The Impact of Credit Default Swaps on Corporations and Financial Markets

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Business Administration)
in The University of Michigan
2012

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To my family.

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ABSTRACT

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Credit Default Swap (CDS) is one of the most salient financial innovations and the utility of CDS markets to our economy is still subject to a heated debate. This dissertation examines the economic impact of CDS on corporations (first chapter) and financial markets (second chapter). In the first chapter, I provide the evidence of CDS playing new economic roles as a commitment device for the borrower (i.e. the firm) to repay their debt to lenders (i.e. creditors). When the firm writes incomplete debt contracts, its limited ability to commit not to default strategically in the future incurs the cost of contracting that will be ultimately paid by the firm. CDS can reduce this cost ex ante by strengthening creditors bargaining power in debt renegotiation. I identify, both theoretically and empirically, the benefit of CDS reducing the contracting cost arising from the possibility of the firms strategic default. I show that firms a priori most likely to face the limited commitment problem (i.e. firms with high strategic default incentives) experience a relatively larger reduction in their corporate bond spreads following the introduction of CDS.

In the second chapter, coauthored with Haitao Li and Weina Zhang, we provide a comprehensive empirical analysis on the implication of CDS-Bond basis arbitrage for the pricing of corporate bonds. Basis arbitrageurs introduce new risks such as funding liquidity and counter-party risk into the corporate bond market, which was dominated by passive investors before the existence of CDS. We show that a basis factor, constructed as the return differential between LOW and HIGH quintile basis portfolios, is a superior empirical proxy that captures the new risks. In the cross-section of investment grade bond returns, the basis factor carries an annual risk premium of about 3% in normal periods. However, speculative grade bonds are not affected by the basis factor as they are not widely used in the basis arbitrage.

CHAPTER I

Credit Default Swap, Strategic Default, and the Cost of Corporate Debt

1.1 Introduction

Credit default swap (CDS) is an essentially insurance-type contract that the protection seller will compensate the protection buyer in a credit event of a reference entity. The use of CDS has been increasingly popular over time so that gross notional amounts outstanding grew from below USD 2 trillion to nearly USD 60 trillion between 2002 and 2007 (see *BIS*, 2010). The recent financial crises, however, have revealed several shortcomings of CDS, which triggered a heated debate regarding the utility of this market among policymakers, academics, and financial market participants. In particular, the definition of a credit event triggering CDS payment is the center of the controversy.

In a CDS contract, typical credit events, defined by the International Swaps and Derivatives Association (ISDA), include the bankruptcy of the debtor or the failure to pay principal/interests on the debt. (Out-of-court) debt renegotiation, instead, does not constitute a credit event so that CDS contracts do not pay out after successful renegotiation.[1] This feature of a CDS contract is criticized by some legal scholars

[1] Only under particular CDS restructuring clauses (i.e., modified restructuring (Mod-R) for U.S.

(e.g., *Hu and Black* (2008a,b)) as giving rise to the 'empty creditors', i.e., the CDS-insured creditors of a financially distressed firms. They argue that empty creditors have financial incentives to push firms into inefficient bankruptcy even though debt restructuring is optimal. The media attributes the recent Chapter 11 bankruptcy filings of General Motors, Chrysler, and Six Flags to the hold-out of empty creditors in debt restructuring.

CDS and the empty creditors, it gives rise to, have attracted much attention and been under extensive scrutiny due to their significant impact on our economy. It is crucial for an informed policy-making to examine every possible effect of the empty creditors, yet existing academic literature has focused on their negative roles. Unlike other papers examining their *ex-post* (i.e. *after* default) effects on the outcome of debt renegotiation, my paper focuses on their *ex-ante* (i.e. *before* default) impacts on corporate debt contracting. In this paper, I explore the benefits of CDS (and empty creditors) as a device to make up for the incompleteness of debt contracts. More specifically, I provide one of the first theoretical and empirical evidence that by serving as a commitment device for firms not to default strategically, CDS can help reduce the cost of corporate debt contracting arising from the possibility of firms' strategic default on their debt.

Since the pioneering work by *Hart and Moore* (1994, 1998) and *Bolton and Scharfstein* (1990, 1996), the possibility of strategic default has been widely recognized as a problem of the incompleteness of corporate debt contracts. When firms cannot credibly commit to repay their debt, since their cash flows are 'observable-but-not-verifiable' and thus their payment is not enforceable in court, firms may choose to default to divert cash flows to themselves even though the cash flows are sufficient to

contracts, and modified-modified restructuring (Mod-Mod-R) for European contracts) does debt restructuring formally constitute a credit event. Even for those contracts, in practice there is often significant uncertainty for creditors whether a particular restructuring qualifies. For example. no debt restructuring in the U.S. corporate segment has ever triggered a credit event, given the general disagreement about what constitutes a restructuring event.

serve contractual payments. The possibility of strategic default reduces firms' capacity to raise debt capital by imposing the extra cost on their debt financing. It is well documented both theoretically and empirically that the threat of strategic default increases the cost of debt (e.g., see *Fan and Sundaresan* (2000) and *Davydenko and Strebulaev* (2007)).

CDS can reduce the strategic-default-related cost of contracting by improving the contracting technology and thus mitigating the limited commitment problem that firms face when making (incomplete) debt contracts. As proposed in the recent paper by *Bolton and Oehmke* (2011), CDS can make up for firms' limited ability to commit not to default strategically by strengthening creditors' bargaining position in case of debt renegotiation upon strategic default. That is, when creditors are insured through CDS, creditors stand to lose less in default (followed by the failure of debt renegotiation) and therefore are less forgiving in debt renegotiation. The better bargaining position enables creditors to extract more in debt renegotiation, and firms have less incentives to strategically renegotiate down their debt payments to their own advantage.

The goal of this paper is to empirically identify the commitment benefits of CDS by analyzing the relationship between the reductions in the cost of debt financing followed by the introduction of CDS and firm-level characteristics that are documented to influence firms' strategic default incentives. The economic intuition is that the commitment benefits should be larger for firms that face the severe problem of limited commitment in the absence of CDS, i.e., firms that are expected (by creditors) to be more likely to default strategically. If CDS plays a role as a commitment device in reducing the strategic-default-related cost of contracting, we should observe a larger reduction in the cost of debt for firms suffering from the higher cost of strategic default.

To convey the intuition more clearly, I develop a simple model by extending a stylized model of strategic debt service in *Fan and Sundaresan* (2000). The model allows me to derive the relationship between the magnitude of reductions in the likelihood of strategic default and three firm characteristics - referred to as strategic variables: (i) shareholder bargaining power, (ii) liquidation costs, and (iii) renegotiation frictions. In the model, CDS provides creditors with better outside options (i.e., the payment from CDS sellers that is presumably higher than the bond's post-default value) in their renegotiation with the firm's shareholders. The creditors' strengthened bargaining position due to the outside options results in the lower payoffs of shareholders through debt renegotiation, and decreases their option value of strategic default ex-ante. The option value of strategic default falls the most for firms whose shareholders originally have high incentives of strategic default, such as firms with high shareholder bargaining power, high liquidation costs, and less renegotiation frictions. Therefore, the model predicts a positive relationship between the commitment benefits and shareholder bargaining power or liquidation costs whereas they are negatively related to renegotiation frictions.

I test empirical predictions of the model using a panel data set of 134 corporate bonds issued to a cross-section of investment grade firms for which CDS trading was initiated between 2001 and 2008. My empirical strategy, which is conducted in a firm-fixed OLS regression with an interaction term, is essentially to regress the changes in a firm's bond spreads followed by the onset of CDS trading on its strategic variable *measured at the time of the onset of CDS trading.* I proxy for strategic variables with commonly used firm-specific variables, namely, the concentration of CEO equity ownership for shareholder bargaining power, asset intangibility for liquidation costs, and the dispersion of bondholders for the probability of renegotiation break-down.

My empirical tests yield two main findings. First, I show that firms that are more vulnerable to the threat of strategic default in the absence of CDS benefit more from the onset of CDS trading. Consistent with existing literature documenting the differential impact of CDS trading on the cost of debt across firms' riskiness (*Ashcraft and Santos* (2009)), I find a reduction (an increase) in spreads for relatively safe (risky) firms. More important, regardless of firms' riskiness, there exist significant cross-sectional patterns in the changes in bond spreads. That is, I find a larger reduction (a smaller increase) for safe (riskier) firms with (1) *higher* shareholder bargaining power, (2) *higher* liquidation costs, and (3) *lower* renegotiation frictions. These results provide empirical evidence of the commitment effects of CDS though they are not of the first-order.

Second, I show that these observed patterns between spread reductions and strategic variables are more pronounced for riskier firms. Specifically, when the sample of firms is divided into two sub-groups based on credit rating at the time of CDS introduction, AAA/AA/A and BBB, the differential effects of CDS continue to hold only for relatively low grade firms. For higher-grade firms, the magnitude of the effects is small and statistical significance disappears. This result provides further evidence of the commitment benefits of CDS. Concern about strategic default does not influence bond spreads greatly for healthy firms because default (including strategic default) is relatively less likely to occur for such firms. Therefore, the commitment effects of CDS are smaller (even negligible) for firms with high credit quality.

Robustness tests address two potential concerns. First is the possibility of other channels through which CDS trading differentially affects bond spreads across firms. Firms could be affected differentially by the introduction of CDS for a number of reasons. Among others, I am mostly concerned with the information channel of CDS, a situation where CDS trading reveals more information on firms' credit risk and thus reduces the information premium required by investors. This channel may also affect a bond spread differentially across firms in that the benefits from the information channel of CDS are more likely to accrue to informational opaque than to transparent firms. To rule out the possibility that the differential effects of CDS trading across my strategic variables arise from differences in firms' information transparency, I control for firms' transparency proxied by analyst coverage measured at the time of onset of CDS trading. My earlier findings do not change significantly in terms of both magnitude and statistical significance.

Another potential concern is that the introduction of CDS may be endogenous. For example, people may initiate the CDS trading in anticipation of the deterioration in firms' creditworthiness, which cannot be fully accounted for by my control variables in a regression. However, the explosive growth of CDS markets over my sample period (2001∼2008) seems likely to be an exogenous technology or financial innovation shock to the onset of CDS trading. Figure 1.6 shows that the notional value of outstanding CDS increased from 1 trillion at the beginning of 2001 to 62 trillion by the end of 2007. Figure 1.6 shows that the number of firms with CDS trading increases monotonically every year. As the markets expand and become more liquid, the timing of the onset of CDS trading is more likely to be exogenously affected by the ease with which traders locate prices and counter-parties owing to the accumulated experience and knowledge of CDS trading. To further address endogeneity concerns, I perform a propensity score matched sample analysis (*Rosenbaum and Rubin* (1983)). Matched firms, identified as firms that have never traded CDS but have similar characteristics to firms with CDS, are used as a control group. My earlier results hold in tests that use this matching technique.

This paper contributes to a growing literature of the implications of credit derivatives on corporations, particularly corporate debt financing. As far as I am aware, my paper is one of the first study to theoretically and empirically document that CDS can help lower the cost of corporate debt by acting as a commitment device for the firm to pay out cash flows. *Ashcraft and Santos* (2009) find that average firms have not benefited from CDS trading, and risky and opaque firms have been particularly adversely affected in terms of the cost of bond issuance. They ascribe this result to the reduced incentives of banks to monitor borrowers. Their explanation is in line with my findings that an average firm's bond spreads increase following the onset of CDS trading. *Saretto and Tookes* (2011) find that firms with traded CDS contracts on their debt are able to maintain higher leverage ratios and lower debt maturities. *Hirtle* (2008) shows that greater use of derivatives is associated with banks' improved credit supply in terms of longer loan maturity and lower spreads, especially for large firms.

My study also sheds light on the current debate over empty creditor problems, the phenomenon that empty creditors - holders of debt and CDS - may have low incentives to participate in debt renegotiation, and thus might force distressed firms into bankruptcies even when continuation is optimal. On this ground, some legal scholars (e.g., *Hu and Black* (2008a,b)) propose the removal of those creditors' voting rights in a debt restructuring process. In contrast, financial economists are concerned about the proposal since it would also erode ex ante commitment benefits of CDS (e.g., *Bolton and Oehmke* (2011), *Campello and Matta* (2011)). This study is one of the first paper to verify the beneficial role of empty creditors in reducing the cost of strategic default.

The rest of the paper is organized as follows. Section 1.2 presents a theoretical framework of how CDS affect the probability of strategic default and, hence, bond yields. The data and empirical methodology are discussed in Section 1.3. Section 1.4 reports empirical findings. Section 1.5 presents the results of the robustness tests. Section 1.6 concludes.

1.2 Theoretical Framework and Hypotheses

In this section I present the theoretical framework for the ex-ante effects of CDS on firms' strategic default incentives. This section is intended to derive testable implications on the relationship between the magnitude of the commitment effects and firm-level characteristics that influence strategic decisions concerning default and debt renegotiation. Building on the *Leland* (1994) model of risky debt where equity holders are assumed to decide *whether* and *when* to default, I examine how their default decision is affected *ex-ante* by the presence of CDS-insured debt holders in debt renegotiation.

1.2.1 Basic Model Setup

Throughout the paper, managers act in the best interest of shareholders and investment policy is fixed. Assets are traded continuously in arbitrage free markets. The term structure is at with risk-free rate r at which investors may borrow and lend freely. Cash flows from operations are independent of capital structure choices and evolve according to a geometric Brownian motion with a constant growth rate $\mu > 0$, and a constant volatility σ:

$$dV_t = (\mu - \beta)V_t dt + \sigma V_t dB_t, \tag{1.1}$$

where B_t is a standard Brownian motion, and $\beta \leq \mu$ is the firm's payout ratio.

Because of the tax deductibility of interest payments, the firm has an incentive to issue debt. Debt payments consist of a perpetual coupon payment, c, whose levels remain constant until the firm declares bankruptcy. Equity holders have the option to default on this payment, and will do so when the firm value falls below an endogenous default threshold, V_D. If the firm defaults on its debt, it can be liquidated at a proportional cost $\alpha \in [0, 1]$. Debt holders have absolute priority in liquidation, leaving them with $(1 - \alpha)V_D$.

1.2.2 Optimal Default Boundary

1.2.2.1 Case I: No Debt Renegotiation and No CDS

This subsection derives the (endogenous) optimal default boundary for the basic model setup, i.e., a situation where debt renegotiation is not possible upon default (*Leland* (1994)). Using contingent claims techniques (see, e.g., *Dixit and Pindyck* (1994)), it is easy to show that the equity value $E(V)$ satisfies the following ordinary differential equation (ODE):

$$\frac{1}{2}\sigma^2 V^2 E_{VV} + (r-\beta)VE_V - rE + \beta V - c(1-\tau) = 0, \tag{1.2}$$

where $\tau \in [0,1]$ is a (constant) tax rate, E_V and E_{VV} are the first and second derivatives of the equity value with respect to the firm value V. As the value of the asset V approaches infinity, debt becomes risk-free and hence the equity value must satisfy:

$$\lim_{V\uparrow\infty} E(V) = V - \frac{c(1-\tau)}{r}. \tag{1.3}$$

Since the equity value is zero at default, the lower boundary conditions are as follows:

$$\lim_{V\downarrow V_R} E(V) = 0, \tag{1.4a}$$

$$\lim_{V\downarrow V_R} E_V(V) = 0. \tag{1.4b}$$

The solution to the ODE is given by:

$$V_D = \frac{-\lambda}{1-\lambda}\frac{c(1-\tau)}{r} \tag{1.5}$$

where λ is a negative constant:

$$\lambda = \left(\frac{1}{2} - \frac{r-\beta}{\sigma^2}\right) - \sqrt{\left(\frac{1}{2} - \frac{r-\beta}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} < 0. \tag{1.6}$$

In equation (1.5), the default threshold is a function of the firm's fundamental such as leverage, c and asset volatility, σ.

1.2.2.2 Case II: Debt Renegotiation and No CDS

In this subsection I present how the possibility of debt renegotiation induces strategic default and thus raises the optimal default threshold derived in equation (1.5). Similar to the renegotiation model of *Fan and Sundaresan* (2000) (FS hereafter), I assume that costly liquidation can be avoided by debt renegotiation and a rupture of renegotiations drives the firm liquidated. To account for renegotiations frictions, I follow *Davydenko and Strebulaev* (2007), and allow the debt renegotiation to fail with probability q. When q is close to zero, there are few frictions in the debt renegotiation, and there is scope for shareholders to extract firm value from debt holders. In the limit where q equals one, the debt cannot be renegotiated and claims are settled based on absolute priority rules.

Once debt renegotiation is initiated, the two parties bargain over the value of the firm at renegotiation, V_R, which is divided according to the equilibrium outcome of a Nash bargaining game between equity holders and debt holders:

$$E(V) = \theta^* V, \tag{1.7a}$$

$$D(V) = (1 - \theta^*)V, \tag{1.7b}$$

where E and V are the values of equity and debt, respectively, and θ^* is the optimal sharing rule which is determined to maximize the aggregate surplus to equity and debt holders in the following Nash bargaining game:

$$\theta^* = \mathsf{argmax}\,[\theta V_R - 0]^\eta\,[(1-\theta)V_R - (1-\alpha)V_R]^{1-\eta} \tag{1.8a}$$

$$= \eta\alpha. \tag{1.8b}$$

In the above game, η represents the bargaining power of shareholders and $1-\eta$ the bargaining power of bondholders. The shareholders' surpluses from bargaining is $\theta^* V - 0$, because the alternative to bargaining is liquidation, in which case shareholders receive nothing. The bondholders' surplus from bargaining is $(1-\theta^*)V - (1-\alpha)V$, since the alternative entails a dissipative liquidation cost, α.

Now the lower boundary conditions in equation (1.4b) can be rewritten by:

$$\lim_{V \downarrow V_R} E(V) = (1-q)E(V) = (1-q)\eta\alpha V_R, \tag{1.9a}$$

$$\lim_{V \downarrow V_R} E_V(V) = (1-q)\eta\alpha. \tag{1.9b}$$

Shareholders choose X_R to maximize the value of equity, taking into account the anticipated outcome of the future debt renegotiation. The optimal default boundary is given by:

$$V_R = \left(\frac{1}{1-(1-q)\eta\alpha}\right)\left(\frac{-\lambda}{1-\lambda}\right)\frac{c}{r} \tag{1.10a}$$

$$= \underbrace{\left(\frac{1}{1-(1-q)\eta\alpha}\right)}_{>1} V_D. \tag{1.10b}$$

In equation (1.10b), the default threshold increases with the shareholders' bargaining power, η, and liquidation costs, α, but decreases with the probability of renegotiation failure, q. Intuitively, the strategic default incentives of shareholders increase with their bargaining power or with the liquidations costs because both increase the share of the total assets that debt holders will concede in order to avoid a costly liquidation. Conversely, the strategic default incentives decrease with more renegotiation frictions because, in that case, shareholders are less likely to extract any renegotiation rents.

