensive because the bondholder commits to tender fewer bonds in a distressed exchange offer, which reduces his payoff due to bankruptcy costs. On the other hand, the benefit is the higher bid offered by the equity holders in case of a distressed exchange offer. It turns out that in equilibrium, the bondholder is a buyer of CDS protection, although that is not assumed *ex ante*. Solving the bondholder's trade-off, the optimal fraction of insured face value is:

$$\beta = \frac{2(1 - \rho)^2}{(2 - \rho)(4 - 3\rho)}. \quad (6)$$

On the domain $\rho \in [0, 1]$, the insured fraction β is non-negative. This means that in equilibrium, the bondholder is a buyer of CDS protection. Also, β is decreasing in ρ . The intuition for this result is the following. If ρ is small, the equity holders can gain most from the distressed exchange offer. Bankruptcy costs are so large that without CDS protection, bondholders are willing to tender their bonds even at very low bids. This is where it makes most sense to buy CDS protection, because it is an effective means to increase the bid offered by equity holders. In a sense, the bondholder is hurting himself with CDSs, because he commits himself not to reduce the debt, although he knows that it would be efficient to reduce it. In fact, this is where the costs of CDS protection come from. Nevertheless, for

low recovery rates in bankruptcy, the benefits of CDS, i.e. a higher bid, outweigh the costs, therefore β is higher.

2 Empirical Framework, Data, and Results

2.1 Empirical framework

The idea behind the empirical methodology is the following. If more bondholders have insured themselves against the default of an issuer, then we should observe lower participation rates ex post, controlling for other factors that might influence participation rates. At this stage, there are two important assumptions. First, that the amount of CDS protection held by bondholders is exogenous. In a linear regression framework, the unexplained participation rates, conditional on the level of CDS protection and the other control variables, are assumed to have zero expectation. Section 3 relaxes this assumption by using a natural experiment as a source of exogenous variation, as well as a structural approach to identification using the theoretical model. An advantage of the assumption is the measurement of the magnitude of the effect of CDS holdings on the level of participation rates.

Second, that the CDS dummy is a good proxy variable for the CDS insurance ratio of bondholders. If there are CDS contracts traded on a firm's debt, then, on average, some CDS investors are assumed to be bondholders. It is clear that this is a noisy measurement of bondholders' CDS holdings. But there is evidence that some investors indeed use CDSs to hedge their corporate bond holdings. The National Association of Insurance Commissioners (NAIC 2011) reports that insurance companies use credit derivatives primarily to hedge existing credit risks. Similarly, Adam and Güttler (2010) show that many fixed income mutual funds use CDSs to hedge credit risk. Also, the Basel regulatory framework gives banks an incentive to reduce credit risk by purchasing CDS protection. Put differently, several classes of institutional investors use CDS contracts to hedge credit risk. Therefore, the CDS dummy seems to be a useful proxy variable for the CDS insurance ratio. This

variable is also used by Saretto and Tookes (2012), Bedendo, Cathcart, and El-Jahel (2011), and Subrahmanyam, Tang, and Wang (2012).

Given these assumptions, the base case specification is given by:

$$PartRate_i = \alpha_0 + \alpha_1 CDS_i + \gamma X_i + \varepsilon_i. \quad (7)$$

The dependent variable is the participation rate in a sample of distressed exchange offers. The participation rate is calculated for each bond separately, as for some companies several bonds are involved in the same exchange offer. The main explanatory variable is the CDS dummy. The vector X_i contains different control variables, including firm characteristics, which are constant across the different bonds of the same issuer, and bond characteristics, which vary across all bonds in the sample. Standard errors are always calculated as cluster-robust standard errors, unless otherwise noted, with observations clustered at the firm level.

2.2 Data and sample selection

This paper builds on a manually collected dataset of U.S. distressed exchange offers. I start with all “Distressed Exchanges” identified by Moody’s, between 01/2006 and 02/2011, using the company’s annual *Corporate Default and Recovery Rates* reports. Every observation is verified by a news search in Dow Jones Factiva. Following Mooradian and Ryan (2005) and Bedendo, Cathcart, and El-Jahel (2011), a firm is only added to the sample if the news search suggests that it is in financial distress. Any distressed exchanges found in Factiva which were left out by Moody’s are added to the sample. This search method yields an initial sample of 122 distressed exchanges. An observation is removed if any of the following conditions are met: only 144a bonds were involved, two offers of the same issuer for the same bonds are closer than 12 months to each other, the offer was not distressed, there is no data in Factiva or Bloomberg, or the government was involved.⁶ This yields a sample of 80 exchange

⁶Two famous examples for the involvement of the U.S. Government are General Motors and Chrysler.

offers, with data on 210 involved bonds. Appendix C shows a list of all distressed exchange offers. Some firms appear more than once on the list. In those cases the exchange offers are either more than 12 months apart, or the offers are for different sets of securities. Also, firms often improve the terms of the offer as the expiration date approaches, or they extend the expiration date by a couple of weeks. In those cases the extended offer and the original offer constitute a single observation in the sample.

Table I provides an overview of the databases used to determine the variables. Bond issue CUSIP bases and the issuer names are used for matching observations across databases. The CDS dummy variable indicates if a CDS contract corresponding to a particular issuer is traded in the six months prior to the offer announcement date. The following bond and firm characteristics are included, based on the existing literature on out-of-court restructurings. A common measure of bondholder concentration is the number of bond issues of a firm (e.g., Gilson, John, and Lang 1990; Asquith, Gertner, and Scharfstein 1994). In addition, since TRACE became available after these papers, I use the number of bond transactions prior to the offer announcement as a proxy for bondholder dispersion. Appendix D contains a discussion of several alternative proxy variables for bondholder dispersion. It shows that the logarithm of the number of transactions in the 12 months prior to the exchange offer is a good proxy variable for bondholder dispersion.

Further control variables are a bond's amount outstanding at the offer date, time to maturity, a dummy variable for secured bonds, and a dummy variable for senior bonds, defined as senior, senior secured, or senior subordinated according to Mergent FISD.

Firm specific control variables are based on Compustat for most firms in the sample. For the remaining companies, the balance sheet is downloaded from the SEC EDGAR database. Book leverage is defined as the sum of debt in current liabilities and long-term debt, divided by total assets. For each firm, the last balance sheet before the announcement date of the offer is used, if available.⁷ The variables amount outstanding, time to maturity, and the

⁷For a small number of firms, financial information in the fiscal year prior to the announcement date is not available. In these cases, the last financial report is used. These cases and the fiscal year ends used

number of trades are winsorized at the 1% and 99% quantiles.⁸ Finally, I use each bond's participation rate, defined as the total face value tendered divided by the amount outstanding at the announcement date, as a proxy variable for x/F .

Table II provides summary statistics for different bond characteristics. It shows that 67% of the bonds were issued by firms which were names in the CDS market. The fraction of issuers with CDS contracts is smaller than this number, because firms with CDS contracts are usually large issuers with several bonds outstanding. There is a large amount of cross-sectional variation in participation rates. Finally, the sample mostly contains bonds classified as senior by Mergent, with a small number of senior subordinate and senior secured bonds.

Table III presents summary statistics for individual exchange offers. Out of 80 exchange offers, 41% of debtors were names in the CDS market, while 59% were not. Approximately one-third of all exchange offers use cash in the package offered to bondholders, and CDS firm seem to use cash more often. Conditional and unconditional offers are evenly split in the full sample. However, CDS firms use unconditional offers more frequently than non-reference entities. There is a large increase in the number of exchange offers from 2006 to 2009, and a decline thereafter. Overall, the sample characteristics are similar to those of comparable samples, such as Daniels and Ramirez (2007) or Bedendo, Cathcart, and El-Jahel (2011).

2.3 Base case estimation results

Table IV summarizes the OLS estimation results of different versions of equation (7). Column (1), the benchmark specification, reveals that the participation rate is on average 29.1 percentage points lower if the issuer is a reference entity in the CDS market. This is an economically significant number, given that the unconditional participation rate is 54%. This variable alone is able to explain 18% of the cross-sectional variation in participation

are Autocam Corp. (2005-12-31), Network Communications Inc. (2009-03-29), Vertis Holdings Inc. (2007-12-31), and Viskase Companies Inc. (2006-12-31). For French Lick Resorts and Casino LLC, no balance sheet information is available. Total assets is therefore estimated using information from the company's press releases, and debt outstanding is taken from press releases by Moody's Investors Service.

⁸If the number of trades takes a value of zero, it is set to not available.

rates, shown in column (2), which is more than half of the explanatory power of all independent variables. The CDS dummy variable is significant across all specifications. Column (3) includes bond-specific covariates and omits firm characteristics, whereas column (4) only considers firm-specific covariates. Taken together, however, there seem to be other variables missing from these specifications, since the largest adjusted R^2 is only 28%.

Other significant covariates are the dummy for secured bonds and time to maturity. A possible explanation for the higher participation rate among senior secured bondholders is that they are less likely to hold CDS contracts. The standard reference obligations in the CDS market are senior unsecured bonds. Therefore, standard CDS contracts are less attractive to secured bondholders. This could mean that secured bondholders are less likely to be empty creditors, which directly affects their incentive to participate in a distressed exchange offer.

One possible explanation for the importance of maturity is the following. Imagine a firm with two bonds outstanding, with different maturities. If it cannot repay the debt at either of the two maturity dates, it is assumed that it has to file for bankruptcy. The equity holders must decide how much to reduce each of the two bonds' face values today. It might be that equity holders are willing to pay more for the short maturity bond, because it poses an imminent threat to the survival of the company and the payoff to equity holders. They want to reduce the face value of long-debt too, in order to avoid bankruptcy at the later date, but this is less attractive to them. The second date lies in distant future, and the firm's operating performance might improve over time. If that happens, then there will be sufficient funds at the later maturity date, which makes it less profitable for them to reduce long-term debt today. These calculations might lead to a lower bid price for long-term bonds today, to which bondholders react by tendering fewer long-term bonds. This explanation is consistent with lower bids for bonds with longer maturities in the sample.⁹

Interestingly, most bond and firm characteristics do not explain the variation in

⁹For cash offers, the bid prices often can be observed directly. For pure exchange offers, the face value of new bonds offered in exchange for a fixed face value of existing bonds can be used as a measure of the firm's bid. Both measures are decreasing in the time to maturity of existing bonds.

participation rates well. On the other hand, the CDS dummy variable is a strong explanatory variable in Table IV, which supports the theory developed in Section 1. The evidence presented so far is consistent with the main hypothesis, assuming that there is no endogeneity problem in the specification of equation (7).

