The Anatomy of the CDS Market *

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November 26, 2013

Abstract

What is the economic role of the market for credit default swaps (CDSs)? Using novel position and trading data for single-name corporate CDSs, we provide evidence that CDS markets emerge as "alternative trading venues" for hedging and speculation: CDS markets are larger and more likely to exist for firms with bonds that are fragmented into many separate issues—suggesting a standardization and liquidity role of CDS markets. While hedging motives are associated with comparable trading volume in the bond and CDS markets, speculative trading volume is concentrated in the CDS market. Finally, we document arbitrage activity that links the CDS and the bond market via the basis trade.

*We would like to thank the DTCC for providing the data used in this research. For comments and suggestions, we are grateful to Viral Acharya, Tobias Berg, András Danis, Merritt Fox, Larry Glosten, Valentin Haddad, Dino Palazzo, Or Shachar, Kumar Sivakumar, René Stulz, Suresh Sundaresan, conference participants at the Econometric Society 2012 Winter Meeting (Chicago), European Finance Association 2012 Annual Meeting (Copenhagen), ESSFM 2012 (Gerzensee), American Economic Association 2013 Annual Meeting (San Diego) and seminar participants at the Bank of England, Boston University, Central European University, UNC, University of Houston, and CU Boulder. We thank the Center for Financial Studies at Columbia University for support, and Adam Laiacano, Aditya Dugar, Shyam Iyer, and Tim Scully for assistance with the data.

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1 Introduction

The market for credit default swaps (CDSs) has grown from an exotic niche market to a large and active venue for credit risk transfer—arguably making it one of the most significant financial innovations of the last decades.[1] Concurrently, CDS markets have become the subject of a number of policy debates, including their role in the recent financial crisis (Stulz, 2010) and, more broadly, their impact on the debtor-creditor relationship (Hu and Black, 2008; Bolton and Oehmke, 2011), firms' costs of capital, financing choices, and credit risk (Ashcraft and Santos, 2009; Saretto and Tookes, 2013; Subrahmanyam et al., 2012).

However, despite their growing importance, relatively little is known about the motivations that determine trading and positions in CDS markets. This paper aims to fill this void: Using newly available, disaggregated data on single-name CDS positions and trading volume, we investigate the motivations for trading in CDS markets and, more broadly, the economic function these markets perform.

Our evidence suggests that CDS markets are "alternative trading venues" for hedging and speculation. CDS markets are larger and more likely to exist when the reference entity's bonds are fragmented into many separate issues, suggesting a standardization and liquidity role of CDS markets: While investors can usually make the same economic trade in the underlying bond, they choose the CDS market when trading frictions in the underlying bond are larger. This interpretation is supported by the finding that bond market fragmentation is associated with both higher trading costs and lower trading volume in the underlying reference bonds. We also show that, whereas hedging motives are reflected to a similar extent in bond and CDS trading volume, speculative trading, which is likely to be more sensitive to the relative liquidity advantage of the CDS market, concentrates in the CDS market. Finally, we document arbitrage activity that links the CDS and the bond market via the

[1] In a CDS, a protection seller agrees to make a payment to the protection buyer in the case of a credit event on a prespecified reference entity. In exchange for this promised payment, the protection seller receives a periodic premium payment (and potentially an upfront payment) from the protection buyer. Credit events usually include bankruptcy, non-payment of debt, and, in some CDS contracts, debt restructuring.

basis trade. By allowing arbitrageurs to lean against mispricing in the bond market, CDS markets may help to compress spreads for bond issuers, thereby improving access to financing.

The data underlying our analysis are newly available CDS market statistics on net notional CDS amounts and CDS trading volume from the Depository Trust & Clearing Corporation (DTCC). Because the DTCC provides disaggregated information at the reference entity level, the data allow a much more detailed investigation of motivations of trading in the CDS market than was previously possible. In our analysis, we focus on *net notional* CDS amounts on individual reference entities, which is calculated as the sum of *net* protection bought by counterparties that are net buyers of protection for a particular reference entity.[2] Intuitively speaking, the net notional amount captures the stock of credit risk transferred in the CDS market.[3] In addition to the stock of credit risk transferred, we also investigate the flow of credit risk by examining trading volume in the CDS market and the underlying reference bonds.

We first provide evidence that CDSs are being used as instruments for hedging. Specifically, we show that firms who have more bonds outstanding also have larger net notional CDS positions. This positive relation between insurable interest and net notional amounts in the CDS market suggests that at least some market participants use the CDS market to hedge their bond exposure. Similarly, a number of other proxies for insurable interest are associated with larger net notional CDS positions. For example, firms that provide credit guarantees (e.g., monoline insurers) and thus represent counterparty exposure for market participants that rely on this credit insurance tend to have larger net notional CDS amounts outstanding. The same is true for firms that have larger accounts payable to trade creditors. Taken together, the documented link between insurable interest and net notional CDS amounts suggests that at least some market participants use the CDS market to hedge their debt, bond, or counterparty exposure.

[2]Equivalently, it can be calculated as the sum of net protection sold by all counterparties that are net sellers of protection for a particular reference entity.

[3]More precisely, the net notional amount represents the maximum amount of payments that need to be made between counterparties in the case of a credit event on a particular reference entity. It is the maximum because actual payments will usually be less than the par value of the CDS, reflecting non-zero recovery rates on the defaulted bonds as well as previous marking-to-market by counterparties.

Second, we document that proxies for speculative trading motives are associated with larger net CDS positions. In particular, for disagreement about a reference entity's future earnings prospects (as measured by analyst earnings forecast dispersion) is associated with larger net notional CDS amounts. This suggests that, in addition to hedging, investors use the CDS market to speculate by taking views on the default probabilities of traded reference entities.

While taken together these results suggest that both hedging and speculation are determinants of CDS positions, they do not explain *why* investors choose to trade in the CDS market as opposed to trading directly in the underlying bond. This leads to the main result of our paper, which suggests that CDS markets serve a standardization role: Holding constant the amount of bonds outstanding, net notional CDS amounts are larger for firms whose bonds are fragmented into many separate issues as proxied by the Herfindahl index. In similar spirit, we also document that, controlling for the overall amount of outstanding bonds, firms with more fragmented bond issues are more likely to be traded reference entities in the CDS markets in the first place.

What is the mechanism through which the standardized nature of the CDS market attracts investors? We provide evidence that the underlying channel is related to bond liquidity. In particular, controlling for the overall amount of bonds outstanding, higher bond market fragmentation is associated with larger roundtrip trading costs and lower trading volume in the underlying bonds. This echoes the view, held among bond market practitioners, that the fragmentation of the corporate bond market impedes its liquidity, thereby generating potential benefits from standardization (BlackRock (2013)). Our evidence suggests that, in the absence of more standardized bonds, the CDS market steps in as a standardized trading venue.

Turning to trading volume in the bond and CDS markets, we show that hedging motives are associated with comparable amounts of trading volume in the bond and the CDS market. In contrast, trading due to speculative motives occurs predominantly in the CDS market. This finding is consistent with the view that speculators, who generally have shorter trading horizons, value the liquidity advantage of the CDS and thus take short-term views in the CDS market and not in the underlying bonds.

Finally, we document that net notional CDS positions are increasing in the CDS-bond basis, a measure of mispricing of the underlying bond relative to the CDS. Specifically, when the CDS-bond basis is negative (as it has been for many reference entities since the financial crisis), the underlying bond is cheap relative to a synthetic bond formed out of a CDS and a risk-free bond. This situation gives rise to the so-called negative basis trade, in which a trader purchases the bond and buys CDS protection to exploit the relative price difference between the bond and CDS markets. Our analysis shows that firms which have a more negative CDS-bond basis have more CDS outstanding. This result suggests that arbitrageurs use CDSs to lean against the negative CDS-bond basis—an interpretation that is supported by the observation that, in the time series, the magnitude of this effect is correlated with funding conditions for arbitrageurs. By allowing arbitrageurs to lean against mispricing in the bond market, CDS markets may help to compress spreads for bond issuers. Hence, consistent with the theoretical predictions in Oehmke and Zawadowski (2013), the presence of CDSs may improve firms' access to financing through the emergence of leveraged basis traders. This interpretation echoes the findings in Saretto and Tookes (2013), who document that the presence of CDSs allows firms to borrow more and at longer maturities. Interestingly, while a negative basis is associated with larger net amounts of CDSs outstanding, the same is not true for a positive basis (which gives rise to a similar arbitrage trade). This asymmetry could be due to short-selling constraints in the underlying bond.

To our knowledge, this is the first paper that investigates the determinants of positions and trading volume in the CDS market based on data at the reference entity level,[4]. However, there are a number of recent empirical studies that investigate CDS positions or transaction volume. Using three months of confidential trading data, Chen et al. (2011) document relatively low unconditional trading volume

[4] Stulz (2010) provides a number of summary statistics based on aggregate position data from the DTCC and survey data from the Bank for International Settlements (BIS), which was the main source of position information before the DTCC data became available.

in CDSs, with spikes in trading around credit events. Consistent with the standardization function of CDS markets documented in this paper, they show that trading in CDS markets concentrates in standardized contracts that follow the industry's "big bang" protocol.[5] Shachar (2011) uses transaction level data to investigate price effects of traded volume, order imbalances and dealer inventories in the CDS market. Lee (2011) uses data from the DTCC to document a predictive effect of the ratio of net notional CDS amounts to debt on future stock prices and CDS spreads. In addition, a number of recent papers investigate the CDS-bond basis (Blanco et al. (2005), Nashikkar et al. (2010), Bai and Collin-Dufresne (2010), and Fontana (2011)). Our paper contributes to this literature by linking the CDS-bond basis to quantities in the CDS market.[6]

The remainder of the paper is structured as follows. Section 2 develops our main empirical hypotheses. In Section 3 we describe our data sources. Section 4 discusses our empirical strategy and presents the main empirical findings. Section 5 concludes.

2 Empirical Hypotheses

Taken together, the theory literature on credit default swaps suggests several economic motives for trading in the CDS market. We distill these motives into four main hypotheses that guide our empirical analysis.

H1: *Higher hedging demand is associated with larger net notional CDS amounts.* To the extent that CDSs are used for hedging, insurable interest should play a role in determining the net notional amounts of CDSs outstanding. Consider, for example, a setting in which a fraction of investors insure

[5] The "big bang" protocol change issued by the International Swaps and Derivatives Association (ISDA) provides a set of standard contractual terms for CDS contracts, including the definition of what constitutes a credit event and the creation of standard coupons and accruals.