1.2.2.3 Case III: Debt Renegotiation and CDS

In the last but most important subsection I present how the presence of CDS-insured debt holders can reduce shareholders' incentives of strategic default and thus lower the default boundary *ex-ante*. Following *Bolton and Oehmke* (2011), I assume that the payment from the CDS seller is higher than bond's post-default value.[2] Because the CDS payment is not triggered by debt renegotiation, a protected creditor has increased outside options and, hence, a strenghened bargaining position in renegotiation.[3] This CDS-induced shift in bargaining power affects the optimal sharing rule in equation (1.8b) as follows:

$$\theta^* = \mathsf{argmax}\,[\theta V_R - 0]^\eta\,[(1-\theta)V_R - (1-\alpha+\pi)V_R]^{1-\eta} \tag{1.11a}$$

$$= \eta\,(\alpha - \pi)\,, \quad 0 < \pi \leq \alpha. \tag{1.11b}$$

While equity holders' surplus from bargaining remains unchanged, the bondholder's payoff from bargaining decreases due to the better outside option, $(1-\theta)V_R - (1-\alpha+\pi)V_R$. Now that she is protected by CDS, she receives the higher amount (i.e., by πV_R) than the bond's recovery value (i.e., the firm's liquidation value, $(1-\alpha)V_R$) in case of renegotiation failure.

Equation (1.11b) presents a reduction in the equity holders' share due to CDS by

[2] The assumption that a creditor exogenously chooses the face value of debt as a CDS amount is made for simplicity. The fact that the amount of CDS may be endogenously chosen, and can be either lower or higher, does not alter the model's main predictions.

[3] The assumption that renegotiation does not trigger CDS payment is consistent with market practice.

$\eta\pi$. Now the lower boundary conditions can be rewritten by:

$$\lim_{V \downarrow V_R} E(V) = (1-q)\eta(\alpha-\pi)V_R, \tag{1.12a}$$

$$\lim_{V \downarrow V_R} E_V(V) = (1-q)\eta(\alpha-\pi). \tag{1.12b}$$

The optimal boundary is given by:

$$V_R^{CDS} = \left(\frac{1}{1-(1-q)\eta(\alpha-\pi)}\right)\left(\frac{-\lambda}{1-\lambda}\right)\frac{c}{r} \tag{1.13a}$$

$$= \underbrace{\left(\frac{1-(1-q)\eta\alpha}{1-(1-q)\eta(\alpha-\pi)}\right)}_{<1} V_R \tag{1.13b}$$

is the renegotiation triggering point, V_R is the default boundary in the original FS model. The reduction in the risk-neutral probability of default is given by:

$$\Delta P_R^{CDS} = \left|\left(\frac{V}{V_R^{CDS}}\right)^{\lambda} - \left(\frac{V}{V_R}\right)^{\lambda}\right| \tag{1.14a}$$

$$= \left|\left(\frac{V}{V_D}\right)^{\lambda}\left([1-(1-q)\eta(\alpha-\pi)]^{\lambda} - [1-(1-q)\eta\alpha]^{\lambda}\right)\right| \tag{1.14b}$$

$$= P_D \cdot \underbrace{\left([1-(1-q)\eta\alpha]^{\lambda} - [1-(1-q)\eta(\alpha-\pi)]^{\lambda}\right)}_{\text{a reduction in the firm's strategic default incentives}} > 0 \tag{1.14c}$$

where P_D is the risk-neutral probability of default when debt renegotiation is impossible:

$$P_D = \left(\frac{V}{V_D}\right)^{\lambda}. \tag{1.15}$$

Equation (1.13b) clearly shows how the default boundary shifts downwards in the presence of CDS contracts. The lower default boundary means that equity holders continue to service their debt at far lower asset values and, hence, keep the firm afloat longer. It should be noted that controlling for the firm's creditworthiness (P_D), a drop in default probability varies with firm characteristics that influence the outcome of debt renegotiation: (1) the shareholders' bargaining power in renegotiation (η), (2) the firm's liquidation cost (α), and (3) renegotiation frictions (q) (i.e. the probability of renegotiation break-down once initiated due to some exogenous factor). The default boundary decreases with η and α, and increases with q.[4] This leads to my first two hypotheses:

H1. (Bond Spread Reductions and Strategic Variables) Controlling for the firm's creditworthiness, the commitment effects of CDS leads to a *larger* reduction in default probability and thus bond spreads for firms with:

H1a: *higher* shareholder bargaining power,

H1b: *higher* firm's liquidation costs,

H1c: *lower* renegotiation frictions.

The firm's default probability is proportional to the ratio of the renegotiation-triggering value to the current value of a firm's assets (i.e., $\frac{V_R}{V}$). Hence, the shift in default boundary (V_R) does not influence default probability greatly for firms with high creditworthiness (i.e. low P_D in Equation 1.6). Therefore, CDS are less effective in reducing default probability of firms with high creditworthiness.[5] This leads to my last hypothesis:

H2. (The Sensitivity of Spread Reductions and Firm Creditworthiness) The absolute value of the spread sensitivity to strategic variables is decreasing in the firm's creditworthiness.

[4]This can be seen more clearly by taking partial derivatives of ΔP_R^{CDS} in equation (1.6) with respect to η, α, and q, respectively.

[5]This can be seen clearly by taking the partial derivatives of $\left|\frac{\partial \Delta P_R^{CDS}}{\partial \eta}\right|, \left|\frac{\partial \Delta P_R^{CDS}}{\partial \alpha}\right|, and \left|\frac{\partial \Delta P_R^{CDS}}{\partial q}\right|$ with respect to P_D in equation (1.6).

1.3 Data and Empirical Methodology

1.3.1 Data Source and Sample Selection

I construct a panel dataset of corporate bonds of publicly traded U.S. firms that initiated CDS trading during the period from January 2001 to December 2008.[6] I begin by building the sample of CDS firms (i.e., firms that have traded CDS) using the Markit CDS Pricing database as follows.[7] I start with CRSP-Compustat firms that have traded CDS by selecting only those that have ever had quote information in the Markit database. For each CDS firm, I then identify the first date (i.e., quarter) in which a U.S.-dollar-dominated CDS contract was traded at a five-year maturity. This quarter is used in the analysis to indicate the onset of CDS trading. Following *Ashcraft and Santos* (2009), I remove all firms that initiated trading in the first month of 2001, when the Markit data begin, because of uncertainty about the starting dates of these firms' CDS trading. I obtain 869 CDS firms with CRSP-Compustat identifiers.

From these, I select only CDS firms for which bond information (e.g. prices and characteristics) is available. Bond pricing information is obtained from TRACE and NAIC, two bond transaction databases widely used in the recent literature.[8,9] I augment TRACE's limited coverage in earlier years with NAIC, and delete firms that have never had bond pricing information in either database. I further merge

[6] Although CDS have existed since the early 1990s, the CDS market grew rapidly and became liquid in this later period.

[7] Markit aggregates from major CDS dealers daily quotes of CDS prices for firms with CDS trading. Markit is used as a benchmark source of CDS pricing because its coverage is quite broad and it currently provides CDS spread information for most corporations with nontrivial CDS trading.

[8] TRACE was established in 2002 by the Financial Industry Regulatory Authority (FINRA), formerly NASD, to disseminate secondary over-the-counter (OTC) corporate bonds transactions on behalf of members. TRACE first recorded bond transactions on July 1, 2002. Today, it includes all trades in the secondary OTC markets for corporate bonds save some small retail trades on NYSE. TRACE includes, among other information, transaction dates and prices. A comprehensive description of the TRACE database is given in *Downing et al.* (2005).

[9] NAIC, an alternative to the no-longer available Lehman fixed income database on corporate bonds used in previous studies, covers approximately 25%-40% of total over-the-counter secondary corporate bond transactions by American life, health, property and casualty insurance companies since 1994.

bond pricing data with the Mergent Fixed Investment Securities Database (FISD) to eliminate all but senior, unsecured, corporate debenture or medium-term notes. Bonds with no rating and with options-like features (callable, puttable, or convertible bonds or bonds with sinking funds) as well as bonds with less than one year or more than thirty years to maturity are removed. This process reduced the number of firms in the sample to 276.

Lastly, my sample is limited to firms that have at least one outstanding bond that has price information available both before and after the onset of CDS trading (169 firms).[10] I further restrict my analysis to firms that had investment-grade credit ratings (no worse than BBB) at the time they initiated CDS trading. Table 1.1 presents descriptive statistics on the final sample, which totals 136 firms and 1,506 firm-quarter observations from 2001:2 to 2008:3. Panels A and B break down the CDS firms by industry and rating, respectively, at the time of CDS introduction. As expected, firms in the manufacturing and financial industries (67 and 32, respectively) comprise the larger portion, and firms with relatively lower ratings (i.e., A and BBB) constitute nearly 90%, of the sample. Panel C breaks down firms by the timing (i.e., year) of CDS introduction. CDS trading begins in 2001 for 34% of firms, 2002 for 29%, 2003 for 16%, and by the third quarter of 2008 for the remainder.[11]

[10]For firms with multiple candidates of bond issues, I use one representative bond per firm to mitigate potential bias (were all available bonds per firm used in the analysis, the results might over represent larger companies with large numbers of bond issues, which could introduce bias inasmuch as my test focuses on credit spreads at the firm-, rather than trade- or bond-, level).

[11]My breakdown of firms is similar to that of *Ashcraft and Santos* (2009), who employ the same CDS database (Markit).

1.3.2 Variable Description

1.3.2.1 Shareholder Bargaining Power

As a measure of shareholders' bargaining power, I use CEO shareholding defined as the proportion of shares held by a CEO (*CEOSHARE*).[12] CEOs with a high stake in a company are likely to aggressively represent equity holders in renegotiation, thus generating collective bargaining force more effectively. This is evidenced by existing studies documenting that equity deviations from the absolute priority rule (APR) in the bankruptcy process are more likely for firms with higher CEO ownership. *Betker* (1995), for example, documents that a 10% increase in CEO shareholding increases equity deviations from the APR in Chapter 11 by as much as 1.2% of firm value.

1.3.2.2 Liquidation Costs

I use asset intangibility (*INTANGIBLE*) as a measure of liquidation costs. Debt holders should be more willing to forgive debt in renegotiation if their alternative is to face high costs in liquidation. Asset intangibility is computed as one minus the asset tangibility measure, which is the average of the expected exit values per dollar of the different tangible assets in liquidation weighted by their proportion of total book assets. Specifically, following *Berger et al.* (1996) and *Almeida and Campello* (2007), I compute asset tangibility as $(0.715 \times Receivables + 0.547 \times Inventory + 0.535 \times Capital + 1 \times Cash\ \ Holdings)$, scaled by the total book value of assets. Subtracting this measure of asset tangibility from one yields the liquidation cost.[13]

[12] *Davydenko and Strebulaev* (2007), *Valta* (2008) and *Nejadmalayeri and Singh* (2011) also use CEO shareholding as a proxy for shareholder bargaining power.

[13] This asset intangibility measure is also employed to measure liquidation cost in *Garlappi et al.* (2008), *Valta* (2008), *Favara et al.* (2011), and *Zhang* (2011).

1.3.2.3 Renegotiation Frictions

I use the dispersion of bond holders as a proxy for renegotiation frictions. Firms with a large number of of bond holders have more difficulty restructuring their debt privately, thus resulting in formal bankruptcies due both to the hold-out problem and to conflicts of interest (*Gertner and Scharfstein* (1991), *Bolton and Scharfstein* (1996), and *Bris et al.* (2006)). I use the number of bond issues (*ISSUENUM*) to capture the dispersion of bond holders. This measure is computed as the logarithm of the number of outstanding public bond issues divided by the logarithm of the book value of a firm's total debt. (*Gilson et al.* (1990)).[14]

1.3.2.4 Credit Worthiness and Information Transparency

Credit rating (*RATING*) used to reflect a firm's credit worthiness. Information transparency is captured by analyst coverage, defined as the number of equity analysts that forecast a firm's earnings (*ANALYSNUM*). Firms with more analyst coverage are considered to be less informationally opaque either because analysts increase the information available about firms or because they extend coverage to more transparent firms.[15]

To obtain the data necessary to compute these variables, my sample of CDS firms is further merged with Compustat Quarterly for accounting and rating information, ExecuComp for managerial shareholding data, and I/B/E/S for data on equity analysts' earning forecasts. Table 1.2 presents the summary statistics for those five variables. As shown in Panel A, the mean (median) is 0.58 (0.11), 0.59 (0.57), and 0.23 (0.24), and the standard deviation 1.76, 0.13, and 0.11 for *CEOSHARE*, *INTANGIBLE,* and *ISSUENUM*, respectively. The median rating (*RATING*) of CDS firms is 7 (i.e., A-) and average number of analysts nine (*ANALYSNUM*). Panel B

[14] The same measure of renegotiation friction is used in *Davydenko and Strebulaev* (2007) and *Nejadmalayeri and Singh* (2011).

[15] *Bhushan* (1989), *Francis and Soffer* (1997),*Hong et al.* (2000), *Chang et al.* (2006).

presents the correlation matrix for these five variables. That the variables are not significantly related to one another suggests that each of variables captures a distinct aspect of the firm.

1.3.2.5 Bond Yield Spread and Control Variable

The dependent variable is a bond's yield spread computed as the difference between its yield-to-maturity and the maturity-matched Treasury bond yield. I construct a complete yield curve of Treasury by linear interpolation from 1, 2, 3, 5, 7, 10, and 30-year Treasury rates using bond yields obtained from the Federal Reserve Bank of St. Louis. I also construct a set of control variables known to be important determinants of credit spreads. These include bond-level, firm-level, and market-level factors. Bond-level factors include maturity, duration, and convexity, firm-specific factors leverage, size, volatility, credit rating, and profitability, and for market-level factors I use the volatility index (VIX). How these control variables are constructed is explained briefly below.

1. MATURITY. Remaining time (in years) to maturity date.

2. DURATION. (Macaulay) duration, defined as a present-value-weighted average of the timing of all promised cash flows, is a *linear* measure of how the price of a bond changes in response to interest rate changes. It is constructed as:

$$Duration = \sum_{i=1}^{n} t_i \times \left(\frac{CF_i}{P(1+y)^{t_i}} \right) \tag{1.16}$$

   where CF_i is the bond's ith cash flows, i indexes the cash flows, t_i is the time in years until the ith payment will be received, and P is the bond price, y the yield to maturity, and n the total number of cash flows.

3. CONVEXITY. Convexity is a measure of the curvature of how the bond price

changes as the interest rate changes. It is constructed as:

$$Convexity = \frac{1}{(1+y)^2} \sum_{t=1}^{n} t_i(t_i+1) \times \left(\frac{CF_i}{P(1+y)^{t_i}} \right) \tag{1.17}$$

4. LEVERAGE. A market value-based definition of firm leverage is computed as the market value of long-term debt divided by the book value of total assets.

5. SIZE. Market value-based firm size is defined as the logarithm of the book value of long-term debt plus the market value of common equity.

6. STOCK VOLATILITY. The historical volatility of equity is measured in terms of the standard deviation of daily stock prices over the past three months.

7. RATING. An ordinal number is assigned to a firm's S&P rating as follows: AAA=1, AA+=2, AA=3, AA-=4, A+=5, A=6, A-=7, BBB+=8, BBB=9, BBB-=10, BB+=11, BB=12, BB-=13, B+=14, B=15, and B-=16.

8. PROFITABILITY. Profitability is defined as earnings before tax and depreciation divided by book value of total assets.

9. VIX. *VIX* is the average implied volatility of eight near-the-money options on the S&P index.

Table 1.3 reports summary statistics on bond yield spreads and control variables described above. Panels A and B show that a bond's yield spreads monotonically increase with a firm's credit rating and a bond's maturity. Panel C compares firms before and after their CDS start to trade. It shows that there is a reduction in stock volatility, a deterioration in the credit quality, an increase in leverage and firm size, and a slight decrease in yield spreads. The results of lower yield spreads and higher leverage after the onset of CDS trading are different from *Ashcraft and Santos* (2009) who find the opposite results. But, when controlling for other credit factors in a regression, I also observe an increase in spreads. My result on leverage is consistent with *Saretto and Tookes* (2011) who document that firms with traded CDS maintain higher leverage ratios. Table 1.4 provides an index of all variables used in the analyis together with brief descriptions and data sources.

1.3.3 Empirical Specification

I estimate the model below in equation (1.18) using ordinary least square (OLS) regression with firm-fixed effects to make use of within-firm variation.[16] The models are estimated both with and without time-fixed effects, and all standard errors are clustered at the firm level.

$$\begin{aligned} CS_{i,t} = \alpha_i + \beta\, TRADING_{i,t} + \gamma\, TRADING_{i,t} \times STRATVAR_i \\ + \theta\, TRADING_{i,t} \times RATING_i + \sum_j \delta_j\, CONTROL(j)_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{1.18}$$

where α_i denotes the firm fixed effects, $CS_{i,t}$ is the credit spreads of firm i in quarter t, and $TRADING_{i,t}$ is equal to zero for firm-quarters before the onset of CDS trading, and one otherwise. $RATING_i$ is the firm's credit rating measured in the quarter before the onset of CDS trading. $CONTROL_{i,t}$ is the bond-level, firm-level, and market-level determinants of credit spreads. $STRATVAR_i$ is my strategic variables measured in the quarter before the onset of CDS trading ($CEOSHARE_i$, $INTANGIBLE_i$, or $ISSUENUM_i$).[17,18] The coefficient γ, which captures the dif-

[16] I use only *within-firm* (rather than *between-firm*) information to control for omitted variables that differ between CDS firms.

[17] Note that the role of the $STRATVAR$ variable in the interactions with $TRADING$ is to differentiate firms according to their value at the onset of CDS trading. In this specification, $STRATVAR_i$ is hence time-invariant, whereas $TRADING_{i,t}$ is time-varying. Specifically, the interaction term $TRADING_{i,t} \times STRATVAR_i$ takes zero for all the quarters of firm i before CDS trading begins and $1\times$(the value of firm i's $STRATVAR$ at the time of CDS introduction) for all quarters after CDS trading has begun. A similar setup is also employed in *Ashcraft and Santos* (2009).

[18] The variable $STRATVAR_i$, is not included in equation (1.18) because it is time-invariant and, hence, subsumed in the time-fixed effect regressions.

ferential effects of CDS on credit spreads, is my main interest.

1.4 Empirical Findings

1.4.1 The Impact of CDS Trading Across Strategic Variables

Table 1.5 shows the estimated coefficients for the regression for CEO shareholding ($CEOSHARE$). The coefficients on $TRADING \times CEOSHARE$ are observed to be *negative* and highly statistically significant in all specifications (at the 1% level for Columns (2), (3), (5), and (6), at the 5% level for Column (4), and at the 10% level for Column (1)), and the magnitude of the coefficients to be quite large. The coefficient in Column (6) (- 8.9), for instance, suggests that a one-standard deviation increase in *CEOSHARE* (1.76) is associated with a reduction of 16 basis points (bps) in average credit spreads.

Table 1.6 presents the results of the regression for asset intangibility (*INTANGIBLE*). Similar to the results in Table VI, the coefficients on the interaction term are all negative regardless of specification, statistically significant for all specifications except Columns (1) and (4), and comparable in magnitude to the coefficients on *CEOSHARE*. A one-standard-deviation increase in the ratio of intangible to total assets (0.13) is associated with a reduction of 14 bps in average bond spreads. Also similar to *CEOSHARE* are the effects of CDS across low and high *INTANGIBLE*.