3 Endogeneity

3.1 A structural approach to identification

The previous section assumes that the cross-sectional variation in the CDS dummy is exogenous. This might be violated if there are omitted variables that explain participation rates in distressed exchange offers and are correlated with the CDS dummy. A candidate for an omitted variable might be the bondholders' expected participation rate. In the theoretical model, however, bondholders are rational and have complete information, and in equilibrium they know what the participation rate is going to be. Even with incomplete information, rational expectations lead to unbiased estimates of the participation rate. Nevertheless, there might be other omitted variables impeding the identification of a causal relationship between CDS protection and recovery rates. An example is the expected recovery rate in bankruptcy, which might be correlated with the CDS insurance ratio.

In this section, simulated data is used to determine the sign of the bias resulting from omitting the expected recovery rate. Theoretical models can be very useful for identification, as demonstrated for example in Davydenko and Strebulaev (2007). The sign of the bias in a linear regression framework equals the sign of the coefficient of the recovery rate times the sign of the covariance between the CDS dummy and the recovery rate (Wooldridge 2002, p. 62). It turns out that both signs are negative, which results in a positive bias. Therefore, omitting the expected recovery rate biases the coefficient of the CDS dummy *upwards*, which means that the true coefficient of the CDS dummy might be even smaller (i.e., larger in absolute terms).

The following procedure is used to simulate a sample from the theoretical model. First, the model is extended to allow for non-strategic reasons for a bondholder to trade in the CDS market. Certain institutional investors, notably banks and insurance companies, face regulatory constraints that make it costly for them to hold the bond of a financially distressed company. These constraints can be relaxed by hedging the default risk of the issuer through CDS contracts, which might be cheaper than selling the bond if it is illiquid. The need for such hedging also depends on shocks to other securities in the investor's portfolio. These and other non-strategic reasons for trading in CDS are modeled by assuming that an exogenous shock to the bondholder in the first period influences his preference for a CDS. More precisely, his private value for a CDS can be higher or lower than the market value of the CDS. The premium to be paid by the bondholder is multiplied by a factor with distribution

$$e^s \sim \ln N(0, \sigma_s^2). \quad (8)$$

After observing the shock, the bondholder optimally purchases or sells CDS protection by taking into account strategic and exogenous reasons for trading.¹⁰ This assumption changes the bondholder's expected payoff to:

$$U_B(\beta, x) = -p(\beta)e^s + bx + \int_0^{F-x} \left[\rho y + \left(1 - \frac{\rho y}{F-x} \right) \beta F \right] dG(y) + \int_{F-x}^{\bar{y}} (F-x) dG(y). \quad (9)$$

Solving the extended theoretical model by backwards induction yields the following optimal insurance ratio:

$$\beta = \frac{2(-7 + 9\rho - 3\rho^2 + s(6 - 7\rho + 2\rho^2))}{(2 - \rho)(2 - \rho - s(6 - 4\rho))}. \quad (10)$$

The participation rate in equilibrium is again given by equation (4). The last two equations

¹⁰There are several other possibilities to introduce an exogenous preference for CDSs. For instance, the bondholder's portfolio and shocks to it could be modeled explicitly. Another possibility would be to assume a concave utility function for investors, with shocks to risk aversion. The present modeling assumption is made for convenience only. Also, the lognormal distribution for shocks is not necessary. Advantages of this distribution are that the shocks are non-negative and that for small values of σ_s , the shocks are close to one.

are used to simulate a sample of distressed exchange offers. The assumptions made are that

$$\rho \sim U(0, 1), \tag{11}$$

and that ρ is independent from s . The simulated sample is used to estimate the regressions

$$\frac{x}{F_i} = \alpha_0 + \alpha_1\beta_i + \alpha_2\rho_i + \epsilon_i, \tag{12}$$

$$\frac{x}{F_i} = \alpha_0 + \alpha_1\beta_i + \epsilon_i. \tag{13}$$

The first specification includes the variable ρ , i.e. there are no omitted variables. The second specification omits ρ , therefore it is comparable to the base case specification in equation (7). The results in Table V show that $\hat{\alpha}_1$ is biased upwards if ρ is omitted from the regression. The sample size of the simulated data is $n = 10,000$. The values of σ_s used in the simulations are $\sigma_s \in \{0.01, 0.05, 0.1, 0.2\}$.

The results of these simulations suggest that omitting the expected recovery rate in bankruptcy is not likely to change the main qualitative findings. However, there might be other omitted variables which cause endogeneity problems.

3.2 A reduced form approach to identification

In addition to the structural approach, the so-called Big Bang protocol in the CDS market is used as a natural experiment to identify the effect of CDS contracts on out-of-court restructurings. According to the International Swaps and Derivatives Association (ISDA), who coordinated the introduction of the protocol, restructurings (e.g., distressed exchange offers) do not trigger a credit event for Standard North American Corporate (SNAC) transactions after April 2009.¹¹ According to ISDA, more than 2,000 market participants adhered to the protocol.¹² Before April 8, 2009, depending on the restructuring clause

¹¹For more information on the Big Bang protocol, see the FAQ under www.isda.org or the summary provided by Markit (Casey (2009)).

¹²See the ISDA press release on April 8, 2009.

chosen by the contracting parties, a distressed exchange offer can be a credit event. The reason why the Big Bang protocol is an interesting natural experiment is that it affects the severity of the empty creditor problem. If a distressed exchange offer is not a credit event, insured bondholders have weaker incentives to participate in such an offer. In fact, the theoretical model assumes that such restructurings are not credit events. On the other hand, if distressed exchanges are credit events and a bondholder is fully insured, he is indifferent between participating and holding out. According to estimates by Markit, when the Big Bang protocol was introduced, 68.5% of North American contracts contained the “Modified Restructuring” clause (restructurings are credit events), while 27.1% contained the “No Restructuring” clause. It follows that after April 2009, one should expect that the empty creditor problem is stronger, i.e., the difference in participation rates between CDS reference entities and non-reference entities should be larger than before. To test this prediction, the following difference-in-differences approach is used,

$$PartRate_i = \alpha_0 + \alpha_1 CDS_i + \alpha_2 BigBang_i + \alpha_3 CDS_i BigBang_i + \gamma X_i + \varepsilon_i. \quad (14)$$

The dependent variable is still the participation rate calculated for each bond involved in a distressed exchange offer. The CDS dummy takes a value of one if the bond issuer is a reference entity in the CDS market. Intuitively, this variable is supposed to capture the differences between reference entities and non-reference entities.¹³ These differences might be due to the empty creditor problem, or to other unobservable firm characteristics. A new dummy variable indicates observations after the introduction of the Big Bang protocol. Intuitively, it captures differences in the two time periods before and after the Big Bang protocol. The interaction of the CDS dummy and the Big Bang dummy is the most interesting for the purpose of the present analysis. If its coefficient is significantly different from zero, then the difference between the average participation rate of the treatment group (CDS = 1)

¹³See Roberts and Whited (2011) for a discussion of the endogeneity problem in general and the difference-in-differences estimator.

and the control group ($CDS = 0$) is different after the treatment, i.e., the introduction of the protocol. The vector X_i summarizes the bond-specific and firm-specific control variables used in the estimation.

3.3 Threats to identification and validity checks

There are at least four threats to the identification strategy based on the Big Bang protocol. First, the introduction of the protocol might be endogenous itself, in the sense that the introduction was related to the empty creditor problem. According to the ISDA, the protocol is a collection of measures among which the ‘hardwiring’ of auctions to determine the recovery rate following a credit event is the central element.¹⁴ Other measures include the role of ‘Determinations Committees’ to define when a credit event has occurred, the introduction of standard effective dates for CDS transactions, and standardized spreads of 100 basis points for investment grade and 500 basis points for speculative grade underlyings. The standardization of restructuring clauses was one of several measures to simplify and standardize the CDS market. While it cannot be completely ruled out that the Big Bang protocol is related to the empty creditor problem, the existing ISDA documentation suggests that the motivation behind the introduction was to facilitate trade the CDS market.

Second, there might be selection bias in the sense that the new protocol is only applied to certain CDS contracts. Fortunately, according to the ISDA, the new protocol applies not only to contracts created after the April 2009, but also to legacy contracts. The new protocol applies if both parties adhere to it, even if the CDS contract was created before April 2009. The ISDA reports that over 2,000 institutions adhered to the protocol by April 7, 2009. According to Chen, Fleming, Jackson, Li, and Sarkar (2011), this is a vast majority of the participants in the CDS market.¹⁵

Third, the point in time used to split the sample period into before and after the introduction of the Big Bang protocol might impact restructuring outcomes. The collapse

¹⁴ISDA press release, dated April 8, 2009.

¹⁵See the ISDA press release on April 8, 2009, and <http://www.isda.org> for additional documentation.

of Lehman Brothers, for example, could have had such an effect. One advantage of the difference-in-differences methodology is that it accounts for time fixed effects if they apply to both CDS and non-CDS firms. Therefore, any time-specific shocks would need to affect CDS firms differently from non-CDS firms in order to threaten identification, which seems less likely. However, since I cannot rule out this possibility, I try to control for the effects of the financial crisis on the outcome of distressed exchange offers. To that end, I use the Financial Stress Index of the Federal Reserve Bank of St. Louis as an additional control variable in the difference-in-differences specification, which does not change the qualitative nature of the results. Alternatively, I use the USD Libor rate at different maturities (1M, 3M, and 6M), which does not affect the results. This suggests that the financial crisis does not affect the difference-in-differences results.