[6] More broadly, our paper relates to a growing literature that investigates the effects of CDS markets on information transmission, risk transfer, and credit market outcomes (Acharya and Johnson (2007), Qiu and Yu (2012), Minton et al. (2009), Ashcraft and Santos (2009), Hirtle (2009), and Saretto and Tookes (2013)), as well as a growing theory literature on the uses of CDSs (Duffee and Zhou (2001), Parlour and Plantin (2008), Thompson (2009), Parlour and Winton (2012), Bolton and Oehmke (2011), Zawadowski (2013), Atkeson et al. (2012), Che and Sethi (2011), Geanakoplos and Fostel (2011), and Oehmke and Zawadowski (2013)). Du and Zhu (2012), Gupta and Sundaram (2012), and Chernov et al. (2013) investigate CDS settlement auctions.

their bond holdings. When more bonds are outstanding (i.e., insurable interest rises) we should expect to see a larger net notional amount of CDSs outstanding. Note that in contrast to hedging activity, there is no reason to believe that speculative activity in the CDS market should be directly related to insurable interest. Speculative activity is a pure bet on future changes in credit quality such that, after controlling for credit quality, it should not depend systematically on the amount of bonds outstanding. To the extent that hedging demand is associated with a larger stock of credit risk transferred in the CDS market, it may also be associated with more CDS trading volume (i.e., the flow of CDS trades).

H2: *Higher speculative demand is associated with larger net notional CDS amounts.* Investors may use CDS contracts as speculative vehicles in order to express views about a reference entity's default prospects, even if they do not own the bond or have any other exposure to the reference entity (Che and Sethi (2011), Geanakoplos and Fostel (2011), Oehmke and Zawadowski (2013)). To the extent that CDSs are used as speculative instruments, all else equal reference entities on which investors' beliefs differ more should have larger CDS positions outstanding and more CDS trading volume than reference entities with less disagreement. To the extent that speculative trading demand is associated with a larger stock of credit risk transferred in the CDS market, it may also be associated with more CDS trading volume (i.e., the flow of CDS trades).

H3: *Net notional CDS amounts are larger when the trading in the underlying bonds involves frictions.* Because investors can choose between trading in the CDS market or directly in the underlying bond, CDS markets should be more likely to emerge and more heavily used when there are frictions in the market for the underlying bonds. The rationale is that, while in principle investors can hedge or take a speculative position either using the bond or the CDS market, they will have a preference for using the CDS market when the underlying bond is illiquid, for example because the firm's bonds are fragmented into many separate bond issues. As pointed out by Stulz (2009), "firms have all sorts of different bonds whose prices are affected by call provisions, covenants, coupon, maturity, liquidity, and so on; in contrast, CDS are like standardized bonds." According to this argument, the more fragmented and diverse a company's bonds, the more attractive the CDS market becomes as a standardized venue for hedging or speculation.

H4: *Higher demand from arbitrageurs is associated with larger net notional CDS amounts.* No arbitrage implies that a long position in a bond hedged with the appropriate CDS should earn (approximately) the risk-free rate (Duffie (1999)). Deviations from this no-arbitrage relationship should thus generate demand for trading in the bond and the CDS as arbitrageurs attempt to exploit relative mispricing between the bond and CDS markets. For example, if insuring the bond in the CDS market is cheap relative to the default premium offered by the bond (a negative basis), arbitrageurs have an incentive to purchase the bond and go long CDS protection, thereby increasing the amount of CDSs outstanding. In the theoretical framework of Oehmke and Zawadowski (2013), such arbitrage trades lead to a positive relation between the CDS-bond basis and the CDS positions taken by arbitrageurs.

3 Data

Our data on CDS positions and CDS trading comes from the Depository Trust & Clearing Corporation (DTCC).[7] The position and trading data from the DTCC capture almost the entire market for standard single-name CDSs. According to the DTCC (2009), their data capture around 95% of globally traded CDSs, making it the most accurate and comprehensive publicly available dataset for CDS positions and trading.[8]

Weekly CDS position data is available from October 31, 2008. In its weekly reports on outstanding CDS positions, the DTCC discloses both the aggregate gross notional as well as the aggregate

[7]The DTCC provides clearing, settlement and trade confirmation in a number of markets, such as equities, corporate and municipal bonds, and over-the-counter derivatives. In the CDS market, the DTCC provides trade processing and trade registration services. All major dealers register their standard CDS trades with the DTCC. The DTCC then enters these trades into a Trade Information Warehouse (TIW). The data is available at http://www.dtcc.com/products/derivserv/data/index.php

[8]Prior to the release of position data by the DTCC, the main source of information about position sizes in the CDS market was the survey data from the BIS (http://www.bis.org/statistics/derstats.htm.) Relative to the DTCC data, the BIS data has a number of disadvantages. First, the BIS data only provides aggregate market statistics, while the DTCC data provides positioning at the reference entity level. Second, the BIS data is based on surveys as opposed to actual registered positions in the market. Third, because of its survey-based nature, the BIS data is prone to double counting: The same CDS transaction may be reported both by the buyer and the seller to the transaction, resulting in a double count.

net notional amounts outstanding on a particular reference entity, where "notional" refers to the par amount of credit protection that is bought or sold. In our analysis, we focus on the *net notional* amount, because it provides a more meaningful measure of the amount of credit risk transferred in the CDS market: The net notional amount outstanding adjusts the gross notional amount[9] for offsetting positions in order to better reflect the actual amount of credit risk transferred in the CDS market. Specifically, the DTCC calculates the net notional amount outstanding as the sum of net protection bought by counterparties that are net buyers of protection for a particular reference entity (or equivalently, as the sum of net protection sold by all counterparties that are net sellers of protection for a particular reference entity).[10] Intuitively, one can thus interpret the net notional amount outstanding as the maximum amount of payments that need to be made between counterparties in the case of a credit event on a particular reference entity.[11] Figure 1 provides a simple example to illustrate the difference between gross notional and net notional.

Weekly CDS trading data is available from August 13, 2010. These data capture all trades recorded with the DTCC that constitute *market risk activity*, which means that they result in a transfer of credit risk among market participants (this includes, for example, new trades, the termination of existing transactions, assignment of an existing transactions to a third party etc.). Trades that do not transfer risk are excluded (for example, the clearing of existing bilateral trades by central counterparties, portfolio compression trades, and backloaded trades).[12] The resulting measure of CDS trading volume is therefore directly comparable to trading volume in the underlying bond.

[9]The gross notional amount outstanding is simply the sum of all notional CDS contracts on a given reference entity. The gross notional amount thus reflects the total par amount of credit protection bought (or equivalently sold). It is defined as either the sum of all long or, equivalently, the sum of all short CDS contracts outstanding. With the exception of occasional compression trades, in which offsetting CDS positions are eliminated, the gross notional amount outstanding increases with every trade. The gross notional position increases even if a trade offsets an existing trade and thus reduces the overall amount of credit risk transfer in the CDS market. This makes the gross notional amount outstanding a very imprecise proxy for the amount of credit risk that is transferred in the CDS market.

[10]A counterparty's net position is less than its gross position whenever it has entered partially offsetting trades. This is usually the case because entering offsetting trades is a common way to reduce exposure in the CDS market.

[11]It is the maximum amount of payments, because actual payments will usually be less than the par value of the CDS, reflecting non-zero recovery rates on the defaulted bonds as well as previous marking-to-market by counterparties.

[12]In constructing these data, the DTCC also attempts to identify prime brokerage trades to only count them once.

Our baseline sample contains all US (parent) companies that are in Compustat, have at least one bond issue outstanding, and are rated by S&P. We restrict our baseline sample to rated companies in order to be able to control for credit quality in our regressions. We then hand-match Compustat firms to DTCC companies. All companies are kept in the sample whether or not they have a match in DTCC. Firms we cannot match to DTCC either do not have a CDS market or their CDS market is too small to make it into the DTCC data which only contains the top 1,000 reference entities (censoring). We define existence of a CDS market as having at least 3 CDS dealers that provide quotes on a 5-year CDS in the Markit data and/or being one of the top 1,000 reference entities in the DTCC data. We assume that once a CDS market exists for a reference entity, it continues to exist for the remainder of our sample.

We combine the DTCC data with a number of other standard data sources: Balance sheet data, credit ratings, and industry codes are from Compustat. For more detailed capital structure information, we hand collect information from Capital IQ. We gather data on outstanding bonds from Mergent FISD, and obtain bond trading data from TRACE. Equity market data is from CRSP and earnings forecasts from IBES. Data on CDS spreads is from Markit. A detailed description of our sample construction and matching procedures can be found in Appendix A.

Our baseline sample comprises 1072 rated US firms that are in Compustat and have at least one bond outstanding. Of these firms, 533 have a CDS market and 321 appear in the DTCC data at least once during our sample period. Our sample with detailed balance sheet data from Capital IQ includes 288 firms, 239 of which have a CDS market and 187 a DTCC entry. Our sample of firms with a CDS-bond basis consists of 138 companies, 109 of which appear in DTCC. Altogether the time series length of our baseline sample is 51 months: October 2008 to December 2012.

4 Empirical Analysis

4.1 Summary Statistics

Table 1 provides summary statistics. The table is split into three parts. We first provide summary statistics that are available for all firms in our sample. Below, we provide summary statistics for firms that are traded reference entities in the CDS market. Finally we provide summary statistics for the the subset of firms for which we have detailed (annual) balance sheet data from Capital IQ.

Overall, we have data on gross and net notional CDS positions for 14,714 firm-month observations. For those firms, the mean net notional CDS amount is given by \$1.029bn. The mean gross notional amount of CDS outstanding on a reference entity in our sample is \$13.02bn. The corresponding medians are \$791m and \$9.585bn respectively. Hence, netting within counterparties on average reduces the amount of CDS outstanding by a factor of more than ten.

The median firm in our sample has \$5.2bn in assets and bonds outstanding of \$800m (\$1bn if we include bonds issued by subsidiaries). Firms that are traded reference entities in the CDS market have median assets of \$9.8bn and \$1.6bn in bonds. For firms in DTCC, normalizing the amount of CDS protection bought or sold by the total amount of bonds the reference entity has outstanding, we find that the median net notional amount of CDS as a fraction of bonds outstanding is equal to 27.1% of bond when only looking at bonds issued directly by that firm and 19.7% when we consolidate bonds to also include bonds issued by subsidiaries. The 90th percentiles given by 116.9% and 95.9%, respectively. Firms in the Capital IQ sample are larger. The median firm in Capital IQ has \$26.41bn in assets and bonds of \$4.6bn. The median net notional CDS amount among Capital IQ firms \$936m, and the median net notional CDS amount as a fraction of bonds 14.3%.

One interesting observation is that, while these numbers suggest that significant amounts of credit risk are transferred through the CDS market, the data do not confirm the conventional wisdom that the amounts outstanding in CDS markets usually vastly exceed insurable interest (at least not when looking at the economically more meaningful quantity of net protection bought or sold). For most firms, net notional CDS amounts outstanding are significantly less than bonds outstanding.[13]

Figure 2 plots the evolution of total net notional CDS amounts over time. The top solid line depicts the total amount of net CDS outstanding on all single-name reference entities captured by the DTCC. This is essentially the entire single-name CDS market. As the figure illustrates, since the fall of 2008 net notional CDS amounts have decreased by about 35%. Nonetheless, aggregate net notional in the single-name CDS market is still substantial at around $1tn. The dashed line depicts the total net notional CDS protection written on the top 1,000 single-name entities. Comparing this line to the total single-name CDS market demonstrates that the top 1,000 reference entities make up a large fraction of the overall single-name CDS market, at least when measured in terms of net notional (in addition to firms, this includes sovereigns, states, and municipalities). The dotted line plots the total net notional CDS amounts for in our final sample. After dropping states, sovereigns, non-US companies and non-rated companies, our sample still constitutes a significant fraction of the total single-name corporate CDS market.