The results of the regression with *ISSUENUM*, are presented in Table 1.7. In contrast to the other two variables, the coefficients on the interaction term are *positive* for all specifications and statistically significant for five out of six specifications. This result indicates that the decrease (not increase, as in the case of former variables) in the number of bond issues results in a larger reduction in credit spreads. The economic impact, though, is similar to that of the other two variables, a one-standard-deviation decrease in the normalized number of bond issues (0.11) being associated with a reduction of 12 bps in average bond spreads.

All these results are consistent with my hypotheses that firms with higher strategic incentives benefit more from the introduction of CDS. Regardless of the empirical specification adopted, interestingly, the interaction term $TRADING \times RATING$ is positive. These results are in line with existing evidence of *Ashcraft and Santos* (2009) who document that the safe firms (i.e. firms with the smaller number for $RATING$) benefit whereas the risky firms (i.e. firms with the larger number for $RATING$) are penalized from CDS trading.

To interpret estimated coefficients more clearly, I plot the impact of CDS trading on bond spreads across strategic variables spread reductions following the onset of CDS trading across the strategic variable for safe and riskier firms separately in Figure 1.6.[19] There is one figure for each variable (*CEOSHARE* in the top, *INTANGIBLE* in the middle, *ISSUENUM* in the bottom panel). The curved line represents the cross-sectional CDF (Cumulative Distribution Function) of each variable. The solid (dotted) straight line plots spread reductions following the onset of CDS trading for safe (riskier) firms. Figure 1.6 reveals two important patterns. First, regardless of the value of strategic variables the spreads decline (increase) after CDS trading for safe (riskier) firms. Second, firms with high strategic incentives benefit whether safe or riskier in that their spreads experience a larger reduction (a smaller increase) for safe (riskier firms).

1.4.2 The Effect of Firm Riskiness

In this section, I examine the effect of firm riskiness on the CDS impact presented in the last section. In other words, I test how the relations between spread reductions and strategic variables revealed by the earlier analyses depend on the firm's riskiness proxied by credit ratings. I investigate this problem in two ways. First, I run the

[19]The graphs are drawn based on the estimated coefficients for specification (6) in each Table

separate regression shown in equation (1.18) for two sub-group of firms, namely, those rated A- and higher, and those rated BBB+ or lower.[20] Second, I include in the earlier regression the $HighGrade$ dummy, which equals one if the firm rating is A or above, and zero otherwise. For each regression specification, I multiply this dummy by proxies for the variables of my interest, i.e., $TRADING \times STRATVAR$.

The results of the regression for the sub-group of firms are presented in Table 1.8. To conserve space, I report only the coefficients of the variables of interest for the two most conservative specifications.[21] Regardless of the strategic proxies, the coefficients on $TRADING \times STRATVAR$ remain highly significant for low-grade firms (Panel A) while the coefficients for high-grade firms in Panel B lose their statistical significance. Moreover, the magnitude of coefficients is much smaller for high-grade firms. In Panel A, for instance, the coefficient on *CEOSHARE* in specification (6) (-9.2) suggests that a one-standard deviation increase in *CEOSHARE* for this group of low-grade firms (2.43) is associated with a reduction of 24 bps. For high-grade firms in Panel B, the coefficient (-1.1) indicates that a one-standard deviation increase (1.02) is associated with only a 1 bps reduction.

Table 1.9 shows the results of the regression with dummy variables indicating different rating category. Like in Table 1.8, only variables of interest are reported for the two most conservative specifications. For all strategic proxies, the differential effect of CDS trading across the proxies is pronounced for lower ratings. Moreover, the values of the coefficient suggest that while the CDS impact may be considerable for low-grade firms, for high-grade firms it is likely to be smaller in magnitude. For example, the coefficient for $TRADING \times CEOSHARE$ in specification (6) is -10.8 for the low-grade sub-sample, but only -0.9 for higher-grade firms. This pattern id clearly shown in Figure 1.4 in which I use the coefficients from the specification (6)

[20] I divide firms in this way in order to have a similar number of firms in each group (A- is the median credit rating of the firms in my sample).

[21] The specifications in (3) and (6) in earlier tables include both firm and bond controls.

in Table 1.9 and plot the sensitivity of bond spread reduction to strategic variables.

Overall, these results are consistent with my hypothesis (H2) that the relations between a reduction in bond yield spreads and strategic variables weaken (are pronounced) for safe (riskier) firms.

1.5 Robustness

So far, my results establish that whether the firm faces the prospect of debt renegotiation favorable to shareholders has important effects on the bond spread changes after the onset of CDS trading. In this section, I evaluate the robustness of my results to (1) the possibility of other channels of CDS trading, (2) the endogeneity of CDS trading, and (3) alternative strategic proxies.

1.5.1 Alternative Channel of CDS Trading

One might argue that the results presented thus far could be driven by other possible channels of CDS trading that may also affect a bond spread differentially across firms. In this section, I investigate whether my earlier findings are robust to accounting for such channels. I am mostly concerned with three channels that have been explored in the past literature.

The first, termed the hedging or diversification channel, describes the situation in which firms with CDS could give investors a new (inexpensive) way to hedge their credit risk exposure, as investors would require a lower risk premium than the bonds of firms without CDS.[22] This channel could also differentially affect firms' credit spreads inasmuch as one would expect riskier firms to be more likely than safer firms to benefit from the hedging role of the CDS market. If the hedging channel exists (i.e., if the effects of CDS on spreads vary with firms' riskiness), and if the renegotiation proxies

[22] *Duffie* (2007) provides an extensive discussion of how CDS can lower credit risk premia by offering investors a broader menu of assets and hedging. *Hirtle* (2008) empirically shows that the use of credit derivatives enables banks to offer firms credits with lower spreads.

to some extent capture firm risk, I need to account for this channel. However, hedging channel is unlikely to be behind my findings because Panel C in Table 1.2 provides counter-evidence that the strategic variable, overall, exhibits little correlation with firm ratings. Moreover, I control for firm riskiness (i.e. $CEOSHARE \times RATING$) in the model.

The second alternative channel, the information channel, reflects the potential for CDS to reveal more information about firms credit risk by facilitating price discovery.[23] This channel may benefit informationally opaque firms more than transparent firms. If there were significant differences in information opacity across firms with different shareholder advantages or renegotiation frictions, it would be difficult to tease out the debt renegotiation channel from the information channel.

To investigate the possibility that information channel might confound my earlier results, I first examine whether my strategic variables are significantly related to the variable that can capture firms' informational transparency. In order for the information variable to drive my results, it should be expected to be highly correlated with both. Panel C in Table 1.2 shows that my strategic variables (except for $CEOSHARE$) are not significantly correlated with *ANALYSNUM*. To further mitigate the concern, I examine whether the differential effects of CDS on a bond's yield spread across the renegotiation proxy are subsumed by differential effects across the information variable. I do this by adding one additional interaction variable, $TRADING \times ANALYSNUM$, to my original regression in equation (1.18). This term enables me to differentiate between transparent and opaque, firms, respectively. As can be seen in Table 1.10, the coefficients on $TRADING \times STRATVAR$ barely change in terms of sign or magnitude, and continue to be highly statistically signifi-

[23] *Acharya and Johnson* (2007) provide empirical evidence that insider trading exists in the CDS markets by documenting a significant and permanent information flow from CDS to equity markets; *Norden and Wagner* (2008) find that CDS spreads predict subsequent monthly changes in aggregate loan spreads; *Hull et al.* (2004) show that the CDS market anticipates credit rating events; and the superior informational efficiency in the CDS markets is documented in *Norden and Weber* (2004), *Blanco et al.* (2005), *Han and Zhou* (2011), and *Ni and Pan* (2011).

cant regardless which proxy is adopted. This result suggests that information channel is unlikely to be driving my earlier findings.

Another possibility is the monitoring channel for which CDS reduce banks' incentive to monitor the firm ex-post by giving them a new mechanism to lay off their credit exposure. As argued in *Ashcraft and Santos* (2009), the device that lead banks use to commit to ex post monitoring – holding a share of the loan at origination – loses some of its effectiveness for firms with trading CDS since it becomes easier for banks to buy credit protection for these firms. Anticipating this effect, syndicate participants may demand higher compensation to extend loans to these firms. Further, this effect is likely to go beyond the loan market since bondholders appear to free-ride on bank monitoring. In order for this channel to confound my results, there should exist monotonic relationship between firms' strategic incentives and the extent to which monitoring is valuable for firms. As far as I am aware of, however, there is no such *a priori* reason for the relationship. Thus, the monitoring channel of CDS is less likely to explain away my results.

1.5.2 Endogeneity of CDS Trading

Another potential concern with respect to my analysis thus far is the possibility that the onset of CDS trading is endogenously determined. To mitigate the potential impact of endogeneity, I perform a matched sample analysis as follows.[24] I first construct a sample of non-CDS firms closely matched to my CDS firms based on several dimensions of firm characteristics likely to predict CDS trading. I then use this sample in the analysis as a control group. My basic assumption is that, conditional on the matching, the timing of the onset of CDS trading is random for firms in the

[24]The matching technique was first developed in the statistics literature (e.g., *Rosenbaum and Rubin* (1983)) and has been widely applied in the finance and economics literatures. *Mayhew and Mihov* (2004), for example, in their study of the selection of stocks for option listing, match stocks that are not selected for option listing to listed stocks, and *Ashcraft and Santos* (2009) and *Saretto and Tookes* (2011) match non-CDS firms to CDS firms based on various firm characteristics.

combined sample. The detailed procedure is explained below.

Following *Mayhew and Mihov* (2004) and *Ashcraft and Santos* (2009), I estimate the ex-ante probability of the onset of CDS trading for each firm each quarter using a Probit model in which the dependent variable is a dummy variable that takes the value one if CDS begins to trade in the current quarter and zero otherwise,[25] and explanatory variables include firm characteristics considered likely to predict CDS trading.[26] I then choose for each quarter non-CDS firms that match CDS firms as closely as possible in terms of the estimated probability of CDS trading. Lastly, provided they have bond information available, I assign to each matched firm a counterfactual date (i.e., quarter) for the onset of CDS trading.

The Probit regression results are reported in Panel A of Table 1.11, which shows that CDS trading is more likely for firms with lower ratings, firms with higher equity volatility, and firms with lower dispersion of analysts' earning forecasts.[27] I use these estimated coefficients to compute the propensity scores and select firms that have not traded CDS but are closely matched to traded firms in terms of the scores. I identify by means of this procedure 55 matched firms from the sample of non-CDS firms. Panel B presents the descriptive statistics of both traded and matched sample.

For the combined sample of both traded and matched firms (i.e., a total of 191 firms), I re-estimate the regression model in equation (1.18) and report the results. As shown in Table 1.12, the coefficients on the three renegotiation proxies remain statistically significant for most cases even after adding the matched firms to my original sample.

[25] I record only the first quarter of CDS trading, after which the firm-quarters of a firm are dropped from the sample.

[26] I include as covariates equity volatility, profitability, firm size, credit rating, leverage, industry, and dispersion of analysts' earnings forecast, all of which are lagged by one quarter to ensure that no outcome variable is included as a regressor.

[27] It is worth noting that this estimation exercise is not intended for making any causal inferences about CDS trading. My goal is to project relevant firm characteristics on the probability of CDS trading and use them as the matching dimension.

1.5.3 Alternative Strategic Proxies

One can argue that my strategic variables are noisy proxies for the firms' strategic default incentives and hence, my inferences mainly based on these variables may be spurious. To mitigate this concern and corroborate the earlier results, I employ additional variables for each category of strategic proxies. Since it is difficult to find a perfect proxy for bargaining power and the literature does not identify a definite proxy for it, I follow *Davydenko and Strebulaev* (2007) and use *CEO's tenure* with the firm as an additional proxy. When the CEO is entrenched and has high firm-specific human capital, measured by her longer tenure, she may be in a better position to bargain on behalf of shareholders. I employ the ratio of *non-fixed assets* and the proportion of short-term debt to proxy for liquidation costs and renegotiation frictions, respectively. In unreported tables, they show the similar patterns to the original variables though less significant.[28]

1.6 Conclusion

In this paper, I provide the theoretical and empirical analysis of ex ante commitment benefits of CDS. First, I develop a model by extending a stylized model of strategic debt service, which allow me to relate the changes in a bond's yield spreads due to the presence of CDS to (1) shareholder bargaining advantages in renegotiation and (2) renegotiation frictions. I use two variables to capture shareholder advantages, namely the concentration of equity ownership (proxied by CEO shareholding) and the firm's liquidation costs (proxied by asset intangibility). The dispersion of bond holders (proxied by the number of public bond issues) is used to reflect renegotiation frictions that the firm faces.

To test my predictions, I employ the secondary market prices of corporate bonds

[28]Tables are available upon requests

of U.S. investment-grade firms that initiated CDS trading between 2001 and 2008, and compare a bond's yield spreads between pre- and post-CDS trading. My analysis shows that while an average firm experiences a slight increase in spreads following the onset of CDS trading, firms whose creditors are highly vulnerable to shareholders' strategic defaults in the absence of CDS enjoy a significant benefits from a reduction in spreads. In particular, the greater benefit accrues to those firms with high shareholder bargaining power and firms with less renegotiation frictions. Furthermore, these relations weaken among safe firms that are not likely to undergo debt renegotiation.

This paper provides the first empirical evidence on the beneficial role of CDS and empty creditors. Much of the news media and existing law literature has focused on the negative impact of them and hence, how to regulate the CDS markets accordingly. For instance, legal scholars propose to remove the voting rights of empty creditors in the debt restructuring process. My results imply that it would also erode the commitment benefits of them. More broadly, my findings support the novel view on the economic role of CDS markets as a commitment devices: by giving more credibility to borrowers' commitment to repay debt, CDS contributes to a reduction in the cost of corporate debt.

Table 1.1: The Breakdown of the Number of Firms

This table reports descriptive statistics on the final sample of CDS firms used in my main analysis (i.e., firms that initiated CDS trading during the period 2001-2008). Panels A, B, and C present a breakdown of the number of firms by industry, rating, and year of onset of CDS trading, respectively. For each panel, number and percentage of firms are reported in the column of Freq. and Perc., respectively. The cumulative number and percentage of firms are reported in the columns of Cum. Freq. and Cum. Perc.. The industry to which a firm belongs and its ratings are measured during the quarter its CDS trading begins. The onset of CDS trading is assumed to occur on the first date a U.S.-dollar-dominated CDS contract is traded at a five-year maturity.

PANEL A: Number of Firms by Industry

Industry	Freq.	Perc.	Cum. Freq.	Cum. Perc.
Agriculture, Mining, and Construction	10	7.94	10	7.35
Manufacturing	67	49.27	77	56.62
Transportation, Communications, and Utilities	12	8.82	89	65.44
Wholesale and Retail Trades	10	7.35	89	72.79
Finance, Insurance, and Real Estate	32	23.53	131	96.32
Services and Public Administration	5	1.47	136	100.00

PANEL B: Number of Firms by Rating

Rating	Freq.	Perc.	Cum. Freq.	Cum. Perc.
AAA	3	2.21	3	2.21
AA	11	8.1	14	10.19
A	60	44.11	74	54.41
BBB	62	45.59	136	100.00

PANEL C: Number of Firms by Year of Onset of CDS Trading

Year	Freq.	Perc.	Cum. Freq.	Cum. Perc.
2001	47	34.56	47	34.56
2002	40	29.41	87	63.97
2003	23	16.91	110	80.88
2004	11	8.09	121	88.97
2005	7	5.15	128	94.12
2006	2	1.47	130	95.59
2007	5	3.68	135	99.26
2008	1	0.74	136	100.00

Table 1.2: Firm-Specific Variables at the Time of the Onset of CDS Trading

This table reports summary statistics on firm-specific variables at the time of the onset of CDS trading. Panel A gives the summary statistic. CEOSHARE is the proportion (in percentage) of shares held by a CEO, INTANGIBLE is the ratio of intangible to total assets, defined as $0.715 \times \textit{Receivables} + 0.547 \times \textit{Inventory} + 0.535 \times \textit{Capital} + 1 \times \textit{Cash Holdings}$, and ISSUENUM is the logarithm of the number of outstanding public bond issues divided by the logarithm of the book value (in billions) of the firm's total debt. RATING is the ordinal S&P rating and is given by the following transformation: AAA=1, AA+=2, AA=3, AA-=4, A+=5, A=6, A-=7, BBB+=8, BBB=9, BBB=10. ANALYSNUM is the number of equity analysts that forecast a firm's earnings. All variables are measured during the quarter of the onset of CDS trading. Panel C presents the correlation matrix between strategic, hedging, and information variables. The *p*-values are reported in parentheses (a,b and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

PANEL A: Summary Statistics - All

	N	Mean	Median	Min	Max	Std. Dev.
CEOSHARE	125	0.58	0.11	0	12.54	1.76
INTANGIBLE	125	0.59	0.57	0.32	0.96	0.13
ISSUENUM	133	0.23	0.24	0	0.56	0.11
RATING	136	7.02	7.00	1	10	2.09
ANALYSNUM	121	9	10.1	1	28	6.5

PANEL A-1: Summary Statistics - High Grade

	N	Mean	Median	Min	Max	Std. Dev.
CEOSHARE	68	0.31	0.08	0	8.38	1.02
INTANGIBLE	70	0.60	0.58	0.32	0.94	0.12
ISSUENUM	72	0.24	0.24	0	0.56	0.09
RATING	74	5.48	6.00	1	7	1.55
ANALYSNUM	71	10.59	9.00	1	26	6.25

PANEL A-2: Summary Statistics - Low Grade

	N	Mean	Median	Min	Max	Std. Dev.
CEOSHARE	47	0.98	0.23	0	12.54	2.43
INTANGIBLE	55	0.56	0.54	0.32	0.96	0.12
ISSUENUM	61	0.22	0.20	0	0.48	0.11
RATING	62	8.85	9.00	8	10	0.74
ANALYSNUM	50	9.54	8.50	1	28	7.01

PANEL B: Correlation Matrix

	CEOSHARE	INTANGIBLE	ISSUENUM	RATING	ANALYSNUM
CEOSHARE	1				
INTANGIBLE	0.03	1			
ISSUENUM	0.09	-0.07	1		
RATING	0.16[c]	-0.10	0.00	1	
ANLYSNUM	-0.19[b]	-0.09	-0.10	-0.14	1

Table 1.3: Bond Yield Spreads and Determinants of Bond Yield Spreads

This table reports the summary statistics on bond yield spreads and control variables. Panels A and B present a breakdown of yield spreads (in basis points) by credit rating and time to maturity, respectively. Panel C reports the summary statistics on control variables as well as credit spreads before and after the onset of CDS trading. Leverage is long-term debt divided by market value of total assets, Size equals the logarithm of long-term debt plus the market value of common equity, Stock Volatility is the standard deviation of daily equity returns for the past three months, Rating is the ordinal S&P rating and is given by the following transformation: AAA=1, AA+=2, AA=3, AA-=4, A+=5, A=6, A-=7, BBB+=8, BBB=9, BBB-=10, BB+=11, BB=12, BB-=13, B+=14, B=15, B-=16, Profitability is earnings before tax and depreciation divided by total assets, and Maturity is the remaining time in years to maturity date.