Fourth, the main technical assumption behind the difference-in-differences methodology concerns parallel trends in the dependent variable between CDS and non-CDS firms. While it is not possible to test for parallel trends after the introduction of the protocol, the growth rates in the participation rate before the protocol are parallel in my sample. Therefore, an important technical condition for the validity of the difference-in-differences methodology is satisfied.

Finally, Roberts and Whited (2011) argue that since the assignment of firms to treatment and control groups is rarely random in empirical finance, it is important to perform additional validity checks. To that end, I examine if the Big Bang protocol has any effect on the restructuring of financially distressed firms. If there were no effect, the natural experiment would not be useful in identifying a causal relationship. In my sample, the introduction of the Big Bang protocol leads to a substantial drop in the number of distressed exchange offers for CDS firms, from 24 to 9; however, there is an increase for non-CDS firms from 15 to 32. This is consistent with the view that the change in restructuring clauses amplifies the empty creditor problem, which in turn reduces the number of distressed exchange offers for affected firms.

3.4 Results of difference-in-differences estimation

Table VI presents the results of the difference-in-differences estimation. Column (1) of that table refers to the benchmark specification in equation (14), including the full set of explanatory variables. It shows that the coefficient of the CDS dummy is negative but insignificant, while the coefficient of the interaction term is negative and highly significant. This means that before the treatment, there is no significant difference between the treatment and control groups. This is consistent with the empirical observation that many CDS contracts used the Modified Restructuring clause prior to April 2009, so the empty creditor problem might be less severe. However, after the treatment the difference in average participation rates is smaller, or larger in absolute terms. In other words, CDS reference entities experience lower average participation rates than non-reference entities. This is consistent with the theoretical prediction that CDS insurance, if purchased by bondholders, reduces the participation of bondholders in a distressed exchange offer. The result is robust to different specifications in terms of the control variables.

Other significant explanatory variables are the Big Bang dummy, the time to maturity, and the dummy for secured bonds. The Big Bang dummy, which is positive in the difference-in-differences specifications (1)-(4) in Table VI and significant in two of those, captures any differences in the time periods before and after April 2009. The intuitive interpretation of the positive coefficients is that there was an increase in average participation rates over time. One possible explanation for this is the tax incentive for debt reductions introduced in early 2009 in the U.S. (e.g., Altman and Karlin 2009). The interpretation of the other significant explanatory variables, time to maturity and the dummy for secured bonds, is similar to Table IV.

4 Simulation Study and Discussion

This paper provides evidence consistent with the empty creditor hypothesis. This appears to be in conflict with Bedendo, Cathcart, and El-Jahel (2011), who argue that the effect of empty creditors is not significant. It is possible to reconcile these seemingly opposing results in a simulation study, which compares the two specifications with simulated data.

Bedendo, Cathcart, and El-Jahel (2011) specify a probit model, where the dependent variable measures the outcome of a debt restructuring. The value of this variable is one if a firm files for bankruptcy, and zero if it successfully restructures its debt in a distressed exchange offer. To compare their methodology with the present one it will be convenient to switch the values of the dependent variable, so it can be interpreted as a measure of the success of a debt restructuring. Bedendo, Cathcart, and El-Jahel argue that under the empty creditor hypothesis, a firm is more likely to file for bankruptcy if it is a reference entity in the CDS market. In the theoretical framework of Section 1, this is indeed the case. Equation (5) shows that the probability of default (i.e., bankruptcy) is increasing in the bondholder's insurance ratio. The simulation study shows that, in principle, the bankruptcy dummy suggested by Bedendo, Cathcart, and El-Jahel is able to identify the effect of empty creditors on debt restructurings. However, the statistical relationship between the CDS insurance ratio and bankruptcy is very noisy. To see this, suppose that the CDS insurance ratio is very low, i.e. the empty creditor problem is not severe. The operating performance of a firm might deteriorate following the distressed exchange offer, which would force the firm to file for bankruptcy. Thus, the realization of bankruptcy might not be caused by an unsuccessful restructuring, but by bad luck. The theoretical prediction that a distressed exchange offer might be followed by bankruptcy is consistent with Altman and Karlin (2009), who find that almost 50% of the firms that completed a distressed exchange ultimately file for bankruptcy. It follows that by looking at the result of the out-of-court restructuring directly, one can estimate the effect of empty creditors with less noise. This is the reason why the specification in the current paper might be more efficient than the specification of Bedendo,

Cathcart, and El-Jahel (2011).

The following steps are used to simulate a sample of distressed exchange offers and bankruptcies. Produce n random draws of the following independently distributed random variables:

$$\xi \sim N(0, 1), \quad \varepsilon \sim N(0, 1).$$

Define the true CDS insurance ratio of the bondholder as:

$$\beta = \Phi(\xi),$$

where Φ denotes the cumulative distribution function of the standard normal distribution.

The observed CDS insurance ratio is defined as:

$$\beta^o = \Phi(\xi + \varepsilon).$$

In other words, the true CDS insurance ratio is observed with an error, which is very likely to be the case with the CDS dummy employed in the empirical analysis. Also, the insurance ratio lies in the unit interval, which is consistent with the theoretical model. The participation rate x/F in the distressed exchange offer of a generic company is given by equation (4), using the true insurance ratio β and a recovery rate of $\rho = 0$.¹⁶ Then the following specification is estimated using ordinary least squares,

$$\frac{x}{F} = \alpha_0 + \alpha_1 \beta^o + u,$$

where u is the usual error term. The expected sign of α_1 is negative, which would be interpreted as evidence in favor of the empty creditor hypothesis. In order to compare this

¹⁶This is assumed for simplicity. Different values for the recovery rate do not change the qualitative nature of the results.

specification with that in Bedendo, Cathcart, and El-Jahel (2011), define

$$z = \begin{cases} 1 & \text{if } y \geq F - x \text{ (no bankruptcy)} \\ 0 & \text{else (bankruptcy),} \end{cases}$$

where y follows a uniform distribution as in the theoretical model, $y \sim U(0, \bar{y})$. It is assumed that y is independent from ξ and ε . The remaining parameter values used in the simulations are $F/\bar{y} = 0.5$, which implies that the expected value of operating cash flow equals the face value of debt. This value is chosen to capture the nature of financially distressed firms, but the main results do not depend on this particular value.

The simplified specification of Bedendo, Cathcart, and El-Jahel (2011) can then be written as:

$$z = a_0 + a_1\beta^o + v,$$

where a negative value for the coefficient a_1 is consistent with the empty creditor hypothesis. Note that the second specification is written as a linear equation for better comparison, but it is estimated as a probit model. Table VII presents estimation results for both specifications based on simulated data. Each specification is estimated 1,000 times, and each round uses a sample size of n , which is shown in the columns of the table. For any given round, the same random draws are used for both specifications. The first row presents the average of the estimator $\hat{\alpha}_1$, whereas the third row contains the average of the estimator \hat{a}_1 . Rows two and four show standard deviations across 1,000 estimators.

In Table VII, the standard errors for the specification of Bedendo, Cathcart, and El-Jahel (2011) are significantly larger than in the specification of the present paper. Even though the mean of \hat{a}_1 is higher in each column in absolute terms, for the most part the standard errors are not small enough to produce significant coefficients. Only for a sample size of $n = 1,000$ is the standard error of \hat{a}_1 smaller than the absolute value of half the average coefficient. On the other hand, the specification used in the present paper produces small standard errors.

The coefficients are significant even in small samples.

The results suggest that by looking at realized bankruptcies, one can potentially identify the empty creditor problem. However, the necessary sample size is rather large. This is consistent with the findings of Subrahmanyam, Tang, and Wang (2012), who use a large sample to show that CDS contracts increase the likelihood of bankruptcy. However, it is difficult to link their findings to a particular channel through which CDSs affect bankruptcy. The present paper suggests that it might be via the failure of out-of-court restructurings that CDS contracts increase the probability of bankruptcy.

5 Robustness

5.1 Bootstrapped regressions

The small sample size raises the question of the robustness of asymptotic p -values presented in Table IV. Therefore, Table VIII contains results from bootstrapped regressions. The number of bootstrap samples is $N = 10,000$ for each specification. The regression coefficients in Table VIII are means across N estimated coefficients. The standard errors are calculated as the standard deviations of N estimated coefficients. The p -values are calculated using these means and standard deviations together with the standard normal distribution. The CDS dummy is still highly significant across all specifications. Also, little has changed for the other explanatory variables. An exception is the control variable for time to maturity, which becomes highly significant in all specifications. Unreported tests show that this is due to the fact that the bootstrapped standard errors are not cluster-robust, in contrast to the standard errors in Table IV. The bootstrapped results suggest that the negative relationship between the CDS dummy variable and participation rates is not likely to be an artifact of the small sample used in this paper.

5.2 Logit-transformed dependent variable

Table IX provides estimation results for OLS regressions where the logit transformation is applied to the participation rate. The transformation does not affect the main results as the CDS dummy variable is negative and significant in all specifications. However, time to maturity is no longer a significant explanatory variable. The overall explanatory power in terms of adjusted R^2 is similar to the base case results in Table IV. Thus, the negative relationship between the CDS dummy variable and participation rates does not seem to be caused by the fact that the participation rate is bounded in the unit interval.