Figure 3 plots monthly trading volumes in bonds and CDSs in our sample. As discussed above, trading volume for CDSs only includes trades that represent market risk activity (i.e., trades that change the allocation of credit risk among market participants) and is available from August 2013. The plot shows that monthly trading volume in the CDS market (solid line) is larger and more volatile than trading volume in the associated bonds (dashed line). Bonds of companies that are not in the DTCC sample have even lower aggregate trading volume (dotted line).

[13] Nonetheless, there are some firms for which the amount of net notional of CDS outstanding significantly exceeds the amount of bonds the firm has outstanding. A typical example are potential buyout targets (with low current debt, but potentially large future debt), such as the clothing retailer Gap and the electronics distributer Arrow Electronics. Other types of companies with high net CDS amounts as a fraction of outstanding bonds are homebuilders, mortgage insurers and suppliers for the automobile industry.

4.2 Hedging and Speculation as Determinants of CDS Positions

Table 2 contains our baseline specification that investigates insurable interest and speculative demand as determinants of outstanding net CDS amounts. The specification of the regression is given by

$$NetCDS_{i,t} = \beta \cdot X_{i,t} + \epsilon_{i,t}, \tag{1}$$

where the vector X contains our explanatory variables and a constant, and ϵ is an error term.[14] Because the DTCC only provides data for the top 1,000 reference entities, there is a censoring issue, which means that a simple OLS estimation would be biased. We thus run a maximum likelihood estimation that takes account of the censoring in the data. Moreover, to mitigate the effect of outliers, we allow the error term to scale with bonds outstanding. Because of autocorrelation of our regressors, we cluster standard errors at the firm level. The econometric details of our estimation procedure can be found in Appendix B.

Table 2 shows that, using a number of different specifications, both insurable interest and speculative trading demand are significant determinants of net CDS positions. The positive coefficient on *bonds outstanding*, significant at the 1% in almost all specifications demonstrates that insurable interest is a significant determinant of the net notional positions in the CDS market. This finding is consistent with Hypothesis H1 and supports the view that at least some traders in the CDS market use CDS to hedge bond exposure. Quantitatively, the coefficient of 0.0821 in the regression that controls for ratings and includes time and industry fixed effects (column (2)) implies that for each additional dollar in bonds outstanding, net CDS positions are 8 cents higher. To gauge the economic magnitude of this effect, note that a one-standard-deviation increase in bonds outstanding (among firms that are traded reference entities in the CDS market) is associated with an increase of $1.07bn in net notional CDS positions. For the median firm (which has $791m in net notional CDS), this more than doubles the net notional amount of CDSs outstanding, although this may slightly overstate

[14] Note that we do not scale net CDS by assets. The reason is that both net CDS and the trading motives (e.g., speculation or the basis trade) do not scale naturally with assets or bonds outstanding.

the economic magnitude because bonds outstanding has a relatively skewed distribution. To mitigate the effect of skewness, we can look at percentiles: A move from the 10th to the 90th percentile in terms of bonds outstanding is associated with an increase in net notional CDS positions of $708m; the corresponding number for a move from the 25th to the 75th percentile is $242m. Column (3) shows that the effect remains significant at the 1% level when we control for CDX index membership (with a coefficient of 0.0559). When we include firm fixed effects, the magnitude of the effect is somewhat smaller but still significant at the 10% level (column (4)). Given our relatively short time series and the fact that bonds outstanding do not vary that much over time, it is not surprising that the effect is weaker when we include firm fixed effects.

To investigate the role of speculation, Table 2 also includes analyst earnings disagreement as a proxy for speculative trading demand. The rationale is that the more traders disagree on a firm's earnings prospects, the more they may want to take views on credit risk because disagreement about default probabilities should naturally be related to disagreement about earnings. Our main disagreement measure divides earnings-per-share forecast dispersion by the share price. It can thus be interpreted as the size of the firm's equity cushion relative to disagreement on earnings.[15] Columns (1)–(4) in Table 2 show that, indeed, higher analyst disagreement is associated with more net CDS outstanding for traded reference entities. The effect is significant at the 1% level when controlling for ratings, including time and industry fixed effects and controlling for CDX index membership. Based on the specification in column (2), which includes ratings controls and time and industry fixed effects, a one standard-deviation increase in earnings disagreement is associated with an increase in the net notional CDS amount of $138m, which corresponds to 17% of the median net notional CDS amount.[16] Columns (5)–(8) repeat the analysis using an unscaled measure of analyst disagreement. The results are essentially unchanged in terms of statistical significance and economic magnitudes, both for bonds outstanding and disagreement.

[15] Note that by dividing through the equity cushion, this measure automatically adjusts for the firm's leverage.

[16] When controlling for firm fixed effects (column (4)), the magnitude of the coefficient is smaller, but still statistically significant at the 10% level.

Overall, the finding that net positions in the CDS market tend to be larger when there is more disagreement about the reference entity's earnings prospects lends support to H2, which predicts a positive relation between speculative trading demand and net CDS amounts.

While we use bonds outstanding as our main proxy for insurable interest (it is the most natural candidate because bonds are directly referenced by the CDS), Table 3 investigates a number of other quantities that may represent insurable interest for hedgers in the CDS markets. In addition to the effect of bonds outstanding (which has the same magnitude as in Table 2), two additional observations emerge. First, the large positive and statistically significant coefficient on the dummy variable *credit enhancement* reflects that there is a large amount of net notional CDS protection written on companies that provide credit enhancement, which include monoline insurers and other insurance companies.[17] This suggests that investors who rely on insurance from monoline insurance companies and other providers of credit enhancement purchase CDSs in order to eliminate their counterparty risk.[18] In these cases, the protection provided by credit enhancement firms represents an insurable interest that purchasers of this insurance may want to hedge in the CDS market.[19] Second, column (5) shows that net notional CDS amounts tend to be larger for firms with larger amounts of accounts payable, suggesting that trade creditors use the CDS market to hedge exposures to their trading partners, at about two cents per dollar. Because for a given firm accounts payable do not vary much over time, this effect is not significant when we include firm fixed effects. These findings corroborate the role of insurable interest as a determinant of net notional CDS positions.

[17]The list of companies we categorized as providing credit enhancement are: AMBAC, MBIA, Primus Guaranty, Triad Guaranty, Assured Guaranty, XL Group, Radian Group, ACE, Berkshire Hathaway, PMI Group, AIG.

[18]For a model where CDS are used to insure counterparty risk, see Zawadowski (2013)

[19]Anecdotal evidence for such behavior is given by the report of the Financial Crisis Inquiry Commission:[20] In 2007-2008 Goldman Sachs purchased CDS protection on AIG after buying substantial amounts of under-collateralized OTC derivatives on subprime housing from AIG.

4.3 The CDS Market as an "Alternative Trading Venue"

We now turn to frictions in the bond market as a determinant of CDS positions. Specifically, while the results in Section 4.2 indicate that CDS markets are used both for hedging and speculation, investors can usually make the required trade also directly in the bond as opposed to the CDS market. The main result in this Section is that, consistent with H2, investors prefer the CDS market as an "alternative trading venue" when trading the underlying bonds involves frictions. To examine this point, we first look at the fragmentation of a firm's bond issues as a determinant of net notional CDS positions. After showing that, controlling for the total amount of bonds a firm has outstanding, bond fragmentation is a significant determinant of CDS positions, we provide evidence that this effect is driven by liquidity considerations.

One major difference between bonds and CDSs is that, while bond issues of a firm are often split into many different issues with different maturities, coupons, covenants and embedded options, CDSs are standardized contracts with standard maturities.[21] The benefit of such standardization is larger when the bond's of the reference entity are more fragmented. We measure the fragmentation of a reference entity's bond issues by constricting a bond Herfindahl index. More specifically, we first calculate a standard Herfindahl measure of bond issues for every firm in our sample. This is done by summing, for each firm i the squared shares that each bond issue j represents of the overall amount of bonds firm i has outstanding:

$$H_i = \sum_{j=1}^{N} \left(\frac{b_j}{B} \right)^2, \tag{2}$$

where b_j denotes the dollar amount of bond issue j and $B = \sum_j b_j$ denotes the total dollar amount of bonds firm i has outstanding. We then take the natural logarithm of the Herfindahl in order to improve the distributional properties of the measure. Finally, we adjust the logged bond Herfindahl measure for the mechanical relationship between total issuance and the number of bond issues (firms

[21]Since the so-called "big bang" protocol change that occurred in April 2009, CDSs also trade with standardized coupons and standardized accruals.

that have more bonds outstanding usually also have more separate bond issues). We do this by running a regression of $\log(H_i)$ on the log of total amount of bonds a particular issuer has outstanding. Our final measure of bond fragmentation is given by the residual of this regression.[22] The measure thereby captures the fragmentation of a firm's bond issues relative to the fitted value from a regression that predicts bond fragmentation based on the overall amount of bonds outstanding.

This bond market fragmentation measure is attractive to us for a number of reasons. First, it captures the economic intuition put forward by Stulz (2009), who points out that "firms have all sorts of different bonds whose prices are affected by call provisions, covenants, coupon, maturity, liquidity, and so on; in contrast, CDS are like standardized bonds." The more fragmented and diverse a company's bonds, the more attractive the CDS market should become as a venue for trading credit risk. Second, the bond market fragmentation is likely to be (relatively) exogenous to CDS trading: It is unlikely that managers choose the fragmentation of their bond issues to affect CDS trading on their bonds.[23] Bond fragmentation is thus a more attractive right hand side variable than direct measures of bond trading costs which are highly endogenous. In addition, while measures of liquidity that rely on trading costs of trading volume usually confound the effects of the ease of trading and the demand for trading, a reference entity's bond fragmentation is likely to be less affected by demand for trading, making it a more accurate measure of the ease with which bonds can be traded.

Consistent with this hypothesis, Columns (1) and (2) in Table 4 show that, controlling for the total amount of bonds that a reference entity has outstanding, bond market fragmentation is indeed a highly significant determinant of net notional CDS positions. In addition to bonds outstanding, column (1) controls for ratings time and industry fixed effects. Column (2) adds control for whether a reference entity is included in the CDX index.[24] In both specifications, bond market fragmentation

[22]In calculating bond market fragmentation, we exclude companies with only a single bond issue from the adjustment regression, since having one bond issues might reflect a corner solution, given that these firms are at the lower bound of the possible number of bond issuances. Our results are not sensitive to this.

[23]As argued by Choi et al. (2012), a first-order consideration in choosing the fragmentation of outstanding bond issues may be rollover risk. Moreover, bond fragmentation is likely to have a large history dependent component that is completely unrelated to CDS markets.

[24]Because bond market fragmentation is very stable over time at the firm level, Table 4 does not include firm fixed effects.

is significant at the 1% level and the coefficients are of similar magnitude. Column (3) and (4) repeat the analysis using a dummy variable for bond fragmentation. This dummy variable indicates that a firm's bond fragmentation is above the median. Also here, controlling for the overall amount of bonds a reference entity has outstanding, net notional CDS positions are larger when the reference entity's bonds are more fragmented.