PANEL A: Yield Spreads by Rating

Rating	Obs	Mean	Median	Std. Dev.
AAA	37	80.1	65.7	47.5
AA	92	152.6	108.8	109.1
A	663	156.7	120.0	122.9
BBB	669	232.5	178.7	180.7
BB	42	343.1	282.4	204.4
B	7	353.1	270.3	210.9
ALL	1,513	195.5	149.1	162.1

PANEL B: Yield Spreads by Maturity

Maturity	Obs	Mean	Median	Std. Dev.
Short (< 3 years)	573	190.5	107.0	194.4
Medium (3-10 years)	689	197.1	163.7	137.8
Large (>10 years)	251	202.3	167.6	141.2
ALL	1,513	195.5	149.1	162.1

PANEL C: Variables Before and After the Onset of CDS Trading

	All			**Before**			**After**		
	Obs	Mean	Std Dev	Obs	Mean	Std. Dev.	Obs	Mean	Std Dev
Spreads	1,513	195.5	162.1	494	199.7	125.4	1,019	193.3	177.1
Leverage	1,502	0.23	0.19	489	0.21	0.15	1,013	0.24	0.20
Size	1,502	9.25	1.22	489	9.00	1.30	1,013	9.37	1.16
Volatility	1,480	0.30	0.17	489	0.30	0.12	991	0.29	0.19
Rating	1,513	7.17	2.16	494	6.73	2.14	1,019	7.38	2.14
Profitability	1,511	0.02	0.01	494	0.02	0.01	1,017	0.02	0.01
Maturity	1,513	6.07	5.85	494	7.42	6.03	1,019	5.42	5.64
Duration	1,513	4.18	2.84	494	5.01	2.58	1,019	3.78	2.87
Convexity	1,513	35.1	49.4	494	43.8	52.3	1,019	30.9	47.33
VIX	1,513	20.8	7.97	494	23.4	7.02	1,019	19.5	8.11

Table 1.4: Variable Descriptions

This table describes all the variables used in the empirical analysis. CRSP is the University of Chicago's Center of Research in Security Prices databases. Compustat is Standard & Poor's Compustat database. Execucomp is Standard & Poor's Execucomp Database on executive compensation. FISD is the Fixed Investment Securities Database provided by Mergent. Markit is the CDS Pricing database provided by Markit. CBOE is the Chicago Board Options Exchange.

Abbreviation	**Name of Variable**	**Variable Description**	**Data Source**
CS	Credit Spreads	The yield-to-maturity of the bond in basis points less the Treasury yield of the same maturity.	TRACE/NAIC
TRADING	CDS Dummy	A dummy variable that takes the value one for bond transactions after the onset of CDS trading.	Markit
CEOSHARE	CEO Shareholding	Percentage of total equity owned by the CEO measured during the quarter the firm's CDS trading begins.	ExecuComp
INTANGIBLE	Intangible Asset	The ratio of intangible assets to total assets measured during the quarter the firm's CDS trading begins.	Compustat
ISSUENUM	Norm. No. Issues	Log(Number of Bond Issues) divided by log(total Debt) measured during the quarter the firm's CDS trading begins.	FISD & Compustat
ANALYSNUM	Number of Equity Analyst	Number of equity analyst estimates of earnings measured during the quarter the firm's CDS trading begins.	Compustat
LEVERAGE	Firm Leverage	Long-term debt divided by market value of total assets.	Compustat
SIZE	Firm Size	Log (long term debt plus market value of common equity).	Compustat
RATING	Firm Credit Rating	The ordinal S&P rating is given by the following transformation: AAA=1, AA+=2, AA=3, AA-=4, A+=5, A=6, A-=7, BBB+=8, BBB=9, BBB-=10, BB+=11, BB=12, BB-=13, B+=14, B=15, B-=16.	Compustat
VOLATILITY	Equity Volatility	Std. dev. of daily equity returns for the past three months.	CRSP
PROFIT	Operating Profitability	Earnings before tax and depreciation divided by total assets.	
MATURITY	Time to Maturity	Remaining time in years to maturity date.	FISD
DURATION	Duration	Macaulay bond duration in years.	FISD, TRACE, NAIC
CONVEXITY	Convexity	Bond convexity in years.	FISD, TRACE, NAIC
VIX	Volatility Index	Average implied volatility of eight near-the-money options on the S&P index.	CBOE

Table 1.5: Bond Spread Reduction and Shareholder Bargaining Power

This table reports the estimated coefficients of the regression model:

$$CS_{i,t} = \alpha_i + \gamma\, TRADING_{i,t} \times CEOSHARE_i + \theta\, TRADING_{i,t} \times RATING_i + \beta\, TRADING_{i,t} + \sum_j \delta_j CONTROL(j)_{i,t} + \varepsilon_{i,t},$$

where α_i denotes the firm fixed effects, $CS_{i,t}$ is the credit spreads of firm i in quarter t, $TRADING_{i,t}$ is equal to zero for the firm-quarters before the onset of CDS trading, and one otherwise. $CEOSHARE_i$ is the proportion of shares held by a CEO in the quarter before the onset of CDS trading. $RATING_i$ is credit rating in the quarter before the onset of CDS trading. $CONTROL_{i,t}$ is the bond-level, firm-level, and market-level determinants of credit spreads. In Columns (1), (2), and (3), the model is estimated without time-fixed effects. Time-fixed effects are added to the model in Columns (3), (4), and (5). Only firm characteristics are used as controls in Columns (2) and (4) and bond characteristics are added in Columns (3) and (6). Market-level control is included in all specifications. All standard errors are clustered at the firm level. The t-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

	(1)	(2)	(3)	(4)	(5)	(6)
TRADING × CEOSHARE	-10.2	-10.5	-10.2	-10.4	-8.7	-8.9
	[-2.35][b]	[-3.49][a]	[-3.25][a]	[-2.92][a]	[-3.33][a]	[-3.59][a]
TRADING × RATING	8.1	10.2	10.4	8.0	9.6	8.5
	[1.81][b]	[2.07][b]	[1.94][a]	[1.78][c]	[1.86][b]	[1.55]
TRADING	15.6	-29.7	-41.9	-10.4	-35.2	-34.7
	[0.55]	[-1.02]	[-1.22]	[-0.33]	[-1.08]	[-0.99]
LEVERAGE		78.2	96.3		10.2	24.1
		[0.65]	[0.99]		[0.09]	[0.26]
SIZE		-15.0	-13.8		-21.4	-4.96
		[-0.73]	[-0.79]		[-1.03]	[-0.28]
STOCK VOLATILITY		297	225		212	160
		[9.45][a]	[6.62][a]		[4.17][a]	[3.39][a]
RATING		-1.06	-6.50		-6.03	-9.66
		[-0.07]	[-0.44]		[-0.42]	[-0.75]
$RATING^2$		1.72	1.92		2.08	2.32
		[1.46]	[1.91][c]		[2.00][b]	[2.66][a]
PROFITABILITY		-558	-452		-479	-405
		[-1.53]	[-1.33]		[-1.16]	[-1.14]
MATURITY			44.3			-9.74
			[6.01][a]			[-0.16]
DURATION			-23.4			-28.0
			[-3.24][a]			[-3.87][a]
CONVEXITY			-4.99			-4.17
			[-6.61][a]			[-5.89][a]
VIX	9.31	4.50	4.54	17.76	10.16	7.74
	[11.13][a]	[6.61][a]	[6.57][a]	[10.42][a]	[4.10][a]	[1.75][c]
Time Fixed Effects	No	No	No	Yes	Yes	Yes
Adj-R^2	0.26	0.38	0.42	0.39	0.46	0.49
Obs	1,322	1,289	1,289	1,322	1,289	1,289

Table 1.6: Bond Spread Reduction and Liquidation Cost

This table reports the estimated coefficients of the regression model:

$$CS_{i,t} = \alpha_i + \gamma\, TRADING_{i,t} \times INTANGIBLE_i + \theta\, TRADING_{i,t} \times RATING_i + \beta\, TRADING_{i,t} + \sum_j \delta_j CONTROL(j)_{i,t} + \varepsilon_{i,t},$$

where α_i denotes the firm fixed effects, $CS_{i,t}$ is the credit spreads of firm i in quarter t, $TRADING_{i,t}$ is equal to zero for the firm-quarters before the onset of CDS trading, and one otherwise. $INTANGIBLE_i$ is the ratio of intangible to total assets in the quarter before the onset of CDS trading. $RATING_i$ is credit rating in the quarter before the onset of CDS trading. $CONTROL_{i,t}$ is the bond-level, firm-level, and market-level determinants of credit spreads. In Columns (1), (2), and (3), the model is estimated without time-fixed effects. Time-fixed effects are added to the model in Columns (3), (4), and (5). Only firm characteristics are used as controls in Columns (2) and (4) and bond characteristics are added in Columns (3) and (6). Market-level control is included in all specifications. All standard errors are clustered at the firm level. The t-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

	(1)	(2)	(3)	(4)	(5)	(6)
TRADING × INTANGIBLE	-104	-161	-161	-51	-116	-119
	[-1.43]	[-2.53][b]	[-2.56][b]	[-0.74]	[-1.98][b]	[-2.02][b]
TRADING × RATING	1.5	3.4	3.2	2.3	2.9	2.0
	[0.37]	[0.73]	[0.65]	[0.55]	[0.61]	[0.41]
TRADING	99	89	81	37	58	57
	[2.02][b]	[2.07][b]	[1.73][c]	[0.79][b]	[1.38]	[1.28]
LEVERAGE		105	124		64.3	72
		[0.90]	[1.29]		[0.59]	[0.80]
SIZE		-17.3	-17.2		-13.7	-1.68
		[-0.85]	[-1.00]		[-0.64]	[-0.09]
STOCK VOLATILITY		298	221		210	152
		[7.89][a]	[5.40][a]		[3.91][a]	[2.93][a]
RATING		8.48	0.11		-1.13	-6.37
		[0.56]	[0.01]		[-0.08]	[-0.50]
$RATING^2$		1.22	1.62		1.86	2.20
		[1.05]	[1.60]		[1.72][c]	[2.35][b]
PROFITABILITY		-521	-403		-417	-349
		[-1.46]	[-1.18]		[-1.08]	[-1.01]
MATURITY			45.6			-16.3
			[6.01][a]			[-0.28]
DURATION			-23.7			-28.3
			[-3.21][a]			[-3.73][a]
CONVEXITY			-5.11			-4.48
			[-6.64][a]			[-6.02][a]
VIX	8.79	4.12	4.07	16.6	9.94	6.91
	[11.01][a]	[6.22][a]	[6.05][a]	[9.90][a]	[4.17][a]	[1.63]
Time Fixed Effects	No	No	No	Yes	Yes	Yes
$Adj\text{-}R^2$	0.23	0.35	0.39	0.36	0.43	0.46
Obs	1,411	1,377	1,377	1,411	1,377	1,377

Table 1.7: Bond Spread Reduction and Renegotiation Frictions

This table reports the estimated coefficients of the main regression model:

$$CS_{i,t} = \alpha_i + \gamma\, TRADING_{i,t} \times ISSUENUM_i + \theta\, TRADING_{i,t} \times RATING_i + \beta\, TRADING_{i,t} + \sum_j \delta_j CONTROL(j)_{i,t} + \varepsilon_{i,t},$$

where α_i denotes the firm fixed effects, $CS_{i,t}$ is the credit spreads of firm i in quarter t, $TRADING_{i,t}$ is equal to zero for the firm-quarters before the onset of CDS trading, and one otherwise. $ISSUENUM_i$ is the normalized number of outstanding public bond issues (i.e. log(the number of bonds)/log(total debt) in the quarter before the onset of CDS trading). $RATING_i$ is credit rating in the quarter before the onset of CDS trading. $CONTROL_{i,t}$ is the bond-level, firm-level, and market-level determinants of credit spreads. Firm-fixed effects are added in all specifications. In Columns (1), (2), and (3), the model is estimated without time-fixed effects. Time-fixed effects are added to the model in Columns (3), (4), and (5). Only firm characteristics are used as controls in Columns (2) and (4) and bond characteristics are added in Columns (3) and (6). Market-level control is included in all specifications. All standard errors are clustered at the firm level. The t-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

	(1)	(2)	(3)	(4)	(5)	(6)
TRADING × ISSUENUM	201	184	164	157	143	123
	[2.43][b]	[2.42][b]	[2.15][a]	[1.99][b]	[1.65][c]	[1.66][c]
TRADING × RATING	5.8	7.3	7.1	5.1	5.8	5.0
	[1.39]	[1.57]	[1.39]	[1.25]	[1.22]	[0.98]
TRADING	-32	-71	-72	-42	-59	-56
	[-0.92]	[-2.11][b]	[-1.86]	[-1.26]	[-1.66][c]	[-1.43]
LEVERAGE		135	141		78.6	76.0
		[1.23]	[1.53]		[0.77]	[0.89]
SIZE		-7.69	-7.37		-7.11	4.68
		[-0.42]	[-0.46]		[-0.37]	[0.28]
STOCK VOLATILITY		298	235		212	164
		[9.42][a]	[6.90][a]		[4.29][a]	[3.52][a]
RATING		0.96	-5.61		-5.89	-10.6
		[0.06]	[-0.40]		[-0.43]	[-0.82]
$RATING^2$		1.53	1.85		2.04	2.37
		[1.35]	[1.87][c]		[1.97][c]	[2.58][b]
PROFITABILITY		-661	-556		-530	-468
		[-1.91][c]	[-1.69][c]		[-1.40]	[-1.39]
MATURITY			43.6			-31.8
			[6.06][a]			[-0.57]
DURATION			-21.8			-27.0
			[-3.02][a]			[-3.73][a]
CONVEXITY			-4.87			-4.22
			[-6.80][a]			[-6.05][a]
VIX	9.21	4.49	4.44	17.1	9.95	3.90
	[11.91][a]	[7.07][a]	[6.90][a]	[10.68][a]	[4.24][a]	[0.89]
Time Fixed Effects	No	No	No	Yes	Yes	Yes
Adj-R^2	0.26	0.38	0.42	0.39	0.46	0.49
Obs	1,501	1,463	1,463	1,501	1,463	1,463

Table 1.8: The Effect of Firm Riskiness: Sub-Sample Anlaysis

This table reports the estimated coefficients on the interaction terms of $TRADING$ with each of the three proxies for the prospect of debt renegotiation, namely $CEOSHARE$, $INTANGIBLE$, and $ISSUENUM$. The same regression models are estimated (shown in Table 1.5 through Table 1.7) separately for two groups of firms, namely those rated A- and higher (Panel A), and those rated BBB+ or lower (Panel B). Firm ratings are measured in the quarter before the onset of CDS trading. To conserve the space, only coefficients on the $TRADING$ variable and interactions terms are reported. Also only results for the most conservative specifications (Column (3) and (6) in Table 1.5 through Table 1.7) are reported. For each panel, the first three columns correspond to specification (3), and latter three to specification (6). The t-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

PANEL A: Low-Grade Firms

	Specification (3)			Specification (6)		
TRADING × CEOSHARE	-11.1			-9.2		
	[-2.66][b]			[-2.65][b]		
TRADING × INTANGIBLE		-338			-270	
		[-3.68][a]			[-2.60][b]	
TRADING × ISSUESNUM			277			133
			[2.32][b]			[1.08]
TRADING × RATING	12.8	29.3	29.6	21.2	39.7	34.3
	[0.68]	[1.52]	[1.42]	[1.14]	[2.09][b]	[1.74][c]
TRADING	-68.7	-75.5	-310	-152	-211	-333
	[-0.42]	[-0.50]	[-1.60]	[-0.94]	[-1.36]	[-1.81][c]
Time Fixed Effects	No	No	No	Yes	Yes	Yes
Adj-R^2	0.47	0.40	0.44	0.55	0.55	0.52
Obs	509	587	639	509	587	639
Firm Obs	47	55	61	47	55	61

PANEL B: High-Grade Firms

	Specification (3)			Specification (6)		
TRADING × CEOSHARE	-5.7			-1.1		
	[-0.83]			[-0.12]		
TRADING × INTANGIBLE		-113			-59	
		[-1.77][c]			[-1.01]	
TRADING × ISSUENUM			-1.3			9.5
			[-0.01]			[0.10]
TRADING × RATING	-5.3	-4.2	-3.5	-8.8	-9.3	-8.3
	[-0.80]	[-0.62]	[-0.55]	[-1.41]	[-1.43]	[-1.36]
TRADING	51	111	38	65	99	57
	[1.43]	[2.24][b]	[1.00]	[1.85][c]	[2.01][b]	[1.54]
Time Fixed Effects	No	No	No	Yes	Yes	Yes
Adj-R^2	0.43	0.43	0.43	0.50	0.51	0.51
Obs	780	790	824	780	790	824
Firm Obs	68	70	72	68	70	72

Table 1.9: The Effect of Firm Riskiness: Dummy Variable Analysis

This table reports the estimated coefficients on the interaction terms of $TRADING$ with each of the three renegotiation variables, namely $CEOSHARE$, $INTANGIBLE$, and $ISSUENUM$, and firm's rating dummy, $HighGrade$. $HighGrade$ equals one if the firm's rating is A or above, and zero otherwise. The same regression models are estimated (shown in Table 1.5 through Table 1.7). Firm ratings are measured during the quarter before the onset of CDS trading. To conserve the space, only coefficients on the $TRADING$ variable and interaction terms are reported for the two specification, (3) and (6) in Table 1.5 through Table 1.7). The results for $CEOSHARE$, $INTANGIBLE$, and $ISSUENUM$ are reported in Panels A, B, and C, respectively. The t-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

	(3)	(6)
Panel A: Shareholder Bargaining Power		
TRADING × CEOSHARE	-11.6	-10.8
	[-3.36][a]	[-3.73][a]
TRADING × CEOSHARE × HighGrade	4.4	9.9
	[0.54]	[1.13]
TRADING × HighGrade	-51.2	-48.8
	[-2.02][b]	[-1.96][c]
TRADING	58.9	51.7
	[2.41][b]	[2.14][b]
Panel B: Liquidation Costs		
TRADING × INTANGIBLE	-232.3	-181.4
	[-2.36][b]	[-1.96][c]
TRADING × INTANGIBLE × HighGrade	123.4	111.3
	[1.04]	[0.98]
TRADING × HighGrade	-74.8	-71.4
	[-1.00]	[-0.99]
TRADING	145.1	110.1
	[2.22][b]	[1.73][c]
Panel C: Renegotiation Frictions		
TRADING × ISSUENUM	252.9	168.4
	[2.02][b]	[1.39]
TRADING × ISSUENUM × HighGrade	-181.4	-80.3
	[-1.09]	[-0.50]
TRADING × HighGrade	15.2	-5.4
	[0.36]	[-0.14]
TRADING	-28.0	-17.2
	[-0.90]	[-0.57]