5.3 CDS data from DTCC

Since October 31, 2008, the Depository Trust and Clearing Corporation publishes weekly data on the notional amounts outstanding in the CDS market. For the 1,000 largest reference entities it reports the gross and net notional amount outstanding. According to DTCC, more than 90% of all global credit derivatives transactions are electronically confirmed through its system.¹⁷ In the base case specification in (7), the CDS dummy is not a very precise measure of the degree of bondholders' CDS protection. The DTCC data allows to construct a more precise measure by dividing the net notional outstanding for each reference entity by the total debt issued by the company. The advantage of this measure is that it takes into account the amount of CDS contracts outstanding and the amount of debt issued by a firm. It measures the amount of protection sold relative to the firm's debt outstanding. Therefore, it is a more precise measure than the CDS dummy. However, this measure still assumes that at least some CDS buyers are bondholders. Another advantage of the DTCC data is that it contains net notional amounts, which is an economically more meaningful measure than gross notionals for the purpose of this application. It excludes positions that exist to offset previously opened positions in the CDS market. The disadvantages of this measure relative

¹⁷See the DTCC press release on October 31, 2008. The data are publicly available at <http://www.dtcc.com/products/derivserv/data>.

to the dummy variable is that it is only available from October 31, 2008, and that is only available for the global top 1,000 reference entities.

The following procedure is applied to construct the new measure of CDS protection. Each firm in the sample of distressed exchange offers is manually matched to the DTCC data based on firm name. Then, divide the net notional outstanding by the sum of long-term debt and debt in current liabilities. The net notional amounts are taken from the latest week before the offer date of the exchange offer. If a firm is not contained in the DTCC data, but it is known from Markit that is not a reference entity in the CDS market, the measure is set to zero.

Table X shows estimation results for the base case specification in (7), where the CDS dummy variable has been replaced with the net notional amount of CDS outstanding divided by debt outstanding. The table reveals that although the number of observations drops from $n = 189$ to $n = 107$ in column (1), the relationship between the new measure and the participation rate is negative and highly significant. Moreover, the new measure can explain a larger amount of the variation in participation rates. Column (1) in Table X shows an adjusted R^2 of 0.59, whereas the corresponding column in Table IV shows only 0.27. A comparison of Columns (1) and (5) in Table X reveals that including the new measure as an additional explanatory variable increases the adjusted R^2 from 0.15 to 0.59. Most other explanatory variables are not significantly different from zero, similarly to the previous tables. Notable exceptions are the number of trades and the number of bond issues involved in the exchange offer. These two variables measure the degree of bondholder dispersion and predict a lower participation rate, which is consistent with the negative regression coefficients. The dummy variable for senior bonds carries a positive and significant coefficient in two specifications.

The same concerns about endogeneity problems that were present in the base case specification (7), carry over to the present analysis. Therefore, the new measure of CDS protection is used to replace the CDS dummy variable in the difference-in-differences

specification (14). After the introduction of the Big Bang protocol in April 2009, more CDS contracts had ‘No Restructuring’ clauses than before. Such clauses reduce the incentive of bondholders to participate in a distressed exchange offer. Therefore, after the Big Bang protocol one expects to see a more negative relationship between the amount of CDS protection and participation rates. Table XI presents estimation results where the new measure of CDS protection is used in the difference-in-differences specification (14). The explanatory power is high, relative to the previous tables. The full specification in Column (1) of Table XI produces an adjusted R^2 of 0.61. The coefficient of net notional divided by debt is negative across all specifications, although not always significant. This is consistent with the idea that even before the Big Bang protocol, the empty creditor problem is present to some extent. The coefficients of the interaction term are negative in all columns, and significant in three out of four specifications. This suggests that after the Big Bang protocol, the relationship between the amount of CDS protection outstanding and participation rates is stronger, consistent with the main hypothesis in this paper. Some specifications show higher p -values, which might be explained by the smaller sample sizes due to the short history of DTCC data.

5.4 The effect of CDSs on future bankruptcy

This section shows that the availability of CDS contracts is related to a higher probability of bankruptcy. Although Lie, Lie, and McConnell (2001) show that less successful out-of-court restructurings lead to a higher likelihood of future bankruptcy, the unique sample used in this paper might be different from existing studies. The sequence of events can be thought of as follows. As a firm experiences a negative cash flow shock and becomes financially distressed, it first tries to reduce its debt out of court. Depending on whether the firm experiences further negative cash flow shocks, it might find it necessary to file for bankruptcy. Besides further negative shocks, the likelihood of future bankruptcy also depends on the success of the out-of-court restructuring. If the firm can reduce its debt substantially, it is unlikely that

it will have to file for bankruptcy. The success of the out-of-court restructuring, assuming the empty creditor hypothesis is correct, depends on the amount of CDS protection held by bondholders.

Table XII shows the results of predictive regressions for a bankruptcy event. The binary dependent variable takes the value one if the firm files for bankruptcy within two years after the announcement date of the distressed exchange offer. Following the literature of bankruptcy prediction (e.g., Chava and Jarrow 2004), several standard predictive variables are included, in addition to a CDS dummy variable.¹⁸ The first column in Table XII shows the results for a probit specification, which suggests that the availability of CDS contracts and a larger number of bond issues involved in a distressed exchange have a significant positive effect on the probability of bankruptcy. Firm size, on the other hand, negatively affects the likelihood of bankruptcy. The third column shows similar results for a logit specification. The second and fourth columns show marginal effects evaluated at the sample means of all explanatory variables, except for the CDS dummy variable.¹⁹ In the probit specification, the marginal effects suggest that the availability of a CDS contract is associated with an increase in the likelihood of bankruptcy of roughly 15 percentage points. In the logit specification, this number is close to 14 percentage points. This confirms that there is a positive relationship between CDS contracts and the probability of bankruptcy. Together with the results above, the predictive regressions show that less successful restructurings translate to a higher likelihood of bankruptcy.

6 Conclusion

This paper examines whether CDS contracts change the incentives of bondholders in a way that makes it more difficult for firms in financial distress to reduce debt. The theoretical

¹⁸The market value of equity is not included in the predictive regression, because some firms in the sample do not have publicly traded equity.

¹⁹Since the CDS dummy is a discrete variable, the marginal effect is calculated as $\text{Prob}[\text{Bankruptcy} \mid \text{CDS} = 1, x = \bar{x}] - \text{Prob}[\text{Bankruptcy} \mid \text{CDS} = 0, x = \bar{x}]$, where \bar{x} represents the means of all explanatory variables except the CDS dummy.

model shows that CDS insurance is related to the participation rate in a distressed exchange offer. Using a unique sample of recent exchange offers, I show that the average participation rate decreases by 29 percentage points if the firm is a reference entity in the CDS market. The results are consistent with the empty creditor hypothesis, originally developed by Hu and Black (2008) and Bolton and Oehmke (2011). To address endogeneity concerns, the paper uses the introduction of the Big Bang protocol in the CDS market as a natural experiment. After the introduction of the protocol, the difference in the participation rates of CDS firms and non-CDS firms is larger, consistent with the hypothesis.

The findings are in contrast with Bedendo, Cathcart, and El-Jahel (2011), who find no evidence to support the empty creditor hypothesis. The main difference between the present paper and the existing literature is that the participation rate of a distressed exchange offer is used as a less noisy measure of the success of out-of-court restructurings. Using simulated data from the theoretical model, I show that a specification based on the participation rate is more efficient than existing specifications.

The findings might be relevant not only for financially distressed firms. First, the results are related to the broader research question of the net welfare effects of CDS contracts. As Bolton and Oehmke (2011) point out, these contracts have both positive and negative welfare effects. While the present paper does not address the benefits of credit derivatives, it provides evidence for their costs. Second, for firms that are not yet in financial distress. The results suggest that their ability to reduce debt in the future depends on the amount of CDS protection purchased by their bondholders. This might influence their investment and financing decisions today. Third, for investors involved in the markets for credit derivatives and corporate bonds. The theoretical model shows that the value of a CDS contract does not only depend on an exogenous probability of default. The price depends on the amount of CDS protection purchased by bondholders. Also, the price of corporate bonds depends on the level of bondholder insurance because it affects the probability of default and the payoff in a distressed exchange offer.

There are several avenues for future research related to this paper. First, one might study how banks behave in restructurings when they are insured, since the present analysis focuses solely on public debt. Second, as time passes more detailed data becomes available on the CDS market, allowing a more precise measurement of the empty creditor problem. Recently the Depository Trust and Clearing Corporation has released data on the total outstanding amount of CDS contracts on single reference entities. In the future, one might observe the derivatives holdings of every investor filing a claim in bankruptcy court. It would be interesting to see how CDS holdings of claimants affect their voting behavior. Third, in light of the recent discussions of the usefulness of credit derivatives, a quantitative comparison of the costs and benefits of CDS contracts might be used to determine their net welfare effects. Finally, the theoretical model predicts that bondholders purchase more CDS protection if the expected recovery rate is low. Testing this prediction would help to understand why bondholders trade in the CDS market, and what is the motive behind purchasing CDS protection.

Appendix

Appendix A: Multiple bondholders

This appendix contains a version of the theoretical model with multiple bondholders. The total face value of the outstanding bond is still $F > 0$ units of consumption, and each of the $n \geq 1$ bondholders is endowed with holdings of F/n . Of course in practice the endowments of bondholders can be very diverse, but the additional assumption of heterogeneity would add complexity to the model without changing the main predictions. The other parameters of the model remain unchanged. For simplicity, assume that the recovery rate in bankruptcy is zero, $\rho = 0$. The firm chooses an unconditional bid $b \in \mathbf{R}$ per unit of face value. Following the offer, bondholders simultaneously and independently decide how much face value to tender, $x_i \leq F/n$, $i = 1, \dots, n$. After the tender offer, the cash flow realizes, and the firm may go into bankruptcy. This is assumed to happen if the cash flow is less than the new face value of the bond, or $y \leq F - \sum_i x_i$. Every bondholder is assumed to have insured a common fraction $\beta \in [0, 1]$ of his exposure through a CDS contract. As before, heterogeneity in the values of β would yield similar predictions. The expected payoff of bondholder i is:

$$U_i(x_i) = bx_i + \int_0^{F-x_i-x_{-i}} \frac{\beta F}{n} dG(y) + \int_{F-x_i-x_{-i}}^{\bar{y}} \left(\frac{F}{n} - x_i \right) dG(y), \quad i = 1, \dots, n,$$

where $x_{-i} = \sum_{j \neq i} x_j$. As before, the game is solved by backwards induction. Given a bid b , the bondholders independently and simultaneously decide how much face value to tender. Bondholder i 's optimal tendering strategy for a fixed amount tendered by the other bondholders is:

$$x_i(x_{-i}) = \frac{F - x_{-i} + (1 - \beta)F/n - \bar{y}(1 - b)}{2}, \quad i = 1, \dots, n.$$