Overall, the results in Table 4 thereby confirm the hypothesis that CDS reference entities have larger net notional CDS amounts outstanding if the underlying bond issues are more fragmented. The effect is economically large. For example, the coefficient of 0.272 on the *fragmentation* dummy variable implies that firms above the 50th percentile of bond fragmentation on average have $272m more net notional in CDSs outstanding. The coefficient of 0.286 on *bond market fragmentation* in column (1) implies that a one standard-deviation increase in bond fragmentation is associated with an increase in net notional CDS positions of $126m. Both of these effects are large relative to the median net notional CDS amount of $791m for firms in the DTCC data.

What is the mechanism through which bond market fragmentation makes the CDS market more attractive as a trading venue? To investigate this channel, Table 5 examines the link between bond market fragmentation and two measures of bond market liquidity, roundtrip trading costs for bonds and bond trading volume. To calculate roundtrip bond trading costs, we follow Feldhütter (2012) and calculate the "implied spread" that traders pay on a roundtrip transaction. Specifically, in TRACE we match trades that are at most 15 minutes and 10 trades apart and then calculate the roundtrip trading cost, expressed as a spread. Our second measure of bond liquidity is bond trading volume, also taken from TRACE.

Both trading costs and trading volume are likely to be highly endogenous variables, which is why we have not included them as regressors in our net notional regressions above. However, in order to investigate the mechanism behind the association between net notional CDS positions and bond market fragmentation, we now use roundtrip trading costs and bond trading volume as left-hand-side variables in Table 5. Specifically, column (1) shows that bond market fragmentation is a significant determinant of roundtrip trading costs for bonds: Controlling for bonds outstanding, the bonds of firms that have more fragmented bond issues have higher roundtrip trading costs. Column (2) documents that bond market fragmentation is a significant determinant of trading volume: holding constant the amount of bonds outstanding, a firm with more fragmented bonds has lower bond trading volume.

Taken together, the results in Table 5 therefore suggest that CDS markets are "alternative trading venues" for the credit risk of firms with bonds that are fragmented and thereby illiquid and costly to trade. This echoes the view, held among bond market practitioners, that the fragmentation of the corporate bond market impedes its liquidity, thereby generating potential benefits from standardization (BlackRock (2013)). Our evidence suggests that, in the absence of more standardized bonds, the CDS market steps in as a standardized trading venue.

The finding that bond fragmentation is associated with higher trading costs is consistent with the predictions of theories of corporate bond markets as OTC markets. For example, Weill (2008) shows that, in a search-based model of OTC markets, bid-ask spreads are larger for assets with smaller outstanding supply. Moreover, empirically our finding that bond fragmentation is associated with bond liquidity is consistent with the findings in Longstaff et al. (2005) and Mahanti et al. (2008), who document that bond issues of smaller size tend to have lower secondary market liquidity. Hence, keeping the overall amount of bonds issued fixed, firms that split their bonds over multiple smaller issues tend to have less liquid bonds than firms that issue the same amount of bonds as part of one issue.

4.4 CDS Market Existence

Our analysis up to now has focused on the net notional amounts of CDSs for firms that are traded reference entities in the CDS market. In this subsection, we show that a similar picture emerges when we investigate the determinants of CDS market existence (i.e., the extensive margin instead of the intensive margin).

Table 6 contains the results of a probit regression of CDS market existence on the amount of bonds outstanding, the two liquidity measures discussed in Section 4.3, and control variables. The results from the regression show the following. First, insurable interest as measured by bonds outstanding is associated with a higher likelihood that a firm is a traded reference entity in the CDS market. Hence, insurable interest is a significant determinant not only of CDS positions for traded reference entities, but also of whether a firm is a traded reference entity in the CDS market. Also in line with the results in Section 4.2, analyst disagreement is a significant determinant of CDS market existence, lending support to the view that speculative trading demand is a significant determinant of whether a firm becomes a traded reference entity in the CDS market.

Second, Table 6 provides further evidence that the CDS market functions as an alternative trading venue for the credit risk of firms whose bonds are fragmented into many separate issues. Specifically, controlling for the overall amount of bonds outstanding, firms whose bond issues are more fragmented are more likely to be traded reference entities in the CDS market. This lends further support, at the extensive margin, to the interpretation of CDS markets as alternative trading venues that provide a standardized forum for the trading of credit risk when firms' underlying bonds are fragmented.

4.5 CDS and Bond Trading Volume

We now turn to trading volume. Examining trading volume, in addition to net notional amounts outstanding, is interesting for two reasons. First, trading volume allows us to examine whether the determinants of trading in the CDS market are the same as the determinants of the stock of credit risk that is transferred in the CDS market (the net notional). Second, looking at trading volume in the CDS allows us to make direct comparisons to trading volume in the underlying bond.

In Table 7, we investigate the effects of insurable interest (bonds outstanding) and speculative trading motives (analyst disagreement) on trading in the bond market and the CDS market. Columns (1)–(4) investigate how insurable interest and disagreement affect monthly trading volume in the bond market, while Columns (5)–(8) examine the effect of the same variables on trading volume the CDS market. The specifications differ with respect to the control variables: Columns (1) and (4) contain time fixed effects. Columns (2) and (5) add industry fixed effects and rating controls. Columns (3) and (6) add CDX membership controls, while columns (4) and (8) contain firm fixed effects.

Overall, the results Table 7 indicate that insurable interest is a significant determinant of trading volume, both in the bond market and the CDS market. Disagreement, on the other hand, is a stronger determinant of trading volume in the CDS market than in the bond market (in the bond market, disagreement is only significant in column (1), which only controls for time fixed effects). In addition, Table 7 shows that there are striking differences in the economic magnitudes of the effects across the two markets. The effect of bonds outstanding (insurable interest) on trading volume in the bond and the CDS markets are comparable in size. In the bond market, an additional dollar of bonds outstanding is associated with an increase in monthly trading volume of around 4-5 cents, significant at the 1% level. In the CDS market, an additional dollar of bonds outstanding is associated with an increase in monthly trading volume of around 2-3 cents, also significant at the 1% level. Hence, the effect of insurable interest on trading volume is of the same order of magnitude in the two markets.

This changes dramatically when we investigate the effect of disagreement on trading volume: Here, the effects are at least an order of magnitude larger in the CDS market. For example, taking the coefficient of 2.935 from column (6), a one standard-deviation increase in disagreement is associated with an increase of $93m in monthly trading volume in the CDS market. In contrast, from column (2), which runs the same specification as column (5), we see that in the bond market a one standard-deviation increase in disagreement is associated with a (statistically insignificant) increase of only $1.1m in monthly trading volume. Hence, while the association between insurable interest and trading volume is comparable in size across the bond and CDS markets, our evidence suggests that trading due to speculative motives occurs predominantly in the CDS market. One interpretation of this finding is that for speculators with short-term horizons, the liquidity advantage of the CDS market may induce them to take short-term views in the CDS market and not in the underlying bonds. This provides further evidence for the interpretation of CDS markets as alternative trading venues for illiquid bonds:

For short-term speculators the relative liquidity difference is likely to be of first order, which suggests that speculative trading volume should concentrate in the CDS market.

In Table 8, we directly examine the effect of the liquidity of the underlying bond on trading in the bond and the CDS market. In addition to insurable interest and disagreement as determinants of the amount of trading in the CDS market, this table also explores the role of bond market fragmentation on trading volume. There are two main observations. First, the effects of insurable interest and disagreement are comparable (both in magnitude and statistical significance) to those in Table 7. Second, bond market fragmentation affects trading volume in the bond and the CDS markets.

We first examine the effect of bond market fragmentation. Here, the coefficients on bond market fragmentation and the fragmentation dummy indicate that for firms with more fragmented bond markets we observe less trading in the underlying bond (columns (1) and (2)) and more trading in the CDS (columns (5) and (6)). These effects are significant at the 1% level in the bond market and at the 5% and 10% level in the CDS market. The coefficient on the dummy variable for fragmentation lends itself to a particularly easy interpretation: A fragmented bond market is associated with $10.3m less in monthly bond trading volume, which corresponds to a reduction of about 50% for the mean firm. In the CDS market, a fragmented bond market is associated with an increase in trading volume of $80m. This finding indicates that, for firms with more fragmented bond issues, more trading of credit risk tends to happen in the CDS market and less in the bond market, suggesting that CDS and bond markets are, at least to some extent, substitutes when it comes to trading credit risk.

4.6 The CDS-bond Basis

One quantity that has received considerable attention over the last few years (and especially during the financial turmoil of 2008-2009) is the CDS-bond basis. The CDS-bond basis is defined as the CDS spread minus the yield of the underlying bond minus the risk-free rate (also known as the Z-spread). No arbitrage implies that the CDS-bond basis should be approximately zero. The reason is that a portfolio consisting of a long bond position and a CDS that insures the default risk of the bond should yield the risk-free rate. While the CDS-bond basis should be exactly equal to zero only if certain assumptions hold (see Duffie, 1999), absent limits-to-arbitrage frictions it should be approximately zero in practice.[25]

During the recent financial crisis, the CDS-bond basis became significantly negative for many reference entities as documented, for example, by Bai and Collin-Dufresne (2010) and Fontana (2011). A negative CDS-bond basis means that the CDS spread is lower than the spread over the risk-free rate on the underlying bond. Intuitively speaking, this implies that one can earn a higher spread on the bond than it costs to insure the default risk of the bond in the CDS market. This gives rise to the so-called negative basis trade, in which a trader buys the underlying bond and purchases credit protection on the bond in the CDS market to profit from the relative mispricing between the two markets. Because the arbitrage trade involves a long position in the CDS, if arbitrageurs seek to profit from a negative CDS-bond basis, such a negative basis should be associated with larger net notional CDS positions outstanding. Similarly, in a positive basis trade a trader would short the reference bond and sell credit protection on the bond to profit from the relative mispricing, thus also increasing net outstanding CDS amounts.

In this section, we use our data on net notional CDS positions to examine this arbitrage role of CDS markets. Specifically, to the extent that basis traders lean against deviations of the CDS-bond basis, this should be reflected in net notional CDS positions: When arbitrageur capital is costly, then, in equilibrium, the CDS-bond basis should reflect arbitrageurs' marginal cost funding the basis trade. Whenever funding for arbitrageurs is not perfectly elastic, such that the cost of funding for arbitrageurs is increasing in the amount of the basis trade they undertake, then, in equilibrium, there is a positive association between the deviation of the CDS-bond basis from zero and the size of the CDS positions that arbitrageurs take as part of the basis trade.[26]

[25]In practice, the CDS-bond basis has historically been slightly positive for technical reasons, such as imperfections in the repo market and the cheapest-to-deliver option (see JPMorgan, 2006).

[26]For a more formal model with predictions along similar lines, see Oehmke and Zawadowski (2013).