Table 1.10: Accounting for Informational Transparency

This table reports the estimated coefficients on the interaction terms of $TRADING$ with each of the three renegotiation variables, namely $CEOSHARE$, $INTANGIBLE$, and $ISSUENUM$, after controlling a firm's credit rating and analyst coverage. The same regression models are estimated (shown in Table 1.5 through Table 1.7) except two additional interaction terms are included (i.e., $TRADING \times RATING$ and $TRADING \times ANALYSNUM$). $RATING$ is a firm's long-term credit rating and $ANALYSNUM$ the number of equity analysts reported in I/B/E/S earnings forecast datasets. Both are measured during the quarter before the onset of CDS trading. To conserve the space, only coefficients on the $TRADING$ variable and interaction terms are reported. The same specifications are used in the analysis for each column (as in Table 1.5 through Table 1.7). The results for $CEOSHARE$, $INTANGIBLE$, and $ISSUENUM$ are reported in Panels A, B, and C, respectively. The t-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Shareholder Bargaining Power						
TRADING × CEOSHARE	-9.2	-9.9	-9.4	-8.5	-8.4	-8.4
	[-2.17][b]	[-3.59][a]	[-3.27][a]	[-2.95][a]	[-3.57][a]	[-3.81][a]
TRADING × RATING	4.5	5.2	5.0	3.0	4.1	2.8
	[1.27]	[1.47]	[1.30]	[0.94]	[1.12]	[0.71]
TRADING × ANALYSNUM	-1.5	-1.2	-0.8	-1.7	-1.4	-1.0
	[-0.88]	[-0.85]	[-0.64]	[-1.12]	[-1.00]	[-0.81]
TRADING	48.7	9.0	-3.9	31.3	12.5	9.4
	[1.46]	[0.32]	[-0.13]	[1.04]	[0.45]	[0.31]
Panel B: Liquidation Costs						
TRADING × INTANGIBLE	-132	-169	-156	-80	-133	-127
	[-1.63]	[-2.60][a]	[-2.45][b]	[-1.13]	[-2.47][b]	[-2.31][b]
TRADING × RATING	-0.2	0.4	-0.2	-0.7	-0.9	-1.8
	[-0.06]	[0.12]	[-0.04]	[-0.24]	[-0.26]	[-0.49]
TRADING × ANALYSNUM	-0.7	-0.9	-0.6	-1.0	-1.2	-0.7
	[-0.37]	[-0.62]	[-0.39]	[-0.59]	[-0.80]	[-0.54]
TRADING	131	121	107	83	108	97
	[1.87][a]	[0.32][b]	[1.99][b]	[1.37]	[2.52][b]	[2.06][b]
Panel C: Renegotiation Frictions						
TRADING × ISSUENUM	154	145	127	117	110	88
	[1.98][b]	[2.04][b]	[1.79][c]	[1.66][c]	[1.65][c]	[1.26]
TRADING × RATING	4.0	4.3	3.7	3.0	1.9	1.1
	[1.09]	[1.16]	[0.91]	[0.62]	[0.52]	[0.27]
TRADING × ANALYSNUM	-0.8	-0.7	-0.4	-1.7	-0.9	-0.5
	[-0.49]	[-0.52]	[-0.31]	[-1.12]	[-0.67]	[-0.41]
TRADING	-3.7	-37	-37	-5.5	-14	-15
	[-0.09]	[1.13]	[-1.02]	[-0.15]	[-0.46]	[-0.43]

Table 1.11: Matching Estimation Results

This table reports the results of the propensity score matching, in which the I run the probit regression for the probability of CDS trading with explanatory variables *a priori* considered to predict the trading of CDS. In Panel A, coefficients on the covariates are reported. *Leverage* is long-term debt divided by total assets, *Firm Size* is natural logarithm of long-term debt plus common equity, *Equity Volatility* is standard deviation of 60 prior day's stock returns, *Profitability* is earnings before tax and depreciation divided by total assets, and *Forecast Dispersion* is the ratio of raw dispersion divided by the firm's stock price. Raw dispersion is equal to the cross-sectional standard deviation of the most recently revised quarterly earnings per share estimates. Panel B reports the descriptive statistics of matching variables for both *traded* and *matched* firms. The *t*-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

Panel A: The Prediction of Probability of CDS Trading

	Probability of CDS Trading
Leverage	-0.0963
	(0.30)
Firm Size	-0.0460
	(0.03)
Equity Volatility	0.7877***
	(0.28)
Rating	0.2135***
	(0.07)
$Rating^2$	-0.0216***
	(0.00)
Profitability	4.0595
	(3.39)
Forecast Dispersion	-81.8905**
	(39.99)
Time Fixed Effects	No
Industry Fixed Effects	Yes
R^2	10.12%
N	8,546

Panel B: Summary Statistics For Traded and Matched Firms

	Traded			Matched		
	N	MEAN	STD	N	Mean	STD
Leverage	1,502	0.2363	0.1940	569	0.2844	0.2233
Firm Size	1,502	9.2524	1.2223	569	9.6123	1.1027
Equity Volatility	1,480	0.3005	0.1791	580	0.3402	0.2175
Rating	1,513	7.1632	2.1780	582	7.2182	2.5267
Profitability	1,511	0.0257	0.0182	569	0.0232	0.0188
Forecast Dispersion	1,335	0.0012	0.0020	562	0.0014	0.0031

Table 1.12: Results for Traded and Matched Firms

This table reports the results of the propensity score matched sample analysis, in which the coefficients on the interaction terms of $TRADING$ with each of the three renegotiation variables, namely $CEOSHARE$, $INTANGIBLE$, and $ISSUENUM$, are estimated with the *matched* sample added to the original sample. The same regression models are estimated (shown in Table 1.5 through Table 1.7). Panels A, B, and C present the results for the regression for $CEOSHARE$, $INTANGIBLE$, and $ISSUENUM$, respectively. All three proxies are measured in the quarter before the onset of CDS trading. To conserve the space, only coefficients on the $TRADING$ variable and interaction terms are reported. The t-statistics are given in brackets (a, b, and c stand for significance at the 1%, 5%, and 10% levels using a two-tailed test).

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Shareholder Bargaining Power						
TRADING × CEOSHARE	-6.3	-9.5	-8.9	-7.7	-9.3	-9.0
	[-1.54]^{b}	[-2.17]^{b}	[-2.36]^{b}	[-2.65]^{a}	[-2.87]^{a}	[-2.97]^{a}
TRADING × RATING	12	13	13	12	12	11
	[2.29]^{b}	[2.92]^{a}	[2.85]^{a}	[2.24]^{b}	[2.71]^{a}	[2.50]^{a}
TRADING	-15	-45	-47	-27	-39	-37
	[-0.48]	[-1.60]	[-1.60]	[-0.83]	[-1.34]	[-1.25]
Adj-R^2	0.23	0.35	0.38	0.35	0.41	0.44
Obs	1,810	1,772	1,772	1,810	1,772	1,772
Firm Obs	163	163	163	163	163	163
Panel B: Liquidation Cost						
TRADING × INTANGIBLE	-70	-112	-101	-42	-85	-80
	[-0.91]	[-1.90]^{c}	[-1.78]^{c}	[-0.61]	[-1.58]	[-1.52]
TRADING × RATING	4.1	7.0	7.0	4.2	6.6	6
	[0.72]	[1.64]	[1.63]	[0.75]	[1.54]	[1.39]
TRADING	70	43	34	33	26	24
	[1.36]	[1.06]	[0.81]	[0.71]	[0.70]	[0.63]
Adj-R^2	0.20	0.33	0.36	0.31	0.39	0.42
Obs	1,974	1,925	1,925	1,974	1,925	1,925
Firm Obs	179	179	179	179	179	179
Panel C: Renegotiation Frictions						
TRADING × ISSUENUM	102	127	133	118	128	124
	[1.49]	[2.04]^{b}	[2.18]^{b}	[1.92]^{c}	[2.30]^{b}	[2.23]^{b}
TRADING × RATING	10	9.9	9.9	8.9	8.5	8.1
	[2.00]^{b}	[2.29]^{b}	[2.24]^{b}	[1.86]^{c}	[1.98]^{c}	[1.84]^{c}
TRADING	-37	-72	-74	-54	-65	-64
	[-1.00]	[-2.18]^{b}	[-2.15]^{b}	[-1.49]	[-1.99]^{b}	[-1.90]^{c}
Adj-R^2	0.23	0.35	0.38	0.35	0.41	0.44
Obs	2,048	2,004	2,004	2,048	2,004	2,004
Firm Obs	184	184	184	184	184	184

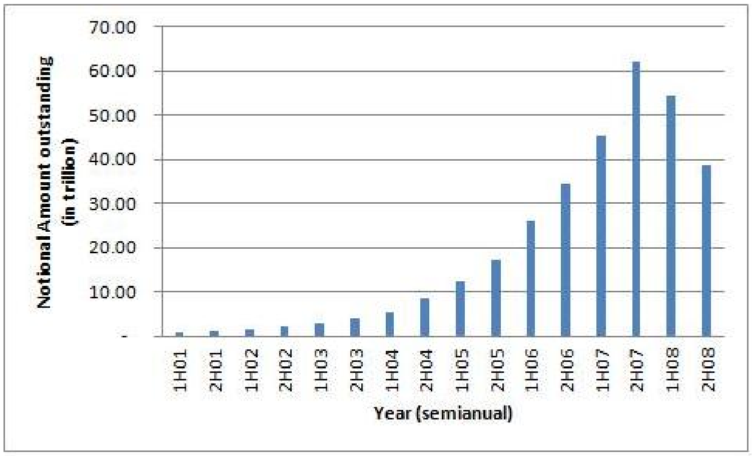


Figure 1.1: Growth of the CDS Markets

This figure displays the notional amount of outstanding CDS contracts in trillion dollars from 2001 to 2008, source: BIS.

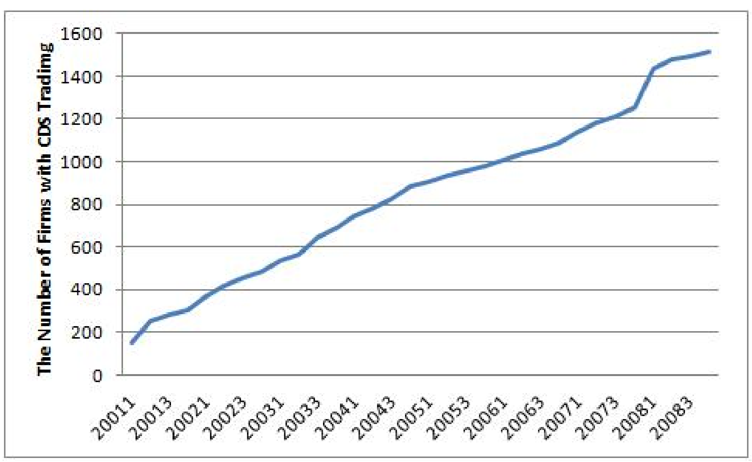


Figure 1.2: Number of Firms with CDS Trading

This figure displays the number of firms with outstanding CDS contracts from 2001 to 2008, source: Markit.

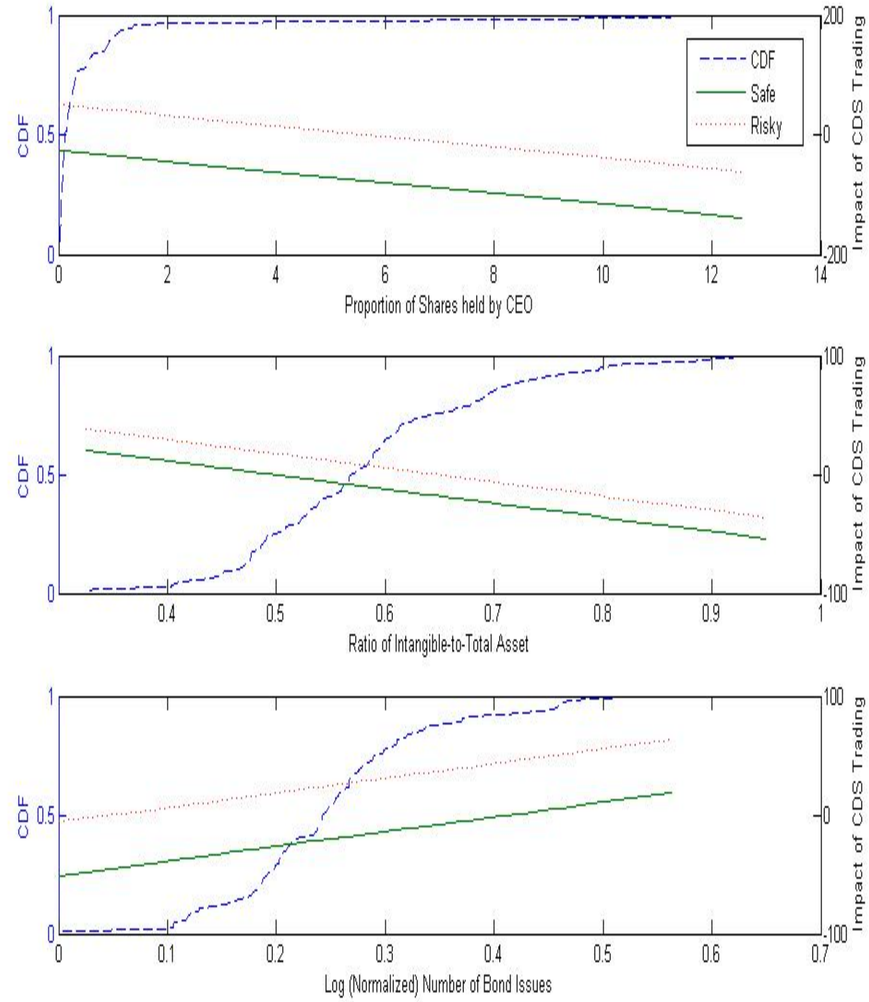
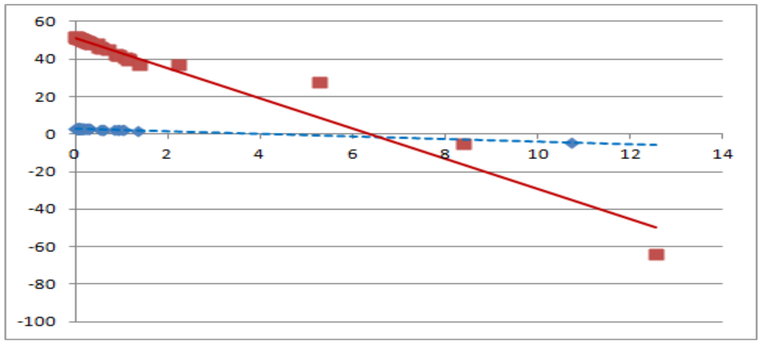
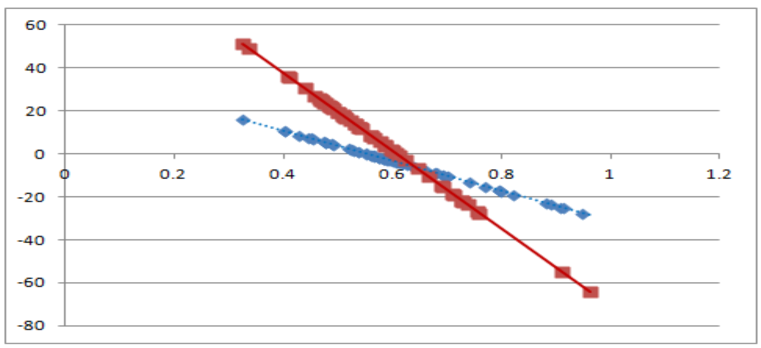


Figure 1.3: Impact of CDS Trading Across Renegotiation Variable

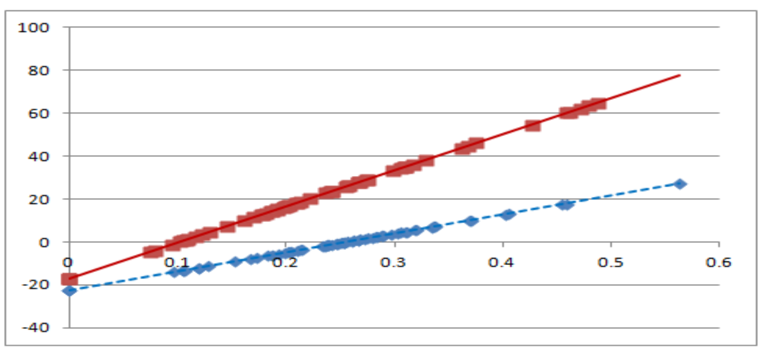
This figure plots the impact of CDS trading across firm characteristics (CEO shareholding in the top panel, asset intangibility in the middle panel, and bondholder dispersion in the bottom panel) an on bond spreads. The curved line illustrates the cross-sectional CDS of a firm characteristic measured in the quarter before the onset of CDS trading. The solid (dotted) straight line plots the impact of CDS trading on bond spreads for safe (riskier) firms.



(a) CEOSHARE



(b) INTANGIBLE



(c) ISSUENUM

Figure 1.4: The Effect of Ratings Across Strategic Variables

This figure provides the plots of the impact of CDS trading (i.e., bond spread changes in basis points) across three strategic variables, *CEOSHARE*, *INTANGIBLE*, and *ISSUENUM* for two different rating categories, higher grades (blue dotted line) and lower grades (red solid line).

CHAPTER II

The CDS-Bond Basis Arbitrage and the Cross Section of Corporate Bond Returns

2.1 Introduction

The credit derivatives markets have experienced tremendous growth during the past decade. According to the Bank for International Settlements (*BIS*, 2010), the notional value of outstanding credit derivatives by the end of 2007 was 58 trillion dollars, more than six times that of the corporate bond market as shown in Figure 1. Credit derivatives have fundamentally changed market practices in the investment, trading, and management of credit risk. Traditionally, institutional investors, such as pension funds and insurance companies, typically adopt a buy-and-hold strategy in their investments in cash corporate bonds. Nowadays, speculators, such as hedge funds and proprietary trading desks of investment banks, can easily long and short the credit risk of individual companies or portfolios of companies using credit derivatives.[1]

The single-name credit default swap (CDS) is the most liquid and popular product and accounts for more than two thirds of all outstanding credit derivatives. Since its first appearance in late 1990s, CDS has been widely used to "arbitrage" the mispricing of the credit risk of the same company in the cash and derivatives markets through

[1]See *Rajan et al.* (2007) and *D'Arcy et al.* (2009) for a review of the credit derivatives markets.

the so-called CDS-Bond basis trade. The CDS-Bond basis (the basis hereafter) is defined as the difference between the CDS spread of a reference firm and the spread of the firm's cash corporate bond with similar maturity. Many studies have shown that CDS and bond spread should follow a co-integrated process since they measure the credit risk of the same company.[2] Investors can easily arbitrage away non-zero basis if the two markets are expected to converge in the future. When the basis is negative (positive), one can long (short) the underlying corporate bond and buy (sell) CDS to bet on the narrowing of the basis. Since it is generally more difficult to short corporate bonds, the negative basis trade has been more popular in practice.