The downward sloping best reply function of the generic bondholder i illustrates the free-rider problem faced by bondholders. If the other bondholders tender a higher face value,

then bondholder i wants to free-ride on them by tendering less. Conjecturing a symmetric Nash equilibrium with an interior solution $x \leq F$, one can write down the face value of bonds tendered as a function of b ,

$$x(b) = F - \frac{\beta F + n\bar{y}(1 - b)}{1 + n}.$$

Finally, the firm chooses a bid b by taking into account the relationship $x(b)$. As in the model with a single bondholder, it can induce the bondholders to tender more bonds by offering a higher bid. On the other hand, it takes into account the costs associated with a tender offer. Using the same technique as in the simple model, the optimal bid can be found to be:

$$b = 1 - \frac{F}{\bar{y}} \frac{(1 + n)^2 - \beta}{2n(1 + n) - n^2}.$$

The corresponding face value tendered in equilibrium is:

$$x = \frac{F(1 - \beta)}{2 + n},$$

and the fraction of the bond tendered is given by the simple expression:

$$\frac{x}{F} = \frac{1 - \beta}{2 + n}.$$

It is easy to see that all comparative statics obtained in the simple model remain valid. The simple expression for x/F is surprising, as it does not depend on the firm's cash flow distribution or leverage. The ratio x/F also decreases with n , which is a symptom of the free-rider problem between bondholders. However, the most important observation for the present analysis is that the fraction of face value tendered is lower when bondholders are insured with CDS contracts, as measured by β .

Appendix B: Sufficient condition for interior solution

Proof. In Section 1 it is claimed that in equilibrium x , derived from the first-order condition, is at an interior solution, that is $x \in [0, F]$. To see that $x \leq F$, note that from (6) it follows that $\beta \in [0, 1/4]$. Therefore, $b < 1$ using (2), which implies that $x \leq F$ using (1).

To see that $x \geq 0$, substitute (6) into (3). The resulting expression can be shown to be larger than zero if and only if:

$$\frac{2(3 - 5\rho + 2\rho^2)}{4 - 3\rho} \geq 0,$$

which itself is equivalent to the inequality:

$$3 - 5\rho + 2\rho^2 \geq 0.$$

Solving the associated quadratic equation in ρ reveals that $\rho \leq 1$ is sufficient for $x \geq 0$. \square

Appendix C: Sample of distressed exchange offers

Company Name	Offer Date	Company name	Offer Date
Abitibi Bowater	2009-03-16	Hovnanian Enterprises	2009-06-19
Allis Chalmers Energy	2009-05-20	Insight Health Services	2007-03-21
American Achievement Group	2009-06-04	Intelsat	2009-01-14
American Capital Ltd.	2010-05-03	Level 3 Communications	2008-11-17
American Media Operations	2008-08-27	Marsico Parent Holdco	2010-10-08
Appleton Papers	2009-08-18	McClatchy	2009-05-21
Atlantic Express Transp.	2009-10-20	Metaldyne Corporation	2008-10-30
Autocam	2007-03-01	MF Global Holdings Ltd.	2010-06-01
Broder Bros	2009-04-20	MGM Mirage	2009-05-13
Brookstone	2010-06-11	Momentive Performance Mat.	2009-05-12
Builders Firstsource	2009-10-23	Morris Publishing Group	2009-12-14
C&D Technologies Inc.	2010-10-21	MXEnergy Holdings	2009-06-26
Centro NP	2009-02-17	NCI Building Systems	2009-09-11
Century Aluminum	2009-10-28	Neff	2008-11-17
Charter Communications	2007-08-29	Network communications	2010-11-16
Charter Communications	2007-03-06	Nexstar Broadcasting	2009-02-27
Charter Communications	2008-05-29	North Atlantic Holding Co.	2007-05-09
Charter Communications	2008-09-30	OSI Restaurant Partners	2009-02-18
Citizens Republic Bancorp	2009-07-31	Pac-West Telecomm	2006-11-15
Clear Channel Comm.	2008-11-24	Primus Telecommunications	2008-05-22
CMP Susquehanna	2009-03-09	Quality Distribution	2009-08-28
Commercial Vehicle Group	2009-08-04	Quantum	2009-03-27
Delta Mills	2006-04-17	R.H. Donnelley	2008-05-06
Duane Reade	2009-07-08	Radio One	2010-06-16
E-Trade Financial Corp.	2009-06-22	RBS Global	2009-03-25
Energy Future Holdings Corp.	2010-07-16	Realogy	2010-11-30
Energy XXI Gulf Coast	2009-09-04	Residential Capital ResCap	2008-05-02
Evergreen Solar Inc.	2011-01-03	Sensata Technologies	2009-03-03
Fairpoint Communications	2009-06-24	Six Flags	2008-05-14
FiberTower Corp.	2009-10-26	Standard Motor Products	2009-03-20
Finlay Fine Jewelry	2008-11-17	Suncom Wireless	2007-01-31
First Data	2010-11-17	Tekni-Plex Inc.	2008-03-28
Ford Motor Company	2009-03-04	The Dress Barn Inc.	2009-12-23
Freescale Semiconductor	2009-02-10	Unisys	2009-04-30
French Lick Resorts	2008-03-31	Vertis Holdings Inc.	2010-04-15
Georgia Gulf	2009-03-31	Viskase Companies	2008-08-04
Haight Cross Comm.	2009-06-08	William Lyon Homes	2009-04-13
Harrahs Entertainment	2008-11-14	Wolverine Tube	2009-02-25
Hawker Beechcraft	2009-05-04	XM Satellite Radio Holdings	2009-02-13
Hexion Specialty Chemicals	2009-05-11	YRC Worldwide	2009-11-09

Appendix D: Proxy variables for bondholder dispersion

In the empirical part of the present paper, the number of transactions of a bond during the twelve months prior to the announcement of a distressed exchange offer serves as a proxy variable for bondholder dispersion. The present section provides a justification for this particular proxy variable. Although data on the holdings of individual bondholders is scarce, there is a possibility to find the holdings of at least some classes of investors. Mutual funds in the U.S., for example, are required to file Form N-Q with the Securities and Exchange Commission, where they disclose which securities they hold and the corresponding amounts.²⁰ Also, U.S. insurance companies must report their portfolio holdings and trades to the National Association of Insurance Commissioners in what is known as Schedule D. Of course there are other classes of investors who do not report their holdings of corporate bonds, notably banks, pension funds, hedge funds, and individual investors. This is partly the reason why there are not many academic papers using holdings data for corporate bonds.²¹ However, these two classes of investors play an important role in the corporate bond market. For the large sample of corporate bonds described below, on average these two classes hold 42% of the amount outstanding. Therefore, it makes sense to look at the holdings of mutual funds and insurance companies and calculate an approximate measure of bondholder dispersion. Bloomberg Professional provides information from N-Q and Schedule D forms, but only contemporaneous data. Therefore, I perform a purely cross-sectional analysis at the end of 2010 and compare the bondholder dispersion from Bloomberg to different dispersion proxy variables for a comprehensive sample of corporate bonds.

The universe of bonds is based on the Mergent FISD database. I use all bonds which were classified by Mergent as “US Corporate Convertible,” “US Corporate Debentures,” or “US Corporate Medium Term Note”. Bonds are removed if the maturity date was before December 31, 2010, if the currency is not USD, or if the bond was issued under SEC rule

²⁰The full name of the form is “Quarterly schedule of portfolio holdings of registered management investment company.”

²¹One recent exception is Mahanti, Nashikkar, Subrahmanyam, Chacko, and Mallik (2008), where the authors use proprietary data from a custodial bank.

144a. The last two criteria are applied because the for some proxies for dispersion data from TRACE is needed, which only contains USD denominated and non-144a bonds. This yields an initial sample of 8244 corporate bonds. For these bonds the holdings of mutual funds and insurance companies are downloaded for the last quarter of 2010.²² The download date is March 10, 2010, because some investors may file the forms later than at the end of the quarter. Bondholder concentration, the opposite of bondholder dispersion, is measured as the aggregate holdings of the top five bondholders, as a fraction of the amount outstanding at the end of 2010. Alternatively, the aggregate holdings of the top 20 investors, the number of bondholders with more than 10%, and the number of bondholders with more than 5% are used as measures of concentration. The four concentration measures turn out to be highly correlated, which is why only the results for the first measure are reported. If the aggregate holdings of the top five bondholders are zero, than the bond is removed from the sample. Finally, the variable used as a measure of bondholder concentration is

$$\text{ownership concentration} = \log \left(\frac{\text{aggregate holdings of top five bondholders}}{1 - \text{aggregate holdings of top five bondholders}} \right). \quad (15)$$

The measure of bondholder concentration from Bloomberg is compared with three candidates for proxy variables. The first candidate is the number of transactions in the particular corporate bond over the prior twelve months. One might expect that a more concentrated ownership structure leads to fewer trades, whereas dispersed ownership is associated with frequent trading. The second candidate is the size of the bond, i.e., the amount outstanding. If investors are risk averse, or if regulations constrain their portfolio weights, then a larger bond might have more dispersed owners. Finally, the number of small trades relative to the total number of trades over twelve months is considered as the third proxy variable. The threshold for small trades is defined as \$ 100,000. More small trades might be associated with fewer blockholders, i.e., higher bondholder dispersion. The

²²Actually Bloomberg only provides this data for the top 20 bondholders. But it turns out that for most bonds this constraint is not binding, because they have less than 20 mutual funds or insurance companies as holders.

natural logarithm is applied to the first two proxy variables, because they are highly skewed and the transformation makes the relationship to the concentration measure (15) linear. The first two measures are winsorized at the 0.5% and 99.5% quantiles. For the sake of comparability, only those observations are used where all three proxy variables are available.