We investigate this prediction in Table 9, where we include the CDS-bond basis as a potential determinant of net notional CDS positions. We calculate the CDS-bond basis using bonds with remaining maturities of 3–30 years. To be conservative, we eliminate bonds with embedded options (puttable, callable, redeemable) and floating rate coupons. We use the overnight indexed swap (OIS) rate as the risk-free rate. This yields data on the CDS-bond basis data for 138 companies. For each company, we calculate the average monthly CDS-bond basis for all outstanding bonds. In the regression, we then use the bond with the largest basis in a given month, because this bond represents the most profitable opportunity for an arbitrageur.[27]

Columns (1) and (2) in Table 9 investigate the CDS-bond basis as a determinant of net notional CDS positions for investment grade firms. We use investment grade firms as our baseline case, because for investment grade firms frictions resulting from margin requirements are likely less severe for arbitrageurs (Garleanu and Pedersen (2011)). Columns (1) and (2) show that deviations of the CDS-bond basis from zero (i.e., the absolute value of the CDS-bond basis) are indeed associated with larger net notional CDS amounts, as predicted by the arbitrage trade required to profit from a negative or positive basis. The coefficient on the CDS-bond basis is significant (at the 1% level) even when we include firm fixed effects. Columns (3) and (4) decompose the effect of the CDS-bond basis by examining negative and positive CDS-bond bases separately. The results indicate that the effect of the CDS-bond basis on net notional CDS positions is asymmetric. A negative CDS-bond basis is associated with a statistically significant increase in net notional CDS outstanding, even when including firm fixed effects. In contrast, the coefficient on the positive CDS-bond basis is smaller and generally not statistically significant. While this could partially be driven by lack of data (during our sample period positive CDS-bond bases are somewhat rare), this finding is consistent with the interpretation that there is an asymmetry in the effect of negative and positive CDS-bond bases on net notional amounts of CDS outstanding: Profiting from a positive CDS-bond basis requires short-selling

[27] In order to ensure that the results are not driven by bonds that do not trade much, we have also performed the analysis using a CDS-bond basis calculated using only trades of at least \$1m in size. The results, reported in Table 10, are similar both in statistical significance and economic magnitudes.

the bond, which is often difficult and costly. Trading against a negative CDS-bond basis, on the other hand, does not require short-selling the bond. Because of this difference in the trading strategies, arbitrageurs may lean less aggressively against a positive CDS-bond basis, resulting in the asymmetry documented in Table 9. Consistent with this interpretation, Blanco et al. (2005) argue that the difficulty of shorting bonds may be one of the reasons why during normal times (i.e., prior to the financial crisis) the CDS-bond basis has usually been slightly positive. Columns (5)–(8) repeat the analysis including both investment grade and non-investment grade firms. The results are similar in terms of statistical significance, with slightly reduced economic magnitudes, most likely reflecting additional frictions (such as larger margin requirements) in financing the basis trade for non-investment grade firms.

In terms of economic magnitudes, column (3) in Table 9 indicates that for bonds with a negative basis, a one standard deviation decrease in the basis (i.e., a more negative basis of 168 basis points) is associated with an increase in net notional CDS outstanding of $208m, which, for the median firm in the DTCC data, corresponds to a 26% increase in net notional CDS positions.

The positive association between net notional CDS positions and deviations of the CDS-bond basis from zero suggests arbitrage activity that links bond markets and CDS markets. This interpretation is corroborated by Figure 5. The figure plots a time series of the coefficients on the negative CDS-bond basis, estimated cross-sectionally for every month in our sample with 95% confidence intervals depicted by the shaded grey area. The figure shows that, at the beginning of our sample period, the coefficient is essentially zero, reflecting the extremely difficult funding conditions of a basis trade in late 2008 and early 2009, as also illustrated by the high TED-spread (dashed line). As funding conditions improve later on in the sample, the basis coefficient becomes positive and statistically different from zero. Finally, towards the end of the sample, the basis coefficient seems to decline, potentially reflecting diminished opportunities in the basis trade (although given the generally compressed basis towards the end of the sample, the coefficient is harder to pin down, as shown by the larger 95% confidence intervals). Note that, because these coefficients are estimated monthly rather than using our entire sample, statistical significance is somewhat lower than in Table 9.[28]

To the extent that the significant coefficient on the negative CDS-bond basis reflects arbitrage activity, this result points to another economic function of CDS markets. By allowing arbitrageurs to lean against mispricing in the bond market, CDS markets may help to compress spreads for bond issuers. The presence of CDSs may thereby improve firms' access to financing. This interpretation echoes the empirical findings of Saretto and Tookes (2013), who document that the presence of CDSs allows firms to borrow more and at longer maturities. The finding is also consistent with the theoretical predictions in Oehmke and Zawadowski (2013), who show that the introduction of CDSs can reduce bond spreads for issuers through via the emergence of levered basis traders.

5 Conclusion

This paper investigates the economic role of the CDS market by analyzing the determinants of the amount credit protection bought (or equivalently sold) in the market for credit default swaps (CDSs). Our analysis, based on novel data on net notional CDS positions and CDS trading volume from the Depository Trust & Clearing Corporation (DTCC), suggests that CDS markets function as "alternative trading venues" for both hedging and speculation in the underlying bond. In particular, net notional CDS positions are larger and CDS markets more likely to emerge when the underlying bonds of the firm are fragmented into separate issues, suggesting a standardization and liquidity role of the CDS market. This interpretation is supported by the finding that such bond fragmentation is associated with higher trading costs and lower trading volume in the underlying bonds.

We also show that, whereas hedging motives are reflected to a similar extent trading volume in the bond and CDS markets, speculative trading volume concentrates in the CDS market. Finally,

[28]The observation that the basis coefficient is lowest when funding conditions are difficult makes it unlikely that the result is driven by dealer inventory coefficients: If it were CDS dealer inventory management that drives the association between net notional CDS positions and the CDS-bond basis, then the effect should be larger (not smaller) when funding conditions for dealers are tough.

we document arbitrage activity that links the CDS and the bond market via the basis trade: Firms which have a more negative CDS-bond basis (i.e., the bond is undervalued relative to the CDS) have larger amounts of CDSs outstanding, suggesting that arbitrageurs use the CDS market to lean against potential misplacing in the bond market. By allowing arbitrageurs to lean against mispricing in the bond market, CDS markets may thus help to compress spreads for bond issuers. Through this channel, the presence of CDSs may improve firms' access to financing.

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A Sample Construction

When matching Compustat to DTCC companies, we only took into account exact matches. Thus the CDS of a subsidiary was not matched to that of the parent. If we found more than one possible DTCC match for a Compustat firm, we dropped it. We also exclude companies which are in bankruptcy and ones for which there was a CDS settlement auction in or after 2007. We check whether a certain reference entity is part of a major CDS index (CDX.NA.IG, CDX.NA.HY) based on the Markit manual.

Given the complicated legal structure of companies, we construct two different measures of bonds outstanding. The first measure, *bonds outstanding (direct issue)*, includes all bonds issued directly by the parent company, including all bonds issued by companies that have been acquired and fully dissolved (in case of mergers and acquisitions, the new parent inherits the bonds of the old company). The second measure, *bonds issued by subsidiaries*, includes all bonds issued by all subsidiaries of the parent company (parent companies may or may not be liable for the bonds of their subsidiaries).[29]

Bonds outstanding are from Mergent FISD. We exclude all short-term bonds; only bonds with at least 366 days of original maturity are considered. We also exclude bonds in the month of their issuance and the month of their redemption. Pass-through notes are also dropped. In Mergent FISD, we drop bonds that have been effectively recalled or decrease the amount outstanding by the recall amount. We also drop bonds with zero or unrecorded offering amount. We calculate bond trading for the bonds in Mergent FISD using Trace and match the two using the CUSIP of the bond issues. In Trace "1MM+" is replaced by 1 million and "5MM+" by 5 million.

Matching between bond issues and Compustat companies is done along two dimensions. First, since most of the companies issuing debt also have traded equity, we use the CRSP files to match old cusips (e.g., acquired company) to new cusips (e.g., acquirer). In case of a merger or acquisition, we use the same file to find the new parent company. We then hand-check all the matches and verify whether

[29] Note that Compustat and Capital IQ both look at consolidated balance sheets thus they treat the bond issuances of all subsidiaries as that of the parent or acquirer.

the acquired companies (or subsidiaries) are limited liability entities or not (i.e., whether the parent is liable for the obligations). Second, we use the Mergent FISD parent identifier to consolidate companies with the same parent. We also hand-search for parent companies using internet recourses (Bloomberg BusinessWeek and Wikipedia). To exclude potential erroneous matches between Compustat and FISD Mergent we exclude companies that have more than twice as many bonds than debt. Note that a company might have somewhat more bonds because Compustat and Mergent FISD data are not perfectly synchronized in time. We then use the first six digits of CUSIP (which identifies the issuer) to match our data to bond data from Mergent FISD. In a second round of matching all unmatched issues in Mergent FISD are, if possible, hand matched to Compustat.

We hand-match Compustat companies to the Markit CDS spread database. For all companies with a CDS spread we then search for fixed-coupon bonds without embedded options (we thus we exclude all bonds with floating coupons and all bonds that are puttable, redeemable, callable, exchangeable, or convertible) and a remaining maturity of 3 to 30 years. We then find a matching maturity CDS spread by interpolating CDS spreads in Markit. We use the overnight indexed swap (OIS) rate as the risk-free rate. The CDS-bond basis is then calculated as the difference between the CDS spread and the bond spread over the OIS rate. For each bond, we calculate the CDS-bond basis at daily frequency and then take a monthly average in order to reduce noise.

We use IBES earnings analyst forecasts to calculate measures of disagreement. We take monthly data on the two-year earnings per share forecast (since it has the most forecasts). For the *analyst disagreement: std* measure we do not normalize the standard deviation; *analyst disagreement: std./price* is calculated by dividing the standard deviation of forecasts by the CRSP stock price if the stock price is above one dollar.

We drop companies with SIC industry code 9995 (non-operating establishments) and companies with no assets. We also drop companies for which we have no SIC codes. To avoid possibly erroneous matches with Capital IQ and Mergent FISD that result in outliers, we filter our matches. We exclude Capital IQ observations for which the total amount of borrowing measured by Capital IQ exceeds the total amount of debt measured by Compustat by more than 50% of assets (measured by Compustat). Similarly we exclude all Mergent FISD observations for which the total amount bonds outstanding measured by Mergent FISD exceeds the total amount of debt measured by Compustat by more than 50% of assets. The results are not sensitive to the exact specification of such data filtering. Companies with SIC code 9997 are hand-assigned to industries.We winsorize all variables unbounded variables at the 1% and 99% level. We winsorize the CDS-bond basis at the 5% and 95% level because of outliers but the exact level of winsorization does not effect the results. Finally, we drop (quasi) state-owned companies (Fannie Mae, Federal Home Loan Mortgage Corporation, United States Postal Service). These companies have large asset bases but no CDS in DTCC, and thus behave very differently from the regular sample.

B Censoring in the DTCC Data

For single-name CDSs, the DTCC provides weekly position data (gross and net notional) for the top 1,000 traded reference entities in terms of aggregate gross notional amounts outstanding. This implies that there is a censoring issue in the data: We do not observe CDS positions for firms that have gross notional amounts outstanding that are too small to make it into the top 1,000 reference entities.