Unlike standard textbook arbitrage, arbitrage in practice is always risky. Arbitrageurs in the basis trade face a wide variety of risks. First, non-zero basis could be due to contractual differences between cash bond and CDS and does not necessarily represent pure arbitrage profits. Second, due to the well-known limits-to-arbitrage constraints of *Shleifer and Vishny* (1997), arbitrageurs could lose money even in potentially profitable trades. For example, levered arbitrageurs in the basis trade could face funding liquidity risk. Arbitrageurs could also face counterparty risk, mostly from sellers of CDS contracts, liquidity risks in both bond and CDS markets, as well as deleveraging risks from other levered players. Therefore, in practice, the basis trade is never a pure arbitrage, but a risky investment with its own risks and rewards.

The huge losses in the basis trade suffered by Deutsche Bank, Merrill Lynch, Citadel and others during the current financial crisis highlight the risks involved in this trade. The equal- and value-weighted index of the basis for investment grade bonds in Figure 2 exhibit wild fluctuations during extreme market turmoil in 2007 and 2008. The widening of the negative basis was further accelerated by the unwinding of levered arbitrageurs due to heightened uncertainty and their funding constraints, creating significant disruptions in the credit market. The basis only started to revert

[2] *Hull et al.* (2004), *Norden and Weber* (2004), and *Blanco et al.* (2005), and *Alexopoulou et al.* (2009) among others have examined the parity relation between CDS and corporate bond spread.

back to a normal level after the U.S. government stepped in and injected capital to major financial firms through the Troubled Asset Relief Program and the Supervisory Capital Assessment Program.[3]

Given the dramatic disruptions in the credit market caused by the unwinding of the basis trade, in this paper, we study the potential impacts of the basis trade on the pricing of underlying cash corporate bonds. The basis arbitrage attracts arbitrageurs to the bond market, which has been dominated by buy-and-hold investors. Consequently, the risks involved in the basis trade could affect the pricing of cash corporate bonds through trading activities of the arbitrageurs. The existence of arbitraging channel can transmit not only the new risk from CDS market but also the risk of basis trade into corporate bond pricing.[4] Such pricing impact is very similar to that of foreign speculators on emerging market equity returns documented in *Bekaert and Harvey* (2011). While one can test whether each individual risk involved in the basis trade affects corporate bond returns, it is more important to understand the total pricing effect of these new risks on corporate bond returns together with existing systematic risk factors. Recent literature also suggests that these new risk factors may not capture all the risks involved in the basis trade and these risk factors can reinforce each other.[5] Hence, we construct a new risk factor based on basis level as a

[3] See *FRB* (2009) and *Duffie* (2010)

[4] For example, *Liu and Mello* (2011) argue that the capital fragility of arbitrageurs such as hedge funds can disrupt the pricing of their traded financial assets. *Gârleanu and Pedersen* (2011) also predict that the sudden increase of margin requirements for some assets can cause the price to deviate from its fundamental value and margin requirements are common in arbitrage activities. Moreover, *Arora et al.* (2011) show that counterparty risk is non-negligibly priced in CDS. Intuitively, the expected return of a given asset mainly depends on its exposure to systematic risk factors that influence the marginal rate of substitution (hereafter MRS) of the dominant investors in the asset. Without CDS, expected returns of cash corporate bonds should depend mainly on their exposures to risk factors that influence the MRS of traditional buy-and-hold investors. With CDS and the basis trade, expected returns of corporate bonds should depend also on the risk factors that influence the MRS of basis arbitrageurs.

[5] For example, *Bai and Collin-Dufresne* (2011) find that a few risks in the basis trade explain less than 50% of the whole basis. Moreover, *Brunnermeier and Pedersen* (2009) show that market liquidity and funding liquidity can be mutually reinforcing and *Aragon and Strahan* (2011) also provide empirical evidence that shocks to traders funding liquidity reduce the market liquidity of the assets that they trade.

convenient empirical proxy of all the risks involved in the basis trade and test whether it plays a role for pricing corporate bonds.

Our paper provides several interesting new empirical findings on the basis and its relation to both the time series and cross section of corporate bond returns. First, we show that the basis level of each individual bond can outperform conventional bond characteristics in predicting its future return. We compute the basis for each corporate bond in our sample using CDS spread from Markit and bond prices from TRACE and NAIC between 2001 and 2008. We have about 890 investment grade bonds in each year. The time series average of the basis for individual bonds is negative at -35 basis points, suggesting a somewhat permanent discrepancy between CDS and bond spread. We find that bonds with more negative basis tend to be older, have lower rating, longer maturity, higher coupon, duration, and convexity. In Fama-Macbeth regression (*Fama and MacBeth*, 1973), we find that the basis level is negatively related to future returns of individual bonds.

Second, we provide strong evidence that the basis is a new risk factor in explaining the cross section of expected corporate bond returns. We form five bond portfolios based on past average basis and find that the return of longing the LOW quintile basis portfolio and shorting the HIGH one (i.e., a LMH strategy) is significantly positive. After we group bonds according to their characteristics and subsequently construct a LMH basis portfolio within each characteristic group, we still find significant returns for the LMH portfolio in most groups. This finding suggests that this portfolio formation method can plausibly provides a convenient new risk proxy that is independent of bond characteristics and known risks. Using the LMH portfolio formed on all bonds as a new basis risk factor, we run Fama-Macbeth (1973) regression for twenty bond portfolios sorted on rating and maturity on this basis risk factor after controlling for all existing systematic risk factors. We find that the risk premium associated with the basis risk factor is significantly positive at about 3% per annum between 2002 and 2006.

Third, we provide more direct evidence that the basis risk factor outperform the existing empirical proxies for the new risks from basis arbitrage. Following the literature, we use TED spread, FINRET, and VIX to proxy for funding liquidity, counterparty risk, and aggregate collateral risk respectively.[6] We find that the basis risk factor is significantly related to them individually and jointly in the presence of existing systematic risk factors. More important, the basis risk premium remains to be significant when we run standard asset pricing tests by including these new risk proxies. The success of the basis risk factor in the horse race confirms our conjecture that the basis factor is a superior empirical proxy for new risks. We also verify that the basis factor is not significantly priced in speculative grade bonds, which are less popular among arbitrageurs for the basis trade.

Finally, we provide interesting evidence on the breakdown of normal pricing relation in the corporate bond market during the current financial crisis in 2007 and 2008. In fact, the basis risk premium becomes negative at about -5% per annum in 2007 and 2008. Other systematic risk factors, such as the market, HML, DEF, and liquidity factors, exhibit negative risk premiums as well during the crisis. The negative basis risk premium indicates that the corporate bond market experienced significant price disruptions as it was abandoned by investors during the financial crisis. The normal price-adjusting mechanism fails to correct for the mispricing of these bonds. The heightened counterparty risk, funding risk, and uncertainty after the Lehman bankruptcy drive corporate bond prices far away from their fundamental values. Further forced sale of highly leveraged arbitrageurs in credit market drives the demand for corporate bonds further down. As a result, the risk premiums become negative during the crisis. Moreover, we also find that both counterparty risk

[6] Specifically, TED spread is the difference between 3-month uncollateralized LIBOR rate minus 3-month T-bill rate, FINRET is the value-weighted excess return of all investment bank equities from CRSP with SIC code 6211, and VIX is the Chicago Board Options Exchange (CBOE) Market Volatility Index that is the implied volatility of S&P 500 index options.

and funding liquidity factors still carry economically and statistically significant risk premiums in the presence of the basis risk factor, suggesting that basis arbitrageurs between CDS and bond market have not priced in these new risks sufficiently during the crisis as compared to normal periods. Our findings here establish the severity of market imperfections in the financial market during the financial crisis.

There is a fast growing literature on CDS spread and the basis. While earlier studies mainly focus on the co-integration of CDS and bond spread, recent studies have examined the existence and determinants of the basis and the cause of the abnormal basis level during the financial crisis. For example, *Mitchell and Pulvino* (2011) show that loss of confidence about primary brokers and subsequently spread-over effect to the rehypothecation lenders and their clients - hedge funds, slow down the movement of investment capital. *Duffie* (2010) generalizes that slow-moving capital is a pervasive market friction over time and across different asset classes. *Bai and Collin-Dufresne* (2011) show that funding liquidity risk, counterparty risk, and collateral quality jointly determine the basis level. *Nashikkar et al.* (2011) find that some determinants of the basis are related to a bond's accessibility, liquidity, and probably short-sale constraints faced by bond investors. *Trapp* (2009) shows that the basis is related to bond, CDS, and market-wide liquidity measures.

Our paper differs from the above studies in fundamental ways. Instead of focusing on the determinants of the basis, we study the potential impacts of the basis arbitrage trade on the pricing of cash corporate bonds. By constructing a new risk factor based on the basis level for corporate bond returns, our paper contributes to the well-established asset pricing literature on corporate bonds. *Fama and French* (1993) find that a two-factor model with TERM and DEF factors captures almost all the common variations in investment grade bond excess returns.[7] *Gebhardt et al.* (2005) find that systematic risk factors such as TERM and DEF are more important than the

[7] TERM is the difference between long-term government bond return and the one-month Treasury bill rate, and DEF is the difference between long-term corporate and government bond return.

characteristics measures such as ratings and duration in explaining the cross-sectional returns of bond portfolios and individual bonds. Many recent papers also demonstrate that liquidity risk is an important systematic risk in the returns of corporate bonds.[8] We demonstrate that even after controlling for all the systematic risk and liquidity factors, the basis factor still carries significant positive risk premium during normal market conditions. It is important to note that our basis risk factor is not a simple proxy for liquidity effect (but certainly can be affected by it through funding liquidity as suggested by *Brunnermeier and Pedersen* (2009) and *Aragon and Strahan* (2011)) because we extensively control for both liquidity factors and liquidity risks in our tests. Moreover, a recent paper by*Friewald et al.* (2011) shows that liquidity effect is more pronounced for speculative grade bonds during crisis period. Similarly, *Dick-Nielsen et al.* (2011) also find that illiquidity increases more for speculative bonds than investment grade bonds from 2005 to 2009. In contrast, our basis risk factor is only significantly priced in investment grade bonds but not speculative bonds. Therefore, our basis risk factor is likely to represent a new risk factor in corporate bond returns due to basis arbitrage activities.

Our study also sheds lights on the impacts of the introduction of derivatives and associated arbitrage activities on the pricing of the underlying securities. While many studies have examined potential impacts of options on underlying securities, our paper is the first to study the pricing impact of CDS and CDS-bond basis arbitrage on cash corporate bonds. While *Arora et al.* (2011) show that counterparty risk is priced in CDS market, we find that it is also priced in cash bond market. Moreover, as prior studies (e.g., *Mitchell and Pulvino*, 2001; *Duarte et al.*, 2007) have documented the risk and return properties of different arbitrage strategies, our paper is one of the first to show that the pricing impacts of basis arbitrage trade on the cross-sectional returns of corporate bonds are significant.

[8] See e.g., *Ericsson and Renailt* (2001), *Chen et al.* (2007), *Edwards et al.* (2007), *Gebhardt et al.* (2005), *Lin et al.* (2011), and *Bao et al.* (2000).

The rest of the paper is organized as follows. In section 1, we discuss the basis arbitrage trade and the risks involved. Section 2 describes the data and the construction of the basis. Section 3 documents the relation between the basis, bond characteristics, and future bond returns. Section 4 shows that the basis is a new risk factor in determining the cross-sectional returns of corporate bonds. Section 5 verifies that the basis risk is a superior proxy for new risks and Section 6 concludes.

2.2 The CDS-Bond Basis Arbitrage

This section describes how investors arbitrage on the non-zero CDS-Bond basis and potential risks involved in such arbitrage activities.

2.2.1 The CDS-Bond Basis Trade

A CDS is essentially an insurance contract, in which the protection buyer pays a premium (called the CDS spread) to the protection seller periodically for protection against the default of a reference entity. A credit event, such as bankruptcy, triggers a contingent payment from the protection seller to the buyer. The payment could be in the form of physical settlement, in which the seller receives the defaulted bond and pays par to the buyer, or cash settlement, in which the seller pays the difference between par and the recovery value of the bond. CDS makes it much more convenient to trade the credit risk of a reference entity. While in the past one has to borrow and sell the cash bond of a company to short its credit risk, right now this can be easily accomplished by buying the CDS of the company.

The basis is defined as the difference between the CDS spread and bond spread for the same company at the same maturity. Many studies argue that CDS and bond spread should be co-integrated because CDS and bond are two ways to invest in the credit risk of the same company and should have the same payoff in either default and at maturity. Therefore, non-zero basis presents trading opportunities for arbitrageurs who expect the basis to narrow in the future. When the basis is positive, the arbitrageur can short the cash bond, which is typically done through a reverse repo, and sell a CDS on the same reference name with the same maturity and notional amount. When the basis is negative, an arbitrageur can buy the cash bond (probably need to use repo to fund the purchase) and buy a CDS on the same reference name. In either case, the arbitrageur can probably hedge the interest rate risk embedded in cash bond by using some interest rate derivatives. The negative basis trade is more popular in practice since it is more difficult to short corporate bonds.

The basis trade was very popular among hedge funds and proprietary trading desks at Wall Street firms before the current financial crisis (see e.g., *Choudhry*, 2006; *Morgan*, 2006). Traders, while deciding on candidate bonds for the basis trade, tend to consider bonds with funding spreads between -500 basis points (bps) and 1000 bps, which would rule out distressed and speculative grade bonds (see *Deutsche Bank*, 2009). A positive funding spread can usually lead to a negative basis, which indicates that a bond is cheaper than CDS. During the few years before the crisis when credit was easily available, speculators tend to lever up the basis trade many times to magnify the profits from small price discrepancies.

2.2.2 Risks Involved in the Basis Trade

It is important to realize that non-zero basis may arise due to market imperfections and does not necessarily represent pure arbitrage profits. As pointed out by *Blanco et al.* (2005), one main reason for non-zero basis is contractual differences between cash bond and CDS contract. For example, one might not be able to find a CDS with exactly the same maturity as the cash bond. Second, in case of default, although the accrued interest is paid upon default in CDS, it is not paid for defaulted bond. Moreover, the interest payment of CDS is on a quarterly frequency whereas it is semi-annual for most cash bonds. The cheapest-to-deliver option embedded in CDS contract can be extremely valuable in some default events.[9] Investors in CDS may not enjoy the same rights as those in cash corporate bonds either. *Bolton and Oehmke* (2011) highlight the empty creditor problem where debtholders with CDS protection might desire for quick bankruptcy resolution whereas it might hurt the rights of debtholders without CDS. The cash bond holder might prefer to restructure rather than bankruptcy resolution.

Non-zero basis could also be due to more efficient price discovery in the CDS market. *Acharya and Johnson* (2007) show that private information of informed banks tends to be reflected in CDS but not cash bond market. *Alexopoulou et al.* (2009) show that the CDS market usually lead corporate bond market in price discovery. But during the recent financial crisis, the CDS market reacts more towards systematic risk whereas the corporate bond market reacts more to liquidity and idiosyncratic risk.

In addition to the above reasons for non-zero basis, arbitrageurs in the basis trade are also exposed to a wide variety of risks. One important risk is funding liquidity risk for arbitrageurs who purchase cash bonds using borrowed money. Margin requirements, perceived changes to margin requirements, terms of financing, conditions under which financing can be renewed or terminated, actual financing cost (such as repo or reverse repo rate) are all important considerations for evaluating funding risk. Arbitrageurs also face counterparty risk in the basis trade, the majority of which arises from the default risk of protections sellers. When highly levered arbitrageurs face a sudden shortage of capital or funding liquidity, their deleveraging activities can affect the basis level in a significant way, which could lead to deleveraging risk. The liquidity risks in both CDS and bond markets might affect the unwinding of the basis arbitrage positions.[10] Given that *Brunnermeier and Pedersen* (2009) and *Aragon and*

[9]The option gives the buyer the right to deliver the cheapest bond for the single name entity when a credit event occurs. For example, when Fannie Mae and Freddie Mac were put into conservatorship by their federal regulator, the companies' bonds increased in value because of government guarantees and the benefits of having embedded cheapest-to-deliver options (*D. E. Shaw Group*, 2009).

[10]Many studies, such as *Collin-Dufresne et al.* (2001), *Elton et al.* (2001), and *Chen et al.* (2007) have shown that liquidity is an important factor in the credit spreads of corporate bonds. *Tang and*

Strahan (2011) both suggest that market liquidity can interact with funding liquidity, such joint effect can complicate the risks involved in the basis arbitrage. Lastly, it is possible that the underlying firms are selling the cash bond and their affiliated financial institutions are also the sellers of the CDS contract. Hence the default risk of the cash bond and the counterparty risk embedded in the CDS can be highly correlated.

While default risk can be hedged to some extent in the basis trade, it is difficult to completely eliminate all other risks involved. Therefore, the seemingly profitable basis arbitrage is not risk free as standard textbook arbitrages. Instead, it is an investment like any other investments, with its own risks and rewards. Since arbitrageurs face all the risks involved in the basis trade and actively trade the cash bonds through the basis trade, these risks might affect corporate bond returns through the trading of the arbitrageurs. Given that the CDS market is many times larger than the cash bond market and that the CDS market often leads bond market in price discovery, basis risk could have big impacts on the pricing of cash corporate bonds through the activities of basis arbitrage. On the other hand, these risks could not have affected corporate bond returns before the introduction of CDS because passive buy-and-hold investors are not exposed to these risks. Instead of explicitly discussing each individual component of the risks in the basis trade, it is more important to understand the total pricing impact of these new risks on the corporate bond returns. To some extent, the compensation for new risks is reflected in the magnitude of the basis level because arbitrageurs demand discounts to enter the trade to be compensated for the risks they bear. Moreover, we can also project the basis level to the returns of corporate bonds directly by forming a new reduced-form risk factor in the spirit of Fama-French SMB and HML factors to capture the overall pricing impact of basis arbitrage since the new risks and traditional systematic risks in corporate bond returns can reinforce each other.

Hong (2007) also find evidence that liquidity premium exists in CDS spreads.

2.3 Data

This section describes the data and the construction of the basis.

2.3.1 CDS and Bond Data

The CDS data used in this study is on standardized ISDA contracts for physical settlement and obtained from Markit, which aggregates quotes from major CDS dealers. We focus on U.S. dollar denominated CDS contracts that are senior unsecured with modified restructuring clauses from 2001 to 2008. The daily CDS spreads are quoted in basis points per year for a notional amount of $10 million. While previous studies have mainly focused on CDS contracts with five year maturity, we have a complete credit curve of CDS spreads for 6 month, 1, 2, 3, 5, 7, 10, 15, 20, and 30 year maturities for most companies.

The bond data between 2001 and 2008 is obtained from three different sources. The price information is from TRACE and NAIC, the two bond transaction databases that have been widely used in recent literature. The transaction data is further merged with the Fixed Investment Securities Database (FISD) to obtain bond characteristic information, such as issue dates, maturity dates, issue amount, and rating information. To compute the basis, we focus on senior-unsecured fixed-rate straight bonds with semi-annual coupon payments. We delete bonds without credit ratings from any of the three rating agencies (i.e., Standard & Poor's, Moody's, and Fitch). We also delete bonds with embedded options (callable, puttable, or convertible bonds), floating coupons, and less than one year to maturity.