To find out which candidate performs best, the three proxy variables are compared by estimating three separate OLS regressions. The dependent variable is the bondholder concentration measure from Bloomberg, while the independent variables are the three proxy variables. Table XIII summarizes the results of the three OLS regressions. It turns out that all three proxy variables have the expected negative coefficient, and that they are highly significant. But the residual standard errors and adjusted R^2 measures show that not all proxy variables explain the variation in bondholder concentration equally well. The estimation results suggest that the number of trades in the prior twelve months is the best proxy variable for bondholder dispersion.

References

- ADAM, T., AND A. GÜTTLER (2010): “The Use of Credit Default Swaps by U.S. Fixed-Income Mutual Funds,” *Working Paper*.
- ALTMAN, E. I. (1968): “Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy,” *Journal of Finance*, 23(4), 589–609.
- ALTMAN, E. I., AND B. KARLIN (2009): “The re-emergence of distressed exchanges in corporate restructurings,” *Journal of Credit Risk*, 5(2), 43–56.
- ASHCRAFT, A. B., AND J. A. SANTOS (2009): “Has the CDS market lowered the cost of corporate debt?,” *Journal of Monetary Economics*, 56(4), 514 – 523.
- ASQUITH, P., R. GERTNER, AND D. SCHARFSTEIN (1994): “Anatomy of Financial Distress: An Examination of Junk-Bond Issuers,” *The Quarterly Journal of Economics*, 109(3), pp. 625–658.
- BEDENDO, M., L. CATHCART, AND L. EL-JAHEL (2011): “In- and out-of-court debt restructuring in the presence of credit default swaps,” *Working Paper*.
- BERNARDO, A. E., AND E. L. TALLEY (1996): “Investment Policy and Exit-Exchange Offers Within Financially Distressed Firms,” *Journal of Finance*, 51(3), 871–888.
- BETKER, B. L. (1997): “The Administrative Costs of Debt Restructurings: Some Recent Evidence,” *FM: The Journal of the Financial Management Association*, 26(4), 56 – 68.
- BOLTON, P., AND M. OEHMKE (2011): “Credit Default Swaps and the Empty Creditor Problem,” *Review of Financial Studies*, 24(8), 2617–2655.
- BRITISH BANKERS ASSOCIATION (2006): *BBA Credit Derivatives Report 2006*. London: BBA Enterprises Ltd.
- CASEY, O. (2009): “The CDS Big Bang,” *The Markit Magazine*, 4.

- CHATTERJEE, S., U. S. DHILLON, AND G. G. RAMÍREZ (1995): “Coercive tender and exchange offers in distressed high-yield debt restructurings An empirical analysis,” *Journal of Financial Economics*, 38(3), 333–360.
- CHATTERJEE, S., U. S. DHILLON, AND G. G. RAMÍREZ (1996): “Resolution of Financial Distress: Debt Restructurings via Chapter 11, Prepackaged Bankruptcies, and Workouts,” *Financial Management*, 25(1), 5–18.
- CHAVA, S., AND R. A. JARROW (2004): “Bankruptcy Prediction with Industry Effects,” *Review of Finance*, 8(4), 537–569.
- CHEN, K., M. FLEMING, J. JACKSON, A. LI, AND A. SARKAR (2011): “An Analysis of CDS Transactions: Implications for Public Reporting,” *Federal Reserve Bank of New York Staff Reports*.
- COFFEE, J. C., AND W. A. KLEIN (1991): “Bondholder coercion: the problem of constrained choice in debt tender offers and recapitalizations,” *University of Chicago Law Review*, 58(4), 1207–1273.
- DANIELS, K., AND G. G. RAMIREZ (2007): “Debt restructurings, holdouts, and exit consents,” *Journal of Financial Stability*, 3(1), 1 – 17.
- DAVYDENKO, S. A., AND I. A. STREBULAEV (2007): “Strategic Actions and Credit Spreads: An Empirical Investigation,” *Journal of Finance*, 62(6), 2633–2671.
- DUFFEE, G. R., AND C. ZHOU (2001): “Credit derivatives in banking: Useful tools for managing risk?,” *Journal of Monetary Economics*, 48(1), 25 – 54.
- DUFFIE, D. (2011): *Measuring Corporate Default Risk*, Clarendon Lectures in Finance. Oxford University Press.
- FRANKS, J., AND W. TOROUS (1994): “A comparison of financial recontracting in distressed

- exchanges and Chapter 11 reorganizations,” *Journal of Financial Economics*, 35(3), 349–370.
- GERTNER, R., AND D. SCHARFSTEIN (1991): “A Theory of Workouts and the Effects of Reorganization Law,” *Journal of Finance*, 46(4), 1189–1222.
- GIAMMARINO, R. M. (1989): “The resolution of financial distress,” *Review of Financial Studies*, 2(1), 25–47.
- GIESECKE, K., F. A. LONGSTAFF, S. SCHAEFER, AND I. STREBULAEV (2011): “Corporate bond default risk: A 150-year perspective,” *Journal of Financial Economics*, 102(2), 233 – 250.
- GILSON, S. C., K. JOHN, AND L. H. LANG (1990): “Troubled debt restructurings: An empirical study of private reorganization of firms in default,” *Journal of Financial Economics*, 27(2), 315 – 353.
- GLOSTEN, L. R., AND P. R. MILGROM (1985): “Bid, ask and transaction prices in a specialist market with heterogeneously informed informed traders,” *Journal of Financial Economics*, 14, 71–100.
- HEGE, U. (2003): “Workouts, court-supervised reorganization and the choice between private and public debt,” *Journal of Corporate Finance*, 9(2), 233 – 269.
- HENNESSY, C., AND J. ZECHNER (2011): “A Theory of Debt Market Illiquidity and Leverage Cyclicity,” *Review of Financial Studies*, forthcoming.
- HU, H. T. C., AND B. BLACK (2008): “Debt, equity and hybrid decoupling: Governance and systemic risk implications,” *European Financial Management*, 14(4), 663–709.
- KYLE, A. S. (1985): “Continuous Auctions and Insider Trading,” *Econometrica*, 53(6), 1315–1335.

- LANDO, D. (2004): *Credit Risk Modeling: Theory and Applications*. Princeton University Press.
- LIE, E., H. J. LIE, AND J. J. MCCONNELL (2001): “Debt-reducing exchange offers,” *Journal of Corporate Finance*, 7(2), 179 – 207.
- MAHANTI, S., A. NASHIKKAR, M. SUBRAHMANYAM, G. CHACKO, AND G. MALLIK (2008): “Latent liquidity: A new measure of liquidity, with an application to corporate bonds,” *Journal of Financial Economics*, 88, 272–298.
- MOORADIAN, R. M., AND J. RYAN, HARLEY E. (2005): “Out of Court Restructurings and the Resolution of Financial Distress: Section 3(a)(9) Compared to Investment Bank Managed Exchange Offers,” *The Journal of Business*, 78(4), pp. 1593–1624.
- NAIC (2011): “Insights into the Insurance Industry’s Derivatives Exposure,” Discussion paper, National Association of Insurance Commissioners.
- NARAYANAN, R. P., AND C. UZMANOGLU (2012): “Empty Creditors and Distressed Debt Restructuring,” *Working Paper*.
- ROBERTS, M. R., AND T. M. WHITED (2011): *Endogeneity in Empirical Corporate Finance*, vol. 2 of *Handbook of the Economics of Finance*, Eds. George Constantinides, Milton Harris, and Rene Stulz. Elsevier.
- SARETTO, A., AND H. TOOKES (2012): “Corporate Leverage, Debt Maturity and Credit Default Swaps: The Role of Credit Supply,” *Review of Financial Studies*, forthcoming.
- SUBRAHMANYAM, M., D. Y. TANG, AND S. Q. WANG (2012): “Does the Tail Wag the Dog? The Effect of Credit Default Swaps on Credit Risk,” *Working Paper*.
- WOOLDRIDGE, J. M. (2002): *Econometric Analysis of Cross Section and Panel Data*. MIT Press.

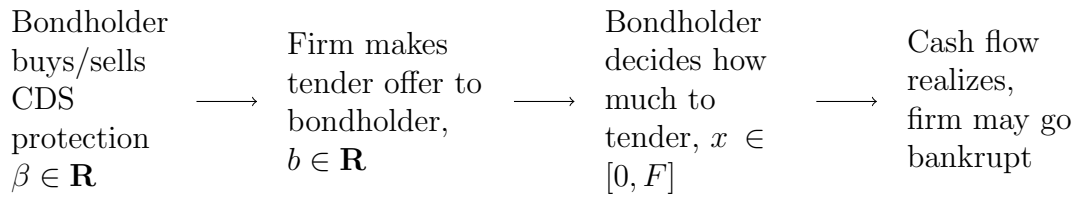


Figure 1: Timeline of events in the model.

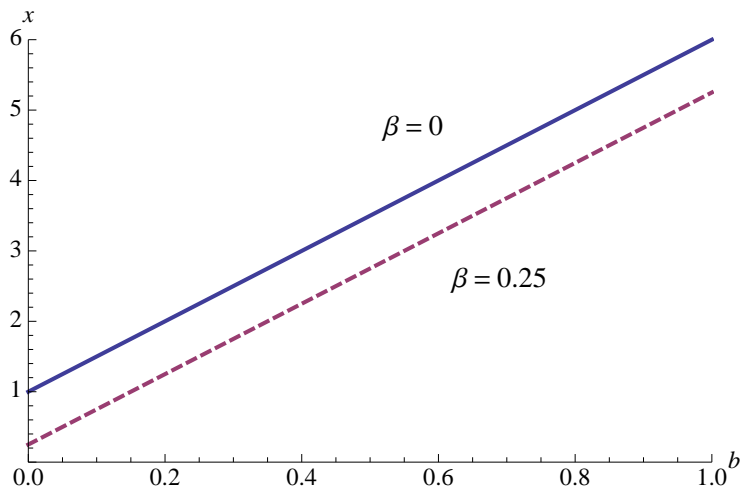


Figure 2: Total face value tendered x as a function of the firm's bid b . The dashed line shows the case where the bondholder has hedged a fraction $\beta = 0.25$ of his exposure, whereas the solid line depicts the case where $\beta = 0$. The other parameter values are $\rho = 0$, $F = 6$ and $\bar{y} = 10$.