The censoring issue is illustrated in Figure 4. The figure plots the logarithm of net notional amounts in CDS outstanding as a function of *log assets*. The figure displays the reference entities for which we have CDS position data from the DTCC and the censored observations, for which we do not have CDS position data. We can thus infer that, conditional on a CDS market existing, these firms have gross notional amounts outstanding that lie below the cutoff to the 1,000 largest reference entities. Not taking into account this censoring problem would result in censoring bias (see, e.g., Wooldridge, 2010). For example, the slope coefficient in on OLS regression of log net CDS on log assets, illustrated in Figure 4, would be biased downward. In our empirical analysis we thus use a censored regression approach that takes into account that firms for which we do not observe CDS position data either are not traded reference entities, or are traded but do not make it into the top 1,000 reference entities.

One complication that arises in adjusting for the censoring problem is that, while our analysis focuses on the net notional outstanding, the DTCC determines the cutoff as to which reference entity makes the top 1,000 list in terms of the gross notional outstanding. Of course, the resulting censoring problem carries over to net notional values: Reference entities that have low gross notional amounts of CDSs outstanding, are also likely to have low net notional amounts outstanding. Hence, because of the cutoff in terms of gross notional outstanding, our data is also likely to leave out reference entities with small amounts of net notional CDS outstanding. However, because the DTCC cutoff is in gross notional, in adjusting for this bias we have to make an assumption on the relation between gross notional and net notional amounts of CDS outstanding.

We make this adjustment by exploiting the empirical relation between gross notional and net notional amounts. To make the adjustment from gross notional to net notional we assume that for companies that are left out of our data because their gross notional amount outstanding are too small, the relation between gross notional to net notional amounts equals the mean of the empirical gross-net relation of firms for which we observe CDS positions in the same month. Adjusting for the uncertainty of this cutoff does not have a significant impact on our estimates so it is omitted for simplicity.

We run a maximum likelihood estimation that corrects for the cutoff in the reference entities that we observe in the data. The likelihood function is constructed as follows. We observe $y_i = Net\_CDS_{i,t}$ for all firms for which $y_{i,t}$ exceeds the threshold $\tilde{y}_{i,t}$, where

$$L_t = \prod_{i=1}^{n} \left[\frac{1}{\sigma} \cdot \phi \left(\frac{y_{i,t} - \beta \cdot X_{i,t}}{\sigma} \right) \right]^{d_{i,t}} \cdot \left[\Phi \left(\frac{NetCutoff_t - \beta \cdot X_{i,t}}{\sigma} \right) \right]^{1-d_{i,t}}, \tag{3}$$

where $d_{i,t}$ is an indicator for observing net notional CDS outstanding,

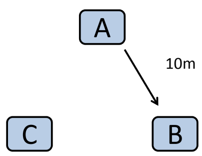
$$d_{i,t} = \begin{cases} 1 & \text{if} \quad y_{i,t} \geq NetCutoff_t \\ 0 & \text{if} \quad y_{i,t} < NetCutoff_t. \end{cases} \tag{4}$$

X is a vector that contains our explanatory variables and a constant. $\phi(\cdot)$ is the pdf of the standard normal distribution, and $\Phi(\cdot)$ the cdf of the standard normal distribution. We jointly estimate

$$\sigma = \text{const} + \gamma \cdot \text{bonds outstanding} \tag{5}$$

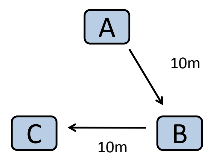
to allow for the scaling of the error term with the size of the bond market.

Example (a): Gross and net notional positions



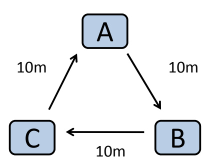
	Gross CDS bought	Gross CDS sold	Net CDS
A	0	10	(10)
B	10	0	10
C	0	0	0
Total	Gross Notional Bought =10	Gross Notional Sold =10	Net Notional Bought/Sold=10

Example (b): Gross and net notional positions



	Gross CDS bought	Gross CDS sold	Net CDS
A	0	10	(10)
B	10	10	0
C	10	0	10
Total	Gross Notional Bought =20	Gross Notional Sold =20	Net Notional Bought/Sold=10

Example (c): Gross and net notional positions



	Gross CDS bought	Gross CDS sold	Net CDS
A	10	10	0
B	10	10	0
C	10	10	0
Total	Gross Notional Bought =30	Gross Notional Sold =30	Net Notional Bought/Sold=0

Figure 1: **Gross notional and net notional CDS amounts**

The figure illustrates the difference between gross notional and net notional amounts in the DTCC data. In Example (a), B has purchased $10m in protection from A. Both the gross notional and the net notional amount outstanding are $10m. In Example (b), B offsets the initial trade by selling $10m in protection to C. This raises the gross notional amount to $20m. The net notional amount remains at $10m. In Example (c), C sells $10m in protection to A, such that all three parties have a net zero position. The gross notional is now $30m but, because all net positions are zero, the net notional is $0.

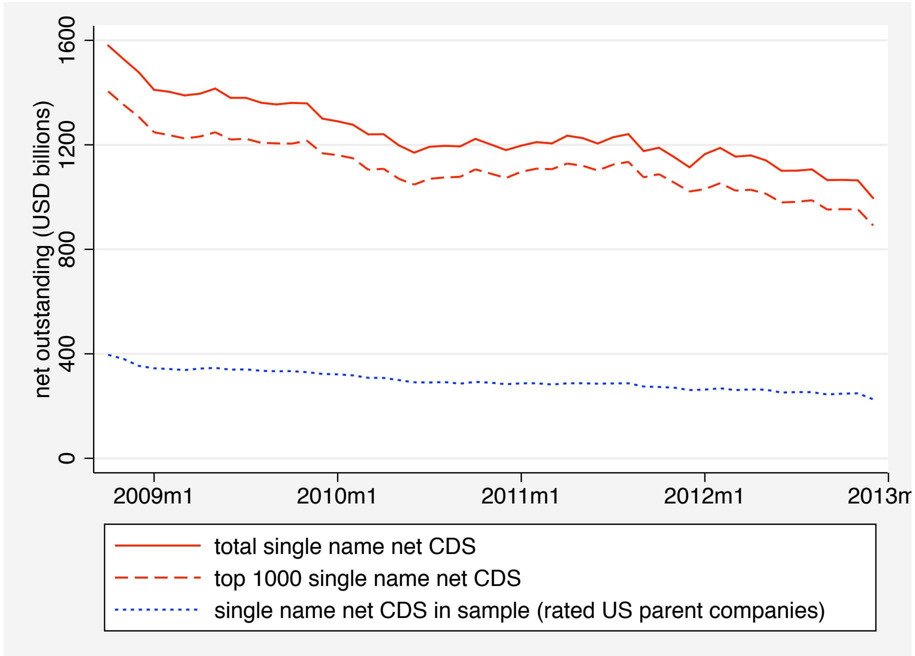


Figure 2: **Single-name CDS net notional amounts over time**

The top solid line plots the total amount of net CDS outstanding on all single-name reference entities, as reported by the DTCC. It thus captures the entire single-name CDS market. The dashed line plots the net total net notional in CDS protection written on the top 1,000 single-name reference entities. Comparing this line to the total single-name CDS market demonstrates that the top 1,000 reference entities make up a large fraction of the single-name CDS market when measured in terms of net notional outstanding. The dotted line plots total net notional CDS amounts for reference entities in our sample: rated US (parent) companies that are in Compustat and have at least one bond outstanding.

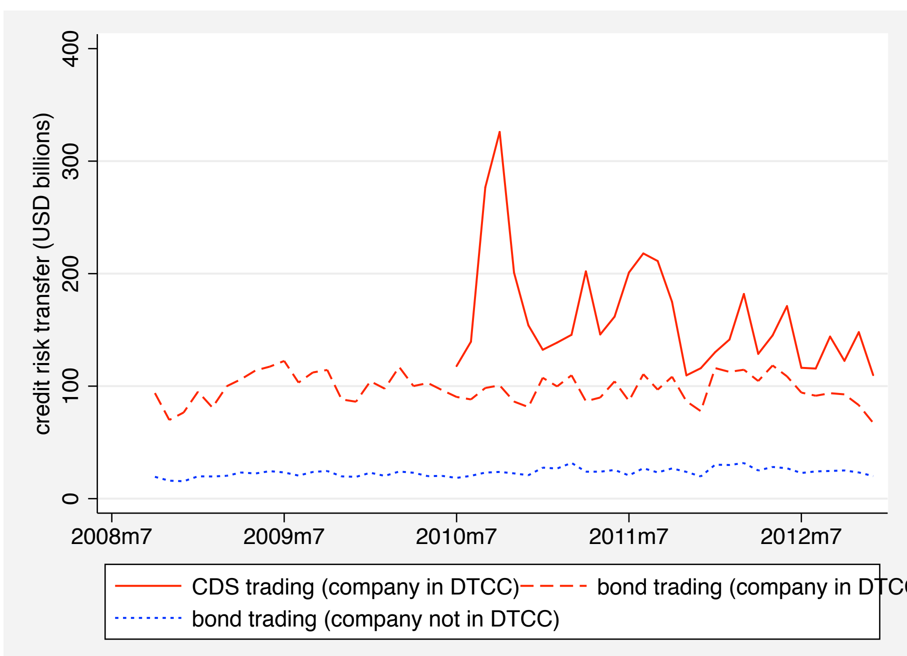


Figure 3: **Trading volume in CDSs and bonds**

The figure plots trading volume in the bond market and the CDS market. The solid line depicts monthly trading volume in the CDS market as measured by trades the represent market risk activity according to the DTCC. The dashed line and the dotted line depict monthly bond trading volume (the total dollar amount of bond trading, as reported in Trace, excluding trading for bonds issued in the last 90 days). The dashed line depicts bond trading for firms for which we also have CDS trading volume (DTCC companies). The dotted line represents bond trading for non-DTCC companies.