TRACE was officially launched in 2002 by the Financial Industry Regulatory Authority (FINRA), which replaced NASD, to disseminate secondary over-the-counter (OTC) corporate bond transactions by its members. TRACE gradually increases its coverage of the bond market over time. By July 1, 2005, FINRA requires all its members to report their trades within 15 minutes of the transaction. Nowadays, TRACE covers all trades in the secondary over-the-counter market for corporate bonds and accounts for more than 99% of the total secondary trading volume in corporate bonds. The only trades not covered by TRACE are trades on NYSE, which are mainly small retail trades. The information contained in TRACE includes transaction dates and transaction price (clean price or price with commissions). We exclude transactions whose prices are mixed with commissions in our study.

Due to limited coverage by TRACE in early years, we supplement the bond transaction information from the NAIC database, which provides all corporate bond transactions by American Life, Health, Property and Casualty insurance companies since 1994. Insurance companies are estimated to hold between 33%-40% of corporate bonds and have completed 12.5% of the dollar trading volume in TRACE-eligible securities during second half of 2002 (*Schultz*, 2001; *Campbell and Taksler*, 2009). A recent study by *Lin et al.* (2011) also uses the combined dataset of NAIC and TRACE to study the liquidity risk in the corporate bond market. NAIC is an alternative to the no-longer available Lehman fixed income database on corporate bonds used in previous studies. Since NAIC does not report the exact time of trading, we use the last transaction price from TRACE as the closing price of the bond for each day. When TRACE has no record of a bond's transaction, we keep the observation from NAIC if it is available.

2.3.2 Summary Information of the Basis

The basis for a given firm i at time t for a given maturity τ is defined as

$$Basis_{i,t,\tau} = CDS_{i,t,\tau} - Z_{i,t,\tau}, \tag{2.1}$$

where $CDS_{i,t,\tau}$ ($Z_{i,t,\tau}$) is the CDS (bond) spread of firm i at time t for maturity τ. While there are many different ways to compute the bond spread, in our empirical analysis, we mainly use Z-spread, which has been widely used in industry in defining the basis according to *Choudhry* (2006). Z-spread is defined as a parallel shift of the credit curve such that the present value of future cash flows equals to the current bond price. A simple definition of the Z-spread for a 3-year plain vanilla bond with annual coupon is the value of Z that solves the following equation:

$$P = \frac{c}{1 + s_1 + Z} + \frac{c}{(1 + s_2 + Z)^2} + \frac{c + 1}{(1 + s_2 + Z)^3}, \tag{2.2}$$

where P is the current price of the bond with face value of 1, c is the coupon rate, s_i is the zero-coupon yield to maturity based on the swap rate curve for a maturity of i year (where i = 1, 2, and 3). Robustness checks show that other measures of bond spread do not significantly affect our results.

To construct the basis, we first compute the Z-spread for each bond on each day in our dataset. We then match the Z-spread with the CDS spread with the same maturity. In case we do not have the exact match for maturity, we linearly interpolate the CDS curve to obtain a CDS spread that has the same maturity as the bond. Then the basis for each bond is constructed by subtracting the Z-spread from the CDS spread. After matching, cleaning, and winsorizing by 1% at the bottom and the top, our final dataset has a total of 392,914 observations. The sample period is between January 2, 2001 and December 31, 2008.

Table 2.1 provides summary information of our sample of bonds and time series patterns of the basis. Panel A of Table 1 shows that our sample contains 1,978 firm-year observations and 7,116 bond-year observations (about 247 firms and 889 bonds per year). Given the growing coverage of TRACE, we observe that the number of bonds in our sample increases dramatically after 2002.

Panel B of Table 2.1 shows that the basis displays significant variation over time. The total sample contains 392,914 daily observations over a period of eight years. The average bond in our sample has a basis of -35 bps. The average basis is significantly negative in every single year between 2001 and 2008. The average basis is negative, ranging from -56 bps to -70 bps, during the last recession between 2001 and 2003. It is interesting to note that during the same period, both the CDS spread and the Z-spread are very wide as well. The basis widens to -102 bps during the crisis in 2008, which also sees dramatic increases in the CDS spread and the Z-spread. The average basis narrows significantly during the boom period between 2005 and 2007, a period with extremely low credit spreads as well.

2.4 The Basis Level, Bond Characteristics, and Future Bond Returns

In this section, we explore the relation between the basis level and individual bond characteristics and future bond returns. We first relate the basis level of each bond to its other characteristics such as rating, maturity, age, coupon, issue size, duration, and convexity. Then we demonstrate that past basis can predict future individual bond returns at 20-, 40- and 60-day horizons based on cross-sectional regression analysis. The different holding periods approximate monthly, bi-monthly, and quarterly frequency in asset pricing tests.

2.4.1 Basis Level and Bond Characteristics

Table 2.2 provides summary information on the basis level and documents the relation between the basis level and various bond characteristics. We use Standard and Poor's (S&P) rating whenever available, followed by Moody's and Fitch's rating. We assign a value of 1 to the highest rating (AAA for S&P or Aaa for Moody's) and 10 to the lowest rating (BBB- for S&P or Baa3 for Moody's). We assign values between 2 and 9 for intermediate ratings.

Panel A of Table 2.2 shows that the average bond in our sample has a rating between A and A-, 8.5 years to maturity, 5.3 years of age, a coupon rate of 6.3%, an issue size of 0.5 billion dollars, a duration of 5.5 years, and a convexity of 59.4. The lowest basis is -371 bps and the highest is 98 bps.

To examine the relation between the basis and bond characteristics, we sort bonds into portfolios based on each of the characteristics and calculate the average basis in each portfolio. Panel B of Table 2.2 present the results based on rating, maturity, age, coupon, issue size, duration, and convexity, respectively.

There is a strict monotonic relation between the basis and rating, maturity, age, coupon, and duration. The lower the rating, the more negative the basis. For example, the basis decreases from -7 bps for AAA-rated bonds to -45 bps for BBB-rated bonds. The average basis of each rating class is statistically significantly different from zero at the 1% significance level. The standard deviation of the basis is also higher for lower-rated bonds. The five maturity groups contain bonds with 1-3, 3-5, 5-7, 7-10 and more than 10 years to maturity. The five age groups contain bonds with less than 3, 3-5, 5-7, 7-10 and more than 10 years of age. The five coupon groups consist of bonds with annual coupon of 0-5.5%, 5.5%-6.5%, 6.5%-7%, 7-8% and more than 8%, and the five duration groups contain bonds with duration of 0-3, 3-5, 5-7, 7-10 and more than 10 years. The basis is more negative for the bond that is older, with longer maturity, higher coupon and duration. Although *De Wit* (2006) shows that the most liquid CDS is concentrated on 5 year-to-maturity, the basis for the bond with 5 year-to-maturity is not the closest to zero, suggesting non-negligible arbitrage risk in basis trade.

The relation between the basis and convexity is largely monotonic. The five convexity groups contain bonds with convexity of 0-10, 10-30, 30-50, 50-70 and more than 70. The convexity group 1 has the least negative basis at -23 bps whereas the convexity group 5 has the most negative basis at -59 bps.

There are no distinctive patterns for the basis across the five issue size. The five issue size groups contain bonds with issue size of 0-0.2, 0.2-0.3, 0.3-0.5, 0.5-0.6 and more than 0.6 billions of dollars and. Bonds in the first and fifth issue size group have the most negative basis whereas bonds in the fourth issue size group have the least negative basis.

In sum, our comprehensive empirical analysis identifies a clear relation between the basis and some but not all bond characteristics: Bonds with more negative basis tend to be older and have lower rating, longer maturity, higher coupon, higher duration, and higher convexity. However, the relation between basis and issue size is not clear.

2.4.2 Basis Level and Future Bond Returns

In this section, we study the predictive power of the basis level for future bond returns. If we interpret the basis level as a reflection of the compensation for the risks in the basis trade, then investors should be compensated in future bond returns by arbitraging away the non-zero basis. In other words, we expect current negative basis leads to higher future bond returns.

For each bond i, we compute its k-day holding period return $HPR_{i,t,t+k}$ using the following equation,

$$HPR_{i,t,t+k} = \frac{(P_{i,t+k} + AI_{i,t+k}) + C_{i,t,t+k} - (P_{i,t} + AI_{i,t})}{(P_{i,t} + AI_{i,t})}, \tag{2.3}$$

when $P_{i,t+k}$ is the closest available transaction price of bond i on day $t+k$, $AI_{i,t+k}$ is the accrued interest on day $t+k$, $C_{i,t,t+k}$ is the coupon payment during the period from day t to $t+k$, $P_{i,t}$ is the closest available transaction price on day t, and $AI_{i,t}$ is the accrued interest on day t.[11]

[11] If there is no price available on day t, we check whether there is any transaction price on day $t-1$, $t-2$, $t-3$, $t-4$ and $t-5$ in the order of priority. If there is no transaction price available on day $t+k$, we will check whether there is any transaction on day $t+k-1$, $t+k-2$, $t+k-3$, $t+k-4$, and $t+k-5$ in the order of priority. If there are no transactions within the five-day window, the bond will be deleted from our sample.

We consider the following Fama-MacBeth regression of future individual bond excess returns on its past basis level, bond characteristics, and one liquidity measure:

$$\begin{aligned} HPR_{i,t,t+k} - r_{f,t,t+k} = \alpha &+ \beta_1\, BASIS_{i,t} + \beta_2\, RATING_{i,t} + \beta_3\, MATURITY_{i,t} \\ &+ \beta_4\, AGE_{i,t} + \beta_5\, COUPON_{i,t} + \beta_6\, ISSUE_{i,t} \\ &+ \beta_7\, INDLIQ_{k i,t} + \epsilon_{i,t}, \end{aligned} \tag{2.4}$$

where $HPR_{i,t,t+k}$ is the k-day (where $k = 20, 40, 60$) holding period return for individual bond i from day t to $t + k$, $r_{f,t,t+k}$ is the cumulative risk free rate from day t to $t + k$, $BASIS_{i,t}$, $RATING_{i,t}$, $MATURITY_{i,t}$, $AGE_{i,t}$, $COUPON_{i,t}$, $ISSUE_{i,t}$, and $INDLIQ_{k i,t}$ is the basis level, credit rating, maturity, age, coupon, issue size, and liquidity of bond i on day t, respectively. The liquidity factor $INDLIQ_{k i,t}$ is the sum of the turnover of bond i that is defined as the total trading volume divided by the total amount outstanding for the bond between day $t - k$ to day t. We run cross-sectional regression on each day and report the time series averages of the estimates of the coefficients. Robust Newey-West t-statistics (*Newey and West*, 1987) of coefficients are reported in brackets. The results are reported in Model 1 in Table 2.3. For robustness checks, we also replace age and maturity by duration ($D_{i,t}$) in Model 2 in Table 2.3.

Table 2.3 report the Fama-MacBeth regression results for 20-, 40- and 60-day holding period returns, respectively. Model 1 shows that the coefficients of the basis are statistically significant at the 1% significance level for 20-, 40-, and 60-day holding periods. The coefficient of the basis factor is negative, ranging from -0.0216 to -0.0223 as the holding horizon increases. This suggests that negative basis leads to higher future bond returns, consistent with our hypothesis. On the other hand, the coefficients of other bond characteristics, such as credit rating, maturity, age, duration, and liquidity factors, are not consistently significant across different models and holding horizons. Model 2 shows that the basis still has significant predictive power for future bond return with a negative coefficient at 40-day and 60-day holding horizon as we replace maturity and age by duration. A slightly weaker result suggests that the basis can have some interaction with duration, a measure of the total risk of bonds. Most of the significant coefficients of basis level have t-statistics ranging from 3.43 to 16.88, representing an economically and statistically significant prediction power of basis level. Overall, our results show that the basis has significant predictive power for future excess returns of individual bonds after controlling for well-known bond characteristics and liquidity measures. We also use other liquidity measures (such as number of transactions and logarithmic of trading volume for each bond from day $t-k$ to day t) for robustness checks and the results are similar.

2.5 Is the Basis a New Risk Factor for Corporate Bond Returns?

In this section, we study whether the basis can provide a good measure for new arbitrage risks in affecting the returns of bond portfolios. We first construct quintile bond portfolios sorted on past basis level and examine its return patterns. This method of constructing a new risk factor is similar to the approach by*Fama and French* (1993) in constructing SMB and HML factors. Second, we then sort bonds into subgroups based on their bond characteristics and form a LOW minus HIGH basis portfolio within each characteristics group. We find that returns of such construction are significantly positive for most of the characteristics groups. This gives us an indication that such portfolio formation method can plausibly be a good risk proxy. Finally, we employ a new basis risk factor constructed from LOW-minus-HIGH basis portfolios on all bonds and test whether it can explain the cross-sectional returns of bond portfolios. Due to the dramatic disruptions in the corporate bond market during the current financial crisis, we conduct our asset pricing tests for two separate periods, one period before the crisis (2002 to 2006) and one during the crisis (2007 to 2008).

2.5.1 Formation of Quintile Basis Portfolios

We form quintile portfolios of bonds based on their past basis level and examine their subsequent returns over different holding periods. We sort bonds into five basis portfolios based on the average basis of each bond over the past 60 trading days. A bond is included in our sample only if it has more than 20 transactions during the past 60 trading days. We then compute the subsequent equal- or value-weighted k-day holding period returns of each basis portfolio on day t, $HPR_{t,t+k}$, where $k = 20$, 40, and 60 days. We further eliminate dates with less than five bonds traded. Our refined sample is from July 17, 2002 to December 31, 2008, with 258,514, 252,850, and 252,540 observations for 20-, 40-, and 60-day holding periods, respectively. After obtaining individual bond holding period returns, we then compute equal- and value-weighted holding period returns for the five basis portfolios. We compute value-weighted portfolio return by weighting each bond's holding period return by the ratio of its market value to the total market value of all the bonds within the portfolio. Table 2.4 presents the results.

Panel A of Table 2.4 reports the raw and excess holding period returns of the five equal-weighted basis portfolios. The excess return is the difference between the raw return and the risk free rate during the same holding period. On average each basis portfolio contains about 35 bonds. The levels of the basis of the five portfolios range from -75 bps (lowest) to 18 bps (highest) within the past 60-day window. We find that the lowest basis portfolio has significantly higher raw and excess returns than the highest basis portfolio over all three holding periods. The return differentials between the two basis portfolios are statistically significant at the 1% level and amount to 28 bps, 49 bps, and 65 bps for 20-, 40-, and 60-day holding period, respectively. On an annual basis, the return differentials range from 2.69% to 3.52%, an economically significant number. The excess return of the lowest basis portfolio is positive whereas that of the highest basis portfolio is negative. This indicates that buying the lowest basis portfolio and selling the highest basis portfolio can generate positive return, consistent with industrial practices. Panel B of Table 2.4 reports similar results for the raw and excess holding period returns of the five value-weighted basis portfolios. The return differentials between the lowest and highest basis portfolios range from 2.19% to 2.74% on an annual basis.

2.5.2 Profitability of Zero-Investment Strategy and Bond Characteristics

Given that the zero-investment portfolio that longs the lowest (LOW) quintile basis portfolio and shorts the highest (HIGH) quintile portfolio based on all bonds generates significant excess returns in the previous section, we further explore whether such an investment strategy can consistently produce excess returns across different bond characteristics considered before. First, we sort all bonds into different characteristic groups. Second, within each group, we form the LOW-minus-HIGH (LMH) basis portfolio and report its equal- and value-weighted 20-, 40-, and 60-day holding period returns in Table 2.5.

Panel A of Table 2.5 reports the holding period returns of the LMH basis portfolio for each year of our sample. Since we delete those dates with less than five different bond transactions, our sample shrinks to the period between July 21, 2002 and December 31, 2008. The result shows that the LMH strategy is significantly profitable for 28 out of 30 tested portfolios (for 2 different weighting schemes and 3 different holding horizons) from 2002 to 2006, suggesting that the basis trade can be profitable under normal market conditions when the negative basis usually converges over time. However, the strategy becomes less profitable in 2007 and even loses money in 2008 when the crisis worsens (i.e., 9 out of 12 portfolios are significantly negative). This result is consistent with Figure 2, which shows that the negative basis widens even further in 2008 from very negative levels at the beginning of the crisis. Therefore, the tightening of credit and unwinding of basis trade positions during the crisis can lead to big losses in the basis trade that is conventionally profitable in normal times.

Panel B of Table 2.5 shows that the LMH strategy is significantly profitable for all rating groups. The profit is the highest for AA-rated bonds (with equal-weighted return of 0.80%, 1.41%, and 1.69% for 20-, 40-, and 60-day horizons, respectively). This result suggests that the profitability of LMH strategy is not concentrated on few rating classes within investment grades, consistent with the prevailing wisdom that any investment grade bond can be a potential target for basis arbitrage. Panel C shows that the LMH strategy is most profitable for bonds with shortest and longest maturities. But it actually loses money for bonds with 5 to 10 years of maturity. The diminished arbitrage profits could be due to the fact that these medium term bonds are the most liquid and efficient segment of the corporate bond market as the CDS of similar maturities are mostly actively traded around 5 years-to-maturity.

Panel D shows that the LMH portfolio is profitable for all age groups. The most profitable age group of bonds is between seven to ten years. Panel E shows that the LMH strategy is most profitable for bonds with the highest coupons. Panel F shows that the LMH strategy generates highest return for the smallest issue size. Similar to the results for maturity, Panel G shows that the LMH strategy is most profitable for bonds with shortest and longest durations. Finally, Panel H shows that the strategy is profitable for the smallest and biggest convexity groups.

In sum, the return of the LMH portfolio is time varying and is not monotonically related to conventional bond characteristics. The return of the LMH portfolio is lowest in 2007 and 2008. More important, the return of the LMH portfolio is highest for AA-rated bond portfolios, lowest for liquid bond portfolios with medium time to maturity, duration and convexity, intermediate level of coupons, and large issue size. These results suggest that it is difficult to reduce the basis measure to any single source of risk. Instead, we can use such an investment strategy to proxy for different risks involved in the basis arbitrage trade, which could include counterparty risk, funding risk, collateral risk, liquidity risk, and residual default risk among others.

2.5.3 The Basis as a New Risk Factor for Corporate Bond Returns

In this section, we test explicitly whether the LMH basis factor, constructed as return differential between the LOW and HIGH basis portfolios formed from all available investment grade bonds, plays the role of a new risk factor for corporate bond returns. Due to the dramatic disruptions to all major financial markets during the crisis, we conduct our analysis in two separate periods, one for normal market conditions before the crisis between 2002 and 2006, and another during the crisis between 2007 and 2008. Since we consider daily portfolio returns, we can still perform a robust sub-period study for the 2007 and 2008 financial crisis.

2.5.3.1 Results Before the Financial Crisis (2002-2006)

Following *Gebhardt et al.* (2005), we form twenty bond portfolios sorted on rating (AAA, AA, A, and BBB) and maturity (1-3, 3-5, 5-7, 7-10, and more than 10 years) and use their 20-, 40-, and 60-day value-weighted holding period returns to conduct our asset pricing tests. Accordingly, we construct the new basis risk factors over corresponding holding horizons. In particular, the three basis risk factors, $BASIS_{20}$, $BASIS_{40}$, and $BASIS_{60}$, are represented by the 20-, 40-, and 60-day holding period returns of the LMH portfolio constructed based on past 60-day average basis.