Table I
Data sources used to construct variables

Variable	Primary source	Secondary source
Announcement date	Factiva	Bloomberg
Availability of CDS contract	Markit	
Amount outstanding (bond)	Factiva	FISD
Face value tendered	Factiva	Bloomberg
Bond maturity	FISD	
Dummy for secured bonds	FISD	
Dummy for senior bonds	FISD	
Number of bond transactions	TRACE	
Number of bond issues involved	Factiva	Bloomberg
Total assets of issuer	Compustat	SEC
Book leverage of issuer	Compustat	SEC

Table II
Summary statistics at the level of individual bond issues

The variables considered are a dummy indicating whether a CDS contract associated with the bond was traded in the six months prior to the exchange offer, the amount outstanding at the announcement date in USD million, the final amount tendered in USD million, the participation rate (amount tendered divided by amount outstanding), the time to maturity in years, the number of trades in the bonds in the 12 months prior to announcement, and different levels of security based on the FISD database. Amount outstanding, time to maturity, and the number of trades are winsorized at the 1% and 99% quantiles. If the number of trades takes the value zero, it is set to not available.

	Mean	Median	SD	Min.	Max.	Obs.
CDS	0.67					210
Amount outstanding	431.2	250.0	528.9	11.5	2617.0	210
Amount tendered	244.7	121.0	388.2	0.6	3035.1	210
Participation rate	0.54	0.55	0.32	0.00	1.00	210
Time to maturity	5.82	3.96	6.71	0.32	37.62	203
Number of trades	784.76	381.00	1041.64	4.76	5688.16	189
Security level junior	0.00					203
Security level junior subordinate	0.00					203
Security level senior	0.78					203
Security level senior subordinate	0.14					203
Security level senior secured	0.04					203
Security level subordinate	0.03					203
Security level none	0.00					203

Table III
Summary statistics at the level of distressed exchange offers

The upper half of the table shows absolute numbers, while the lower half shows fractions. The variables considered are the number of offers where a CDS contract associated with the issuer was traded in the six months prior to the offer, the number of offers where cash was used, the number of pure exchange offers, the number of conditional offers, the number of unconditional offers, the mean of the number of bond issues involved in an offer, and the number of offers per year.

	All exchange offers	CDS reference entities	Non-reference entities
Offers using cash	25	19	6
Pure exchange offers	55	14	41
Conditional offers	37	7	30
Unconditional offers	43	26	17
Issues involved	2.62	4.27	1.47
2006	2	0	2
2007	6	2	4
2008	16	12	4
2009	44	19	25
2010	11	0	11
2011	1	0	1
Total	80	33	47
Offers using cash	0.31	0.58	0.13
Pure exchange offers	0.69	0.42	0.87
Conditional offers	0.46	0.21	0.64
Unconditional offers	0.54	0.79	0.36
Issues involved			
2006	0.03	0.00	0.04
2007	0.07	0.06	0.09
2008	0.20	0.36	0.09
2009	0.55	0.58	0.53
2010	0.14	0.00	0.23
2011	0.01	0.00	0.02
Total	1	0.41	0.59

Table IV
Basecase regression results

Estimation results of OLS regressions with cluster-robust standard errors, where the dependent variable is the participation rate of the individual bonds involved in a distressed exchange offer. The independent variables are a dummy that indicates whether a CDS contract corresponding to the bond was traded, the log of the bond's time to maturity in years, the log of the amount outstanding, the log of the number of transactions in the bond in the twelve months prior to the offer, a dummy indicating whether the bond is secured, a dummy indicating whether the bond is senior, the number of bond issues involved in the exchange offer, the log of total assets, and book leverage. The numbers below regression coefficients are p -values, with standard errors clustered at the firm level. The symbols *, **, and *** refer to estimates significantly different from zero at the 10%, 5%, and 1% confidence levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	-0.046 (0.943)	0.736*** (0.000)	-0.070 (0.901)	0.712*** (0.001)	-0.250 (0.727)
CDS	-0.291*** (0.001)	-0.289*** (0.000)	-0.297*** (0.000)	-0.248*** (0.004)	
log(Maturity)	-0.061* (0.077)		-0.064** (0.018)		-0.049 (0.220)
log(AmtOut)	0.037 (0.349)		0.040 (0.192)		0.055 (0.221)
log(Trades)	-0.015 (0.541)		-0.017 (0.448)		-0.030 (0.263)
Secured	0.181*** (0.003)		0.178*** (0.001)		0.277*** (0.000)
Senior	0.217 (0.148)		0.220 (0.140)		0.167 (0.340)
Issues involved	-0.003 (0.829)			-0.007 (0.552)	-0.010 (0.481)
log(Assets)	0.003 (0.916)			-0.001 (0.963)	-0.017 (0.596)
Leverage	0.018 (0.837)			0.055 (0.550)	0.003 (0.977)
Adj. R^2	0.27	0.18	0.28	0.18	0.15
Obs.	189	210	189	209	189

Table V
Regressions based on simulated data, with and without omitted variables

The table shows estimation results of two different specifications using simulated data. The first specification is an OLS regression where the dependent variable is the participation rate in distressed exchange offers and the independent variables are a measure of the insurance of bondholders and the recovery rate. In the second specification, the recovery rate is omitted. The simulated sample size is $n = 10,000$. The columns of the table present different standard deviations of the random variable s .

	$\sigma_s = 0.01$	$\sigma_s = 0.05$	$\sigma_s = 0.1$	$\sigma_s = 0.2$
$\hat{\alpha}_1$, complete model	-0.195	-0.378	-0.386	-0.450
Standard error	0.012	0.003	0.001	0.001
$\hat{\alpha}_1$, incomplete model	0.722	0.102	-0.230	-0.438
Standard error	0.004	0.006	0.004	0.002

Table VI
Difference-in-Differences regression results

Estimation results of OLS regressions with cluster-robust standard errors, where the dependent variable is the participation rate of the bonds involved in a distressed exchange offer. The independent variables are a dummy that indicates whether a CDS contract corresponding to the bond was traded, a dummy indicating the time after the introduction of the Big Bang protocol, the interaction of the CDS dummy and the Big Bang dummy, the log of the bond's time to maturity in years, the log of the amount outstanding, the log of the number of transactions in the bond in the twelve months prior to the offer, a dummy indicating whether the bond is secured, a dummy indicating whether the bond is senior, the number of bond issues involved in the exchange offer, the log of total assets, and book leverage. The numbers below regression coefficients are p -values, with standard errors clustered at the firm level. The symbols *, **, and *** refer to estimates significantly different from zero at the 10%, 5%, and 1% confidence levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	0.182 (0.766)	0.575*** (0.000)	0.042 (0.946)	0.752*** (0.000)	-0.255 (0.724)
CDS	-0.039 (0.741)	-0.069 (0.436)	-0.102 (0.343)	0.041 (0.677)	
Big Bang	0.181 (0.102)	0.228*** (0.005)	0.179 (0.120)	0.235*** (0.004)	-0.057 (0.496)
CDS \times Big Bang	-0.450*** (0.002)	-0.465*** (0.000)	-0.409*** (0.004)	-0.525*** (0.000)	
log(Maturity)	-0.047 (0.122)		-0.059*** (0.005)		-0.045 (0.238)
log(AmtOut)	0.024 (0.547)		0.028 (0.446)		0.059 (0.191)
log(Trades)	-0.008 (0.732)		-0.018 (0.421)		-0.033 (0.221)
Secured	0.166** (0.032)		0.163** (0.017)		0.300*** (0.000)
Senior	0.224 (0.121)		0.201 (0.165)		0.188 (0.305)
Issues involved	-0.006 (0.661)			-0.008 (0.524)	-0.011 (0.453)
log(Assets)	-0.014 (0.632)			-0.022 (0.380)	-0.022 (0.478)
Leverage	-0.037 (0.653)			-0.012 (0.885)	-0.018 (0.848)
Adj. R^2	0.37	0.28	0.36	0.30	0.15
Obs.	189	210	189	209	189

Table VII
Regression results based on simulated data

The table shows estimation results of two different specifications using simulated data. The first specification, based on the present paper, is an OLS regression where the dependent variable is the participation rate in distressed exchange offers and the independent variable is a measure of the insurance of bondholders. The second specification, based on Bedendo et al. (2011), is a probit model where the dependent variable is zero if a firm files for bankruptcy after a distressed exchange offer, and one if it does not. The independent variable is the same as before. Each specification is estimated 1,000 times, and the average coefficient of the CDS insurance measure as well as the standard deviation of the coefficients is reported. The columns of the table present different sample sizes for one estimation round.