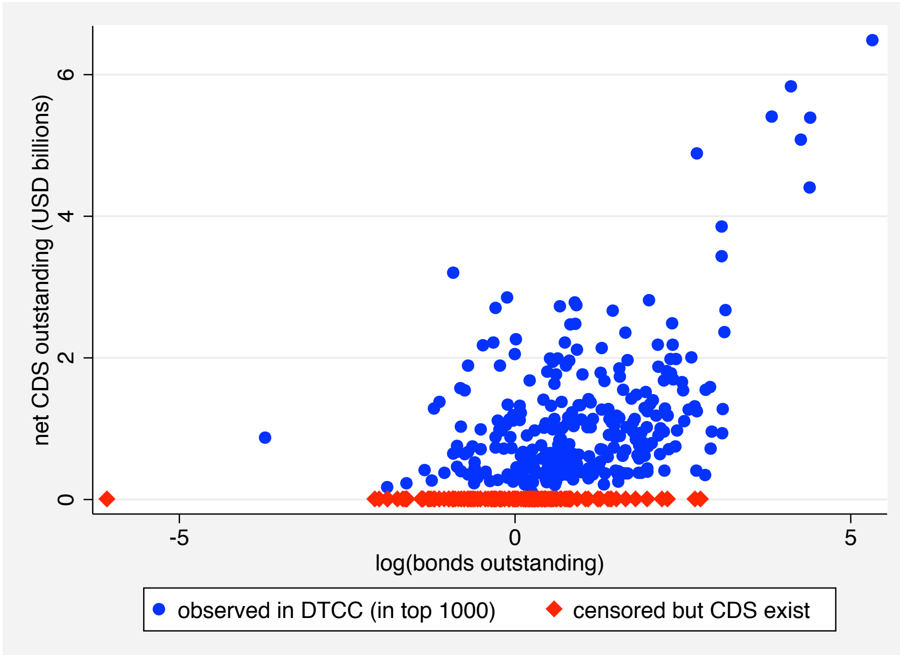


Figure 4: **Censoring in net notional CDS amounts**

This figure illustrates the censoring in our sample based on one example month, December 2009. We plot the net CDS for *all* companies for which we know that the CDS market exists: companies that we observe in the DTCC data and/or for which we can find a Markit CDS quote from at least 3 dealers. Firms in the DTCC data are denoted by circles, firms not in DTCC by diamonds. For firms not in DTCC, in the figure we set the net notional CDS amount to zero. However, we know that these firms have positive net notional CDS amounts but do not make it into the top 1,000 reference entities.

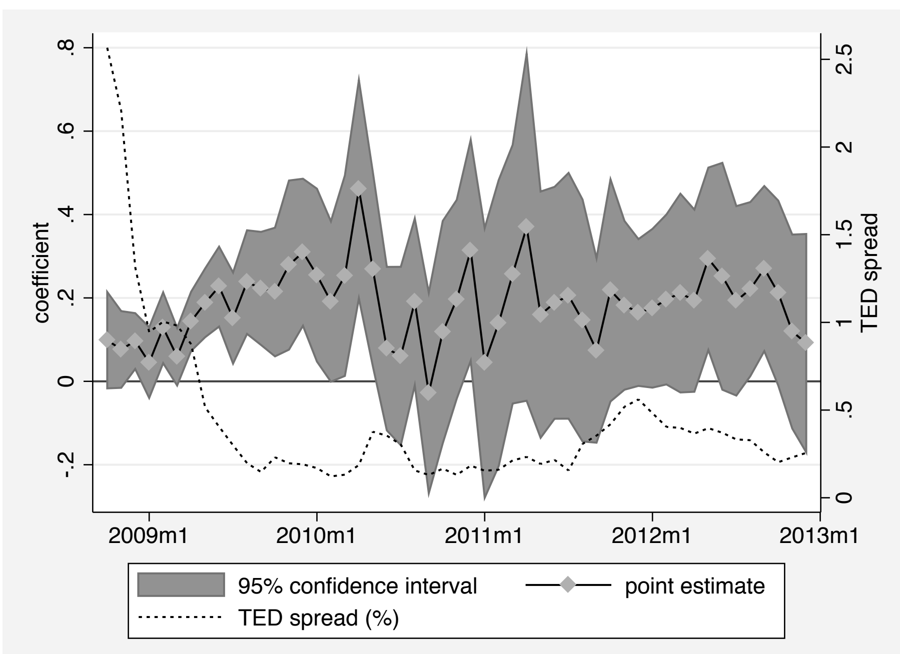


Figure 5: **Cross-sectional coefficient of negative basis on net CDS over time**

This figure plots the time-series of the cross-sectional coefficient of net notional CDS amounts on the absolute value of the negative CDS-bond basis (left scale). The regression specification is the same as in Table 9, column (3), but allows for time-variation in the basis coefficient. The grey shaded region denotes the 95% confidence interval. The dashed line plots funding conditions as measured by the TED spread (right scale).

Table 1: **Summary Statistics**

This table presents summary statistics for monthly data from October 2008 to December 2012 for all companies in our sample: US parent companies in Compustat with at least one bond outstanding and rated by S&P. *assets* is total assets and *debt* is total long and short-term debt from Compustat. *issuer bonds outstanding* is the total amount of bonds outstanding of the issuing entity (parent) from Mergent FISD, while *consolidated bonds outstanding* is the total amount of bonds issued by including this issued by subsidiaries of the parent. Quarterly data from Compustat is converted into monthly. *net CDS*, *gross CDS* are the net and gross notional amount of CDS outstanding respectively as reported by the DTCC. The last weekly DTCC observation each month is used. *accounts payable* is from Compustat and set to zero for financials. *S&P rating (notch)* captures a firm's S&P rating; it takes value 1 for AAA, 2 for AA+ etc. The maximum value, 22, indicates that the bond has defaulted. *5y CDS spread (bps)* is the CDS spread from Markit in basis points. *absolute CDS-bond basis* is the largest CDS-bond basis in absolute value for a company where the basis is calculated as the CDS spread plus the OIS-swap spread (interpolated to match maturity) minus the bond yield. *negative CDS-bond basis* and *positive CDS-bond basis* are the absolute value of the smallest negative basis and the largest positive basis. *implied bond roundtrip cost for large trades* is the implied roundtrip cost of paired bond trades from Trace with trade volume above $1 million. *issuer bond Herfindahl* is the Herfindahl measure of the fragmentation of bonds outstanding in different issues based on Mergent FISD. *fragmentation of bond market* is negative *log(issuer bond Herfindahl)* adjusted for *log(issuer bonds outstanding)*. *bond volume (monthly)* is total monthly bond trading volume from Trace for all off the run (more than 3 months old) bonds of a company in Mergent FISD. *bond turnover (monthly)* is volume divided by total bonds outstanding. *analyst disagreement: std/price* is defined as the standard deviation of analyst earnings forecast from IBES normalized by stock price from CRSP. *analyst disagreement: std* is defined as the standard deviation of analysts earnings forecasts without scaling. *commercial paper, other borrowing, capital lease, revolving credit, term loans* and *trust preferred borrowing* are annual data from the detailed balance sheet data from Capital IQ. All dollar amounts in billions, ratios winsorized at the 1% level.

All firms in sample (monthly data Oct 2008 - Dec 2012):

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	N	mean	std	p10	p50	p90
assets	43,944	31.24	148.3	1.023	5.201	44.87
bonds outstanding (direct issue)	43,944	2.703	9.900	0.200	0.800	5.233
consol'd bonds outstanding	43,944	4.126	14.22	0.200	1.008	7.850
debt	43,944	8.744	51.42	0.315	1.543	10.21
bond volume (monthly, off the run)	43,944	0.120	0.431	0	0.0225	0.236
bond turnover (monthly, off the run)	43,944	0.0361	0.0371	0	0.0269	0.0808
implied bond roundtrip cost for large trades (%)	27,179	0.387	0.321	0.120	0.289	0.759
issuer bond Herfindahl	43,944	0.509	0.340	0.121	0.414	1
bond market fragmentation	43,944	-0.267	0.440	-0.808	-0.284	0.298
S&P rating (notch)	43,944	10.64	3.440	6	10	15
disagreement: analyst std/price	38,881	0.0146	0.0305	0.00163	0.00608	0.0298
analyst disagree.: std	39,041	0.270	0.323	0.0500	0.160	0.580

Sample firms with CDS market (monthly data Oct 2008 - Dec 2012):

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	N	mean	std	p10	p50	p90
assets	24,584	51.25	195.6	2.403	9.817	76.07
bonds outstanding (direct issue)	24,584	4.347	12.99	0.376	1.645	9.000
consol'd bonds outstanding	24,584	6.686	18.54	0.475	2.144	13.05
debt	24,584	14.53	68.15	0.685	2.896	16.70
net CDS	14,714	1.029	0.896	0.310	0.791	1.890
gross CDS	14,714	13.02	12.17	2.891	9.585	25.43
net CDS / bonds (direct issue)	14,714	0.517	0.696	0.0782	0.271	1.169
net CDS / consol'd bonds (FISD)	14,714	0.393	0.546	0.0537	0.197	0.959
5y CDS spread (bps)	21,752	299.8	629.3	51.98	147.2	614.8
absolute CDS-bond basis (%)	4,862	1.627	1.634	0.250	1.198	3.365
negative CDS-bond basis (%)	4,214	1.704	1.681	0.302	1.241	3.549
positive CDS-bond basis (%)	1,369	0.905	1.076	0.0728	0.437	2.470
CDS volume (monthly)	8,643	0.508	0.637	0.0583	0.326	1.090
CDS turnover (monthly)	8,643	0.512	0.358	0.139	0.439	0.975
bond volume (monthly, off the run)	24,584	0.196	0.563	0.00189	0.0531	0.420
bond turnover (monthly, off the run)	24,584	0.0387	0.0351	0.00330	0.0305	0.0803
implied bond roundtrip cost for large trades (%)	17,141	0.394	0.320	0.117	0.305	0.769
issuer bond Herfindahl	24,584	0.347	0.278	0.0937	0.259	1
bond market fragmentation	24,584	-0.147	0.439	-0.733	-0.129	0.386
S&P rating (notch)	24,584	9.493	3.282	6	9	14
disagreement: analyst std/price	22,674	0.0139	0.0320	0.00154	0.00555	0.0265
analyst disagree.: std	22,769	0.282	0.339	0.0600	0.170	0.610

Sample firms in Capital IQ (annual data 2008-2012):

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	N	mean	std	p10	p50	p90
assets	1,052	90.78	252.9	11.60	26.41	165.8
net CDS	694	1.212	1.032	0.369	0.936	2.199
net CDS / bonds	692	0.235	0.522	0.0396	0.143	0.477
cons'd bonds outstanding	1,052	13.58	39.50	0.886	4.600	19.03
term loans	1,052	1.393	5.525	0	0	2.614
commercial paper	1,052	1.185	5.734	0	0	1.500
other borrowing	1,052	7.193	40.32	0	0.0373	4.720
capital lease	1,052	0.0944	0.312	0	0	0.259
revolving credit	1,052	0.447	2.201	0	0	0.914
trust preferred	1,052	0.502	2.581	0	0	0.412

Table 2: **Net notional CDS outstanding: hedging and speculation**

The left hand side variable is net CDS outstanding for companies for which CDS market exists. Right hand side variables are proxies for hedging and speculation and controls. Censored regression allowing for heteroskedasticity in the functional form of constant plus a coeff. times bonds outstanding. When including firm fixed effects, we only include companies that appear in the DTCC data at least once. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	(1) net CDS	(2) net CDS	(3) net CDS	(4) net CDS	(5) net CDS	(6) net CDS	(7) net CDS	(8) net CDS
bonds outstanding (direct issue)	0.0814***	0.0821***	0.0559***	0.0193*	0.0787***	0.0822***	0.0560***	0.0202**
	(7.42)	(7.12)	(7.62)	(1.96)	(7.23)	(6.96)	(7.51)	(2.05)
disagreement: analyst std/price	4.182***	4.316***	3.471***	0.734*				
	(3.80)	(4.41)	(3.67)	(1.86)				
disagreement: analyst std					0.327***	0.279**	0.269***	0.0904*
					(2.82)	(2.43)	(2.85)	(1.77)
time fixed effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
firm fixed effects	No	No	No	Yes	No	No	No	Yes
industry fixed effects	No	Yes	Yes	No	No	Yes	Yes	No
ratings controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
CDX membership controls	No	No	Yes	No	No	No	Yes	No
Number of Firms	502	502	502	305	503	503	503	305
Number of Observations	22674	22674	22674	14169	22769	22769	22769	14202