	$n = 100$	$n = 200$	$n = 300$	$n = 500$	$n = 1,000$
Mean of $\hat{\alpha}_1$	-0.192	-0.192	-0.192	-0.192	-0.192
Standard error of $\hat{\alpha}_1$	0.019	0.013	0.011	0.009	0.006
Mean of $\hat{\alpha}_1$	-0.251	-0.241	-0.255	-0.243	-0.250
Standard error of $\hat{\alpha}_1$	0.386	0.271	0.220	0.172	0.114

Table VIII
Regression results with bootstrapped standard errors

Estimation results of bootstrapped OLS regressions, where the dependent variable is the participation rate of bonds involved in a distressed exchange offer. The independent variables are a dummy that indicates whether a CDS contract corresponding to the bond was traded, the log of the bond's time to maturity in years, the log of the amount outstanding, the log of the number of transactions in the bond in the twelve months prior to the offer, a dummy indicating whether the bond is secured, a dummy indicating whether the bond is senior, the number of bond issues involved in the exchange offer, the log of total assets, and book leverage. The numbers below regression coefficients are p -values. For each regression specification, the number of samples drawn is 10,000. The symbols *, **, and *** refer to estimates significantly different from zero at the 10%, 5%, and 1% confidence levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	-0.063 (0.893)	0.736*** (0.000)	-0.084 (0.841)	0.709*** (0.000)	-0.286 (0.564)
CDS	-0.293*** (0.000)	-0.289*** (0.000)	-0.297*** (0.000)	-0.250*** (0.000)	
log(Maturity)	-0.063*** (0.005)		-0.067*** (0.001)		-0.052** (0.042)
log(AmtOut)	0.037 (0.178)		0.041* (0.063)		0.056* (0.055)
log(Trades)	-0.014 (0.465)		-0.016 (0.347)		-0.029 (0.151)
Secured	0.178*** (0.001)		0.176*** (0.000)		0.277*** (0.000)
Senior	0.221 (0.179)		0.223 (0.178)		0.168 (0.355)
Issues involved	-0.003 (0.712)			-0.007 (0.302)	-0.010 (0.198)
log(Assets)	0.003 (0.895)			-0.001 (0.961)	-0.018 (0.421)
Leverage	0.022 (0.719)			0.058 (0.309)	0.006 (0.916)
Adj. R^2	0.27	0.18	0.28	0.18	0.15
Obs.	189	210	189	209	189

Table IX
Regression results with logit-transformed dependent variable

Estimation results of OLS regressions, where the dependent variable is the logit transformation of the participation rate of bonds involved in a distressed exchange offer. The logit transformation is equal to the function $\log(x/(1-x))$. The independent variables are a dummy that indicates whether a CDS contract corresponding to the bond was traded, the log of the bond's time to maturity in years, the log of the amount outstanding, the log of the number of transactions in the bond in the twelve months prior to the offer, a dummy indicating whether the bond is secured, a dummy indicating whether the bond is senior, the number of bond issues involved in the exchange offer, the log of total assets, and book leverage. The numbers below regression coefficients are p -values, with standard errors clustered at the firm level. The symbols *, **, and *** refer to estimates significantly different from zero at the 10%, 5%, and 1% confidence levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	-2.009 (0.614)	1.852*** (0.000)	-2.094 (0.552)	2.742* (0.054)	-3.446 (0.435)
CDS	-2.039*** (0.000)	-2.141*** (0.000)	-2.120*** (0.000)	-1.803*** (0.002)	
log(Maturity)	-0.250 (0.260)		-0.258 (0.141)		-0.166 (0.523)
log(AmtOut)	0.257 (0.294)		0.238 (0.215)		0.385 (0.169)
log(Trades)	-0.201 (0.278)		-0.217 (0.190)		-0.303 (0.135)
Secured	1.223** (0.014)		1.250*** (0.008)		1.898*** (0.000)
Senior	0.999 (0.308)		0.935 (0.341)		0.651 (0.550)
Issues involved	0.007 (0.928)			-0.007 (0.916)	-0.045 (0.610)
log(Assets)	-0.065 (0.737)			-0.131 (0.418)	-0.209 (0.295)
Leverage	-0.188 (0.755)			0.048 (0.937)	-0.297 (0.643)
Adj. R^2	0.26	0.21	0.27	0.20	0.15
Obs.	189	210	189	209	189

Table X
Basecase regression results with DTCC data

Estimation results of OLS regressions with cluster-robust standard errors, where the dependent variable is the participation rate of the individual bonds involved in a distressed exchange offer. The independent variables are the net notional amount of CDS contracts outstanding divided by the book value of debt, the log of the bond's time to maturity in years, the log of the amount outstanding, the log of the number of transactions in the bond in the twelve months prior to the offer, a dummy indicating whether the bond is secured, a dummy indicating whether the bond is senior, the number of bond issues involved in the exchange offer, the log of total assets, and book leverage. The numbers below regression coefficients are p -values, with standard errors clustered at the firm level. The symbols *, **, and *** refer to estimates significantly different from zero at the 10%, 5%, and 1% confidence levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	0.910*	0.682***	0.055	1.018***	-0.250
	(0.083)	(0.000)	(0.927)	(0.000)	(0.727)
NetNotional/Debt	-1.361***	-1.372***	-1.429***	-1.267***	
	(0.000)	(0.000)	(0.000)	(0.000)	
log(Maturity)	-0.009		-0.061*		-0.049
	(0.763)		(0.056)		(0.220)
log(AmtOut)	-0.013		0.045		0.055
	(0.639)		(0.182)		(0.221)
log(Trades)	-0.029		-0.070***		-0.030
	(0.203)		(0.010)		(0.263)
Secured	0.175***		0.166***		0.277***
	(0.006)		(0.007)		(0.000)
Senior	0.303**		0.267*		0.167
	(0.027)		(0.085)		(0.340)
Issues involved	-0.025***			-0.015*	-0.010
	(0.007)			(0.072)	(0.481)
log(Assets)	0.008			-0.031	-0.017
	(0.794)			(0.218)	(0.596)
Leverage	-0.022			-0.007	0.003
	(0.719)			(0.917)	(0.977)
Adj. R^2	0.59	0.34	0.53	0.48	0.15
Obs.	107	115	107	114	189

Table XI
Difference-in-Differences with DTCC data

Estimation results of OLS regressions with cluster-robust standard errors, where the dependent variable is the participation rate of the bonds involved in a distressed exchange offer. The independent variables are the net notional amount of CDS contracts outstanding divided by the book value of debt, a dummy indicating the time after the introduction of the Big Bang protocol, the interaction of net notional / debt with the Big Bang dummy, the log of the bond's time to maturity in years, the log of the amount outstanding, the log of the number of transactions in the bond in the twelve months prior to the offer, a dummy indicating whether the bond is secured, a dummy indicating whether the bond is senior, the number of bond issues involved in the exchange offer, the log of total assets, and book leverage. The numbers below regression coefficients are p -values, with standard errors clustered at the firm level. The symbols *, **, and *** refer to estimates significantly different from zero at the 10%, 5%, and 1% confidence levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Intercept	0.858*	0.468***	0.114	0.702***	-0.255
	(0.058)	(0.000)	(0.774)	(0.002)	(0.724)
NetNotional/Debt	-0.947**	-0.502	-0.842**	-0.638	
	(0.024)	(0.306)	(0.048)	(0.118)	
BigBang	0.189**	0.344***	0.247**	0.235***	-0.057
	(0.049)	(0.000)	(0.012)	(0.004)	(0.496)
NetNotional/Debt \times BigBang	-0.559	-1.221**	-0.804*	-0.911**	
	(0.249)	(0.019)	(0.098)	(0.049)	
log(Maturity)	-0.005		-0.030		-0.045
	(0.873)		(0.247)		(0.238)
log(AmtOut)	-0.023		0.030		0.059
	(0.372)		(0.197)		(0.191)
log(Trades)	-0.029		-0.045**		-0.033
	(0.232)		(0.031)		(0.221)
Secured	0.155**		0.125**		0.300***
	(0.013)		(0.035)		(0.000)
Senior	0.184		0.143		0.188
	(0.187)		(0.264)		(0.305)
Issues involved	-0.023***			-0.008	-0.011
	(0.006)			(0.277)	(0.453)
log(Assets)	0.029			-0.018	-0.022
	(0.304)			(0.475)	(0.478)
Leverage	0.038			0.028	-0.018
	(0.537)			(0.609)	(0.848)
Adj. R^2	0.61	0.51	0.59	0.53	0.15
Obs.	107	115	107	114	189

Table XII
Predictive regressions for bankruptcy

Estimation results for predictive regressions where the dependent variable indicates if a firm files for bankruptcy within two years after the distressed exchange offer date. The unit of observation is a corporate bond involved in a distressed exchange offer. The predictive variables are a dummy indicating whether a CDS contract corresponding to the bond was traded, the log of the bond's amount outstanding, the number of bond issues involved in the exchange offer, the log of total assets, and book leverage. The marginal effects are evaluated at the sample means of the explanatory variables, except for the CDS dummy variable. Since the CDS dummy is a discrete variable, the marginal effect is calculated as $\text{Prob}[\text{Bankruptcy} \mid \text{CDS} = 1, x = \bar{x}] - \text{Prob}[\text{Bankruptcy} \mid \text{CDS} = 0, x = \bar{x}]$, where \bar{x} represents the means of all explanatory variables except the CDS dummy. The numbers below regression coefficients are p -values. The symbols *, **, and *** refer to estimates significantly different from zero at the 10%, 5%, and 1% confidence levels, respectively.

	Probit	Marg. Effect	Logit	Marg. Effect
Intercept	-2.125 (0.338)		-5.255 (0.195)	
CDS	1.183** (0.014)	0.152	2.565** (0.023)	0.141
Leverage	0.451 (0.238)	0.072	1.152 (0.110)	0.078
log(Assets)	-0.392*** (0.008)	-0.063	-0.671** (0.011)	-0.046
log(AmtOut)	0.094 (0.434)	0.015	0.196 (0.348)	0.013
Issues involved	0.214*** (0.000)	0.034	0.374*** (0.000)	0.025
McFadden's R^2	0.28		0.28	
Obs.	209		209	

Table XIII
Comparison of different proxy variables

Estimation results of OLS regressions, where the dependent variable is the bondholder concentration measure obtained from Bloomberg. The independent variables are the different proxy variables, the number of trades in the prior twelve months, the amount outstanding, and the fraction of small trades in the prior twelve months. The numbers below regression coefficients are p -values.

	Number of trades	Amount outstanding	Small trades
Intercept	0.507	2.480	-0.768
	0.000	0.000	0.000
Proxy variable	-0.259	-0.180	-0.348
	0.000	0.000	0.000
Residual standard error	1.254	1.316	1.331
Adj. R^2	0.12	0.03	0.01
Obs.	5413	5413	5413