Table 3: **Net notional CDS outstanding: detailed insurable interest**

The left hand side variable is net CDS outstanding for companies for which CDS market exists. Right hand side variables are proxies for hedging and controls. Censored regression allowing for heteroskedasticity: std of error term allowed to vary in *total debt* (and *industry bonds outstanding*, where applicable). When including firm fixed effects, we only include companies that appear in the DTCC data at least once. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	full sample			
	(1) net CDS	(2) net CDS	(3) net CDS	(4) net CDS
bonds outstanding (direct issue)	0.0825***	0.0166*		
	(7.08)	(1.93)		
bonds issued by subsidiaries	0.0106	0.000748		
	(1.64)	(0.20)		
cons'd bonds outstanding			0.0254***	0.0126**
			(4.89)	(2.14)
other borrowing	-0.00523	0.0106**		
	(-1.58)	(2.17)		
accounts payable	0.0226***	-0.00241		
	(2.79)	(-0.64)		
credit enhancement (dummy)	2.598***		2.384***	
	(6.90)		(4.69)	
term loans			-0.0140	-0.0244*
			(-0.47)	(-1.72)
commercial paper			-0.0475	0.0140
			(-1.62)	(1.14)
other borrowing			0.00784	0.0189
			(1.58)	(1.17)
capital lease			0.130	-0.128***
			(1.46)	(-3.09)
revolving credit			-0.00236	0.0218
			(-0.07)	(1.44)
trust preferred			-0.0408	-0.0656
			(-0.35)	(-0.67)
time fixed effects	Yes	Yes	Yes	Yes
firm fixed effects	No	Yes	No	Yes
industry fixed effects	Yes	No	Yes	No
ratings controls	Yes	Yes	Yes	Yes
Number of Firms	533	321	239	187
Number of Observations	24584	15212	892	708

Table 4: **Net notional CDS amounts and bond market fragmentation**

The left hand side variable is net CDS outstanding for companies for which CDS market exists. Right hand side variables are proxies for bond market liquidity and controls. Censored regression allowing for heteroskedasticity in the functional form of constant plus a coeff. times bonds outstanding. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	(1) net CDS	(2) net CDS	(3) net CDS	(4) net CDS
bond market fragmentation	0.286***	0.182***		
	(3.76)	(2.78)		
high fragmentation (dummy)			0.272***	0.181***
			(4.07)	(3.33)
bonds outstanding (direct issue)	0.0799***	0.0563***	0.0798***	0.0562***
	(6.59)	(7.87)	(6.62)	(7.91)
time fixed effects	Yes	Yes	Yes	Yes
industry fixed effects	Yes	Yes	Yes	Yes
ratings controls	Yes	Yes	Yes	Yes
CDX membership controls	No	Yes	No	Yes
Number of Firms	533	533	533	533
Number of Observations	24584	24584	24584	24584

Table 5: **Bond market fragmentation and bond liquidity**

The left hand side variable is a measure of bond market trading costs and bond market trading, the right hand side variables are explanatory variables and controls. OLS regressions. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	(1) bond roundtrip cost	(2) bond volume
bond market fragmentation	0.0261***	-0.00582***
	(3.13)	(-2.73)
log(bonds outstanding)	0.000811	
	(0.22)	
bonds outstanding (direct issue)		0.0446***
		(39.22)
disagreement: analyst std/price	1.857***	0.0241*
	(10.99)	(1.73)
time fixed effects	Yes	Yes
industry fixed effects	Yes	Yes
ratings controls	Yes	Yes
Number of Firms	905	968
Number of Observations	24406	38881

Table 6: **Existence of a CDS market (Probit)**

The left hand side variable is *1* if a CDS market exists and *0* if it does not. Right hand side variables are proxies of bond market liquidity, speculative and hedging demand and controls. Probit regression. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	(1) exist	(2) exist
log(bonds outstanding)	0.673***	0.651***
	(11.74)	(11.99)
bond market fragmentation	0.677***	0.606***
	(5.50)	(4.86)
disagreement: analyst std/price		4.430***
		(3.65)
time fixed effects	Yes	Yes
industry fixed effects	No	Yes
ratings controls	No	Yes
Number of Firms	1072	965
Number of Observations	43944	38743

Table 7: **Bond and CDS trading volume: credit risk transferred in USD billions**

The left hand side variable is bond trading volume and CDS transactions that result in credit risk transfer. Right hand side variables are proxies of speculative and hedging demand and controls. Sample firms are ones in the DTCC data, the sample period is July 2010 to December 2012. Censored regression allowing for heteroskedasticity in the functional form of constant plus a coeff. times bonds outstanding. When including firm fixed effects, we only include companies that appear in the DTCC data at least once. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	bond				CDS			
	(1) volume	(2) volume	(3) volume	(4) volume	(5) volume	(6) volume	(7) volume	(8) volume
bonds outstanding (direct issue)	0.0457***	0.0460***	0.0458***	0.0471***	0.0261***	0.0297***	0.0252***	0.0203***
	(35.03)	(34.89)	(33.55)	(12.41)	(8.22)	(8.53)	(7.56)	(3.51)
disagreement: analyst std/price	0.0626***	0.0334	0.0325	0.00174	7.096***	2.935***	2.780***	2.771***
	(2.63)	(1.49)	(1.52)	(0.06)	(3.59)	(2.63)	(2.60)	(3.29)
time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
firm fixed effects	No	No	No	Yes	No	No	No	Yes
industry fixed effects	No	Yes	Yes	No	No	Yes	Yes	No
ratings controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
CDX membership controls	No	No	Yes	No	No	No	Yes	No
Number of Firms	502	502	502	305	292	292	292	292
Number of Observations	22674	22674	22674	14169	8206	8206	8206	8206

Table 8: **Bond and CDS trading volume and bond market fragmentation**

The left hand side variable is bond trading volume and CDS transactions that result in credit risk transfer. Right hand side variables are proxies of bond market liquidity, speculative and hedging demand and controls. Sample firms are ones in the DTCC data, the sample period is July 2010 to December 2012. Censored regression allowing for heteroskedasticity in the functional form of constant plus a coeff. times bonds outstanding. When including firm fixed effects, we only include companies that appear in the DTCC data at least once. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	bond		CDS	
	(1) volume	(2) volume	(3) volume	(4) volume
bonds outstanding (direct issue)	0.0476***	0.0471***	0.0290***	0.0287***
	(33.29)	(34.28)	(8.43)	(8.41)
bond market fragmentation	-0.0153***		0.0719*	
	(-4.49)		(1.79)	
high fragmentation (dummy)		-0.0103***		0.0804**
		(-4.41)		(2.35)
disagreement: analyst std/price	0.0434*	0.0401*	3.072***	3.023***
	(1.83)	(1.70)	(2.72)	(2.66)
time fixed effects	Yes	Yes	Yes	Yes
industry fixed effects	Yes	Yes	Yes	Yes
ratings controls	Yes	Yes	Yes	Yes
Number of Firms	502	502	292	292
Number of Observations	22674	22674	8206	8206

Table 9: **Net notional CDS amounts: CDS-bond basis**

The left hand side variable is the net notional CDS amount for companies for which a CDS market exists. Right hand side variables are measures of the CDS-bond basis and controls. We calculate the basis for firms with CDS quotes from at least 3 dealers in Markit and at least one fixed coupon bond without embedded options that matures within 3-30 years. Censored regression allowing for heteroskedasticity in the functional form of constant plus a coefficient times bonds outstanding. When including firm fixed effects, we only include companies that appear in the DTCC data at least once. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	IG only				all			
	(1) net CDS	(2) net CDS	(3) net CDS	(4) net CDS	(5) net CDS	(6) net CDS	(7) net CDS	(8) net CDS
absolute CDS-bond basis (%)	0.121***	0.0440***			0.106***	0.0360***		
	(3.34)	(2.61)			(3.76)	(2.81)		
negative CDS-bond basis (%)			0.124***	0.0482***			0.108***	0.0375***
			(3.57)	(2.66)			(3.87)	(2.70)
positive CDS-bond basis (%)			0.0892	-0.00231			0.0508	0.0159
			(0.84)	(-0.06)			(0.92)	(0.69)
bonds outstanding (direct issue)	0.0527***	0.0170	0.0517***	0.0166	0.0552***	0.0165	0.0547***	0.0161
	(6.22)	(1.19)	(6.16)	(1.20)	(6.62)	(1.26)	(6.59)	(1.27)
credit enhancement (dummy)	2.709***		2.723***		2.165***		2.192***	
	(3.02)		(3.03)		(4.97)		(5.02)	
time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
firm fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
industry fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
ratings controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Firms	119	94	119	94	138	109	138	109
Number of Observations	3713	3322	3713	3322	4501	4069	4501	4069

Table 10: **Net notional CDS amounts: CDS-bond basis for large trades**

The left hand side variable is the net notional CDS amount for companies for which a CDS market exists. Right hand side variables are measures of the CDS-bond basis and controls. We calculate the basis for firms with CDS quotes from at least 3 dealers in Markit and at least one fixed coupon bond without embedded options that matures within 3-30 years. We only use bond trades of at least $1m in size ("large trades"). Censored regression allowing for heteroskedasticity in the functional form of constant plus a coefficient times bonds outstanding. When including firm fixed effects, we only include companies that appear in the DTCC data at least once. T-stats are given in parentheses based on clustered standard errors (by firm). ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	IG only				all			
	(1) net CDS	(2) net CDS	(3) net CDS	(4) net CDS	(5) net CDS	(6) net CDS	(7) net CDS	(8) net CDS
absolute CDS-bond basis (%)	0.173***	0.0560***			0.167***	0.0360**		
	(3.58)	(2.60)			(4.08)	(2.06)		
negative CDS-bond basis (%)			0.176***	0.0551***			0.170***	0.0349**
			(3.81)	(2.62)			(4.22)	(1.98)
positive CDS-bond basis (%)			0.0122	0.0704			0.0104	0.0443
			(0.05)	(1.01)			(0.08)	(0.95)
bonds outstanding (direct issue)	0.0550***	0.0188	0.0549***	0.0184	0.0567***	0.0162	0.0566***	0.0159
	(5.85)	(0.92)	(5.83)	(0.93)	(6.13)	(0.92)	(6.12)	(0.91)
credit enhancement (dummy)	2.903***		2.933***		2.338***		2.389***	
	(2.83)		(2.77)		(4.48)		(4.51)	
time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
firm fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
industry fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
ratings controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Firms	106	86	106	86	123	100	123	100
Number of Observations	2265	2030	2265	2030	2793	2539	2793	2539