We perform the following rolling regression for each of the twenty rating-maturity bond portfolio q to obtain the betas of the all the factors over the past 180 trading days,

$$
\begin{aligned}
HPR_{q,t-k,t} - r_{f,t-k,t} = \alpha_{q,k} &+ \beta_{b,q,k}\ BASIS_{kt} + \beta_{m,q,k}\ MKT_{kt} + \beta_{size,q,k}\ SMB_{kt} \\
&+ \beta_{bm,q,k}\ HML_{kt} + \beta_{def,q,k}\ DEF_{kt} + \beta_{term,q,k}\ TERM_{kt} \\
&+ \beta_{l,q,k}\ LIQ_{kt} + \beta_{amh,q,k}\ AMH_{kt} + \epsilon_{q,k,t},
\end{aligned} \tag{2.5}
$$

where $HPR_{q,t-k,t}$ is the k-day holding period return of the bond portfolio q formed on four credit rating classes and five maturity groups ($q = 1, 2, , 20$) from day $t - k$ to t, $BASIS_{kt}$ is the k-day holding period return of the basis factor from day $t - k$ to t, MKT_{kt}, SMB_{kt}, and HML_{kt} are the three standard factors used in *Fama and French* (1993) from day $t - k$ to day t, DEF_{kt} and $TERM_{kt}$ are the two standard bond factors of *Fama and French* (1993) from day $t-k$ to day t, LIQ_{kt} measures the turnover in the bond market as the ratio of total trading volume divided by the total number of bonds outstanding from day $t - k$ to day t, and AMH_{kt} is the *Amihud* (2002) liquidity risk factor measured from day $t-k$ to day t. $\beta_{b,q,k}$ is the beta for the basis risk factor for portfolio q for time horizon k, $\beta_{m,q,k}$ is the market beta, $\beta_{size,q,k}$ is the size beta, $\beta_{bm,q,k}$ is the BM beta, $\beta_{def,q,k}$ is the default beta, $\beta_{term,q,k}$ is the term beta, $\beta_{l,q,k}$ is liquidity beta, and $\beta_{amh,q,k}$ is the Amihud liquidity beta. We follow the procedures in *Lin et al.* (2011) to construct the *Amihud* (2002) liquidity measure for the corporate bond market. In addition, we demean all these risk factors to interpret the second step estimates as risk premiums. For robustness checks, we also construct *Pástor and Stambaugh* (2003) liquidity risk measure (PS) as an alterative liquidity risk measure as shown in *Lin et al.* (2011).

After obtaining the estimated betas from equation (5), we run the following Fama-

Macbeth regression to obtain estimates of the risk premium for each of the risk factors:

$$\begin{aligned} HPR_{q,t,t+k} - r_{f,t,t+k} = \gamma_0\ \alpha_{q,k} + \gamma_b\ \beta_{b,q,k} + \gamma_m\ \beta_{m,q,k} + \gamma_{size}\ \beta_{size,q,k} \\ + \gamma_{bm}\ \beta_{bm,q,k} + \gamma_{def}\ \beta_{def,q,k} + \gamma_{term}\ \beta_{term,q,k} \\ + \gamma_l\ \beta_{l,q,k} + \gamma_{amh}\ \beta_{amh,q,k} + \delta_{q,k}, \end{aligned} \tag{2.6}$$

where $HPR_{q,t,t+k}$ represents the realized return of bond portfolio q from day t to $t+k$ and is a proxy for the expected return on day t till day $t+k$ (where q =1,2,,20, and k =20, 40, or 60), all the betas with the hat sign are the estimated betas for various risk factors for portfolio q for the time horizon k from the first-stage time series regression from day $t-180$ to t. Hence, the regression results from equation (6) report the risk premiums of eight systematic risk factors, which are denoted by γs.

Table 6 reports the empirical results of our asset pricing tests. Panel A of Table 6 shows that the three basis risk factors are highly positively correlated with MKT, HML, DEF, $TERM$, and AMH (with correlation coefficient above 0.10). The correlation coefficients tend to increase as holding horizons increase. On the other hand, the basis factors are less correlated with the liquidity factor, SMB, and PS. Panel B shows the summary statistics of all the risk factors and the basis factors in percentage terms. There is no extreme outlier in the risk factors.

Panel C of Table 6 reports the Fama-MacBeth regression results for the asset pricing test from 2002 to 2006. Model 1 and Model 2 show the results of seven-factor asset pricing model without the basis factor. Consistent with the literature, we find that MKT, SMB, DEF, and $TERM$ carry significant positive risk premiums. LIQ and AMH (and PS) carry significant risk premiums in 20-day and 40-day horizons respectively. The adjusted R^2s of the seven factor model range from 48% to 65%. The abnormal returns (the intercept) are slightly negative for the 40-day (value-weighted) and 60-day (both equal- and value-weighted) horizons, ranging from -7 to -14 bps. After including the basis risk factor in Model 3 and Model 4, we find that the basis risk premium is significantly positive during this time period. The basis risk premiums range from 1.48% to 4.30% on an annual basis. On average, the basis risk carries an annual basis risk premium of 2.87% on average across different time horizons. Moreover, the new basis risk factor continues to be significant in the presence of other existing systematic risk factors across all time horizons. This result confirms our conjecture that the basis risk factor represents new sources of risk that are independent of the existing systematic risk factors. We will further verify the source of the basis risk in relation to the new risks arisen from basis arbitrage in the following sections.

2.5.3.2 Results During the Financial Crisis (2007-2008)

In this section, we report the results for the asset pricing tests during the current financial crisis between 2007 and 2008. Model 1 and Model 2 show that the existing systematic risk factors such as MKT, HML, and DEF carry significantly negative risk premiums during the financial crisis. The adjusted R^2s range from 50% to 59%. Model 3 and Model 4 show that the basis risk premium is also significantly negative, ranging from -2.45% to -7.00% on an annual basis (about -5.17% on average). The negative risk premiums for existing systematic risk factors imply that the financially-constrained bond investors are willing to take huge price discounts to cash out from the credit market even though they know that the expected return in the long-run can be positive if they can hold on to their investments. Since standard asset pricing theory requires systematic risk factors to earn positive risk premium, we interpret the negative risk premium as a result of the failure of the market self-adjusting mechanism during the extreme turmoil of the current financial crisis.

In summary, our results provide novel evidence that the basis risk is a new risk factor for the expected corporate bond returns even after controlling for well-known risk factors documented by *Fama and French* (1993), *Gebhardt et al.* (2005), and *Lin et al.* (2011). In the next section, we test more directly whether the basis risk factor is related to the new risks arisen from basis trade.

2.6 What is the Basis Risk Factor?

In this section, we show that the basis risk factor is a convenient empirical proxy for the new risks in basis trade. First, we show that it is directly related to the new risks, such as funding liquidity, counterparty risk, and collateral risk documented in the recent literature after controlling for existing systematic risk factors. For example, *Brunnermeier and Pedersen* (2009) establish a theoretical link between funding liquidity and market liquidity and suggest that the shortage of speculators' capital can drive liquidity risk premium. *Gârleanu and Pedersen* (2011) argue that margin requirements for trading securities can affect a security's required rate of return in addition to the usual beta risks. The funding liquidity crisis (such as the one in 2007-2008) can lead to the possibility of the basis trade. They define basis in a general way as the price gap between securities with identical cash flows but different margins. They show that the required return on a high-margin security such as corporate bond is greater than that of a low-margin security with the same cash flow such as a CDS. *Fontana* (2009) shows that funding liquidity dried up during the 2007-2008 crisis. Moreover, *Fontaine and Garcia* (2009) also argue that funding liquidity can potentially be an important missing aggregate risk factor that commands a risk premium. Moreover, *Arora et al.* (2011) show that counterparty risk is priced in CDS market. *Bai and Collin-Dufresne* (2011) try to explain the basis level by their constructs of funding liquidity measure, counterparty risk measure, liquidity, and collateral risk measure and find that these proxies can explain the basis level up to 50% in time series and less than 25% in cross-sectional test.

Second, we run a horse race between the basis risk factor and the empirical measures of above-mentioned new risks and show that basis risk factor is more consistently priced than the other empirical measures separately and jointly. This shows that basis risk factor is a superior empirical risk proxy than other proxies. Lastly, we demonstrate that the basis risk and other new sources of risks are not consistently priced in speculative grade bonds, which should be less affected by the basis risk since they are not widely used in the basis trade.

2.6.1 The Relation between the Basis Risk Factor and the Existing Risk Factors

In addition to the traditional seven systematic risk factors, we construct three empirical risk factors to proxy for the new risks involved in CDS and basis trade, such as funding liquidity, counterparty risk and collateral risk. First, funding liquidity is proxied by TED spread, which is the difference between 3-month uncollateralized LIBOR rate minus 3-month T-bill rate. Second, counterparty risk is proxied by $FINRET$, which is the value-weighted excess return of all investment bank equities from CRSP with SIC code 6211. Third, aggregate collateral risk is proxied by VIX, which is the S&P500 option implied volatility from CBOE. We run a time series regression for the basis risk factor against the existing systematic risk factors as well as the three new risk factors. The results are reported in Table 7.

Specification (1), (2) and (3) in Table 7 include each of three new risks one at a time, and specification (4) include all the new risks. We test the relationship for 20-, 40-, and 60-day horizons. The basis factor is significantly related to HML, $TERM$, LIQ, TED, and VIX at 20-day when each new risk is included separately. In 40-day and 60-day horizon, HML, $TERM$, LIQ, and VIX continue to be significantly related to the basis factor. When all the old and new risk factors are included, risk factors $TERM$ and VIX are consistently and significantly related to the basis risk factor across three holding horizons. This result suggests that the basis risk factor is related to the uncertainty in term structure (i.e., $TERM$) and in the aggregate collateral risk related to macroeconomic situation (i.e. VIX). It is very likely that these considerations reflect the uncertainty in obtaining funding and collateral in the basis trade. Although empirically, the basis risk factor is not closely related to the counterparty risk proxied by $FINRET$, it can plausibly be due to the fact that basis trade involves not only investment banks, but also hedge funds and other types of speculators. Hence, the $FINRET$ may not be a good empirical proxy to measure the true counterparty risk involved.

2.6.2 Horse-race of the Basis Factor with the Proxies of New Risks

In this section, we compare the basis risk factor with the old and new risk factors and test whether the basis factor can survive the horse-race. If it does, it shows that the basis risk factor is a superior proxy of new risks. Panel A and Panel B in Table 8 report the results for 2002-2006 and 2007-2008 periods respectively.

Model 5 in Panel A of Table 8 includes TED spread and shows that across all three time horizons the basis risk premium continues to be statistically significant ranging from 1.94% to 3.62% for the 2002-2006 period. Model 6 in Panel A includes $FINRET$ and shows a similar result as before. The basis risk premium carries a significant premium ranging from 1.76% to 4.75% in 2002-2006. Model 7 includes VIX and shows a slightly higher basis risk premium, from 1.90% to 3.67%. Finally, Model 8 includes all three new risk factors together with the basis risk factor. The basis risk factor survives still across all time horizons, and carries an average risk premium of 2.37%. There is also some indication that the basis risk factor is the most dominant risk factor in 40-day horizon as the three new risks are jointly insignificant.

Panel B of Table 8 shows that the basis risk factor continues to carry a significant negative risk premium about -4.63% during the crisis period on average. The non-zero basis risk premium is strongest in the 60-day horizon whereas it is not significant in the 20-day horizon. Moreover, we find that both the direct proxy of funding liquidity and the counterparty risk carries significant negative risk premiums during the crisis period. This result indicates that basis risk reflects the arbitrage risk conveniently and not completely. During the crisis period, the arbitrage risk can last for a long time as price discovery can be very slow (i.e., *Duffie*, 2010) and more direct proxies for funding liquidity and the counterparty risk can capture risk-return relationship in the bond returns as arbitrage activities are frozen during the crisis since the terms and availability of financing deteriorate significantly. This dramatically reduces the demand for the basis trade. Moreover, many levered players in the trade have been forced to unwind their positions due to the tightening of credit. As a result, the basis widens and becomes hugely negative in the height of the crisis. As shown in Figure 2, the basis of investment grade index in late 2008 is about -250 basis points. Many banks and hedge funds, such as Deutsche Bank, Merrill Lynch, and Citadel, have lost billions of dollars due to the blow up of the basis trade.

The widening of the basis has also created serious disruptions in the credit market even for investors who have not invested in CDS. For example, traditional investors in cash bonds suffer huge losses as well due to the unwinding of the basis trade. As a result, investment-grade corporate credit spreads, such as CDX.IG index rose from 50 bps in early 2007 to about 250 bps by the end of 2008. The spread of even the safest tranche, such as CDX.IG super senior tranche, widens to about 100 bps from 5 bps. Figure 3 provides time series plots of BAA and AAA credit spreads and their difference, as well as the LIBOR-OIS spread between 2001 and 2008. The LIBOR-OIS spread is the difference between LIBOR and the overnight indexed swap rate and measures the counterparty risk in the financial system. The difference between BAA and AAA spreads increases from 100bps to 330 bps from January 2007 to December 2008. The LIBOR-OIS spread shoots up from about 10 bps to more than 80 bps in early July 2007 and increases further to more than 360 bps in October 2008, before settling back to about 10bps in August 2010.

On the other hand, the potential cash-rich investors are reluctant to step in to bring the price back to its fundamental value. They also enter into a massive fear as they are not sure whether the market might collapse and they might lose all their investments. The joint effects of deleveraging by the financial-constrained arbitrageurs and fearful investors make the prices of corporate bonds deviate significantly from their equilibrium values for a prolonged period and arbitrageurs fail to step in to bring the price back to equilibrium. Only when the government steps in to restore the confidence in the financial system, the bond market starts to revert back to its equilibrium level.

Overall, our results show that the basis risk outperforms some direct measures of new risks such as funding liquidity, counterparty risk and collateral risk. It represents these new risks better in normal periods when arbitrage activities are normal than in crisis periods when arbitrage activities are less active due to limits-to-arbitrage. This is the first study, as far as we know, that shows clearly how corporate bond market can be affected by the introduction of credit derivatives and the associated arbitrage activities.

2.6.3 Speculative Grade Bonds

According to *Deutsche Bank* (2009), arbitrageurs tend to favor investment grade bonds over speculative grade bonds when conducting the basis trade. As a result, we do not expect the basis risk to play an important role for pricing speculative grade bonds.

Table 9 repeats our asset pricing tests for high-yield bonds. There are altogether twenty bond portfolios with five maturity groups as defined before and four rating classes (BB, B, CCC, and CC-C). Panels A and B report the results for the normal and crisis periods respectively. Similar to before, we include the three new risks to compete with the basis risk factor. As expected, the basis risk premium is indifferent from zero during the normal period in Table 9. The basis risk premium is statistically significantly negative for 40-day holding horizon during the crisis period, but is indifferent from zero for 20- and 60-day horizons.

Overall, the results for high yield bonds are much weaker than that for investment grade bonds. The basis risk premiums are zero between 2002 and 2006. They are occasionally significantly negative between 2007 and 2008 but much less so than that for investment grade bonds. Other new risks such as counterparty risk and collateral risk carry significant risk premiums for the 20-day horizon during the normal period, similar to investment grade bonds. But the results are more mixed across other holding horizons. During the financial crisis, these new risks can have positive or negative risk premiums at different time horizons as well. These results indicate that bonds that are not widely used in the basis trade are not affected by the basis risk. The other new risks can also affect speculative bonds, but plausibly through different channels other than basis arbitrage and therefore the risk premiums are not consistently negative or positive.

We also conduct extensive robustness checks on the alterative empirical proxies of funding liquidity, counterparty risk and uncertainty measures. For example, we use LIBOR minus OIS and LIBOR minus REPO to replace TED spread. We also construct the sensitivity measure of the investment bank equity returns with respect to the interest rate change to capture the counterparty risk of the financial intermediaries. We also employ alternative basis measures by using adjusted Z-spread and asset swap spread. Lastly, we also test the results on the alternative twenty bond portfolios formed on duration and ratings. The prevailing results are largely consistent with our conjecture. The results are available upon requests.

2.7 Conclusion

In this paper, we have identified a new risk factor, the basis factor, for pricing corporate bonds. In contrast to traditional fundamental corporate bond risk factors, the basis factor affects corporate bond returns only after the introduction of CDS and the associated CDS-Bond basis arbitrage trade. The basis factor, constructed as the return differential between LOW and HIGH quintile basis portfolios, is priced in the cross section of investment grade bonds with an annual risk premium of about 3% in normal periods. Our result shows that the introduction of CDS has fundamentally changed the pricing of cash corporate bonds. It also highlights the inter-connections of global financial markets. Just like foreign speculators can affect emerging market equity returns as documented in *Bekaert and Harvey* (2011), arbitrageurs in credit derivatives can affect the pricing of cash corporate bonds through their trading activities. Hopefully these effects can be incorporated more explicitly into future asset pricing theories.

Table 2.1: Time Series Patterns of the CDS-Bond Basis

The table reports a summary of the sample and time series patterns of the basis. Panel A reports the number of firms and bonds in each year in our sample. The basis is defined as the difference between CDS spread and Z-spread on the same bond and is reported in percentage terms. Panel B reports the total number of daily observations, mean, standard deviation, median, skewness and kurtosis of CDS spread, Z-spread, and the basis for each year. All the spreads and the basis are in percentage terms. The sample period is from January 2001 to December 2008.

PANEL A: The Number of Firms and Bonds by Year

	2001	2002	2003	2004	2005	2006	2007	2008	Total
Firm	145	200	238	263	288	283	278	269	1,978
Bond	531	770	889	970	1,026	986	947	865	7,116

PANEL B: CDS Spread, Z-Spread, and CDS-Bond Basis by Year

Year		2001	2002	2003	2004	2005	2006	2007	2008	AVG.
N		4,232	9,662	40,439	57,185	79,223	76,406	63,412	62,715	49,114
CDS Spread	MEAN	0.99	1.31	0.54	0.41	0.43	0.38	0.44	1.33	0.60
	STD	0.79	1.35	0.61	0.40	0.42	0.34	0.43	1.52	0.62
	MED	0.76	0.84	0.36	0.31	0.33	0.29	0.33	0.87	0.42
	SKEW	2.76	3.04	3.86	3.70	4.01	2.66	3.13	5.35	3.72
	KURT	14.98	13.58	19.34	20.16	28.26	14.67	19.77	53.57	25.70
Z Spread	MEAN	1.69	2.06	1.10	0.72	0.51	0.45	0.64	2.35	0.96
	STD	1.02	1.58	0.93	0.68	0.58	0.50	0.60	1.81	0.84
	MED	1.53	1.61	0.94	0.61	0.39	0.35	0.52	1.91	0.78
	SKEW	1.11	2.17	1.63	1.29	1.79	1.43	1.70	3.49	1.89
	KURT	3.44	7.89	4.38	2.69	5.78	3.49	6.61	28.39	8.51
CDS-Bond Basis	MEAN	-0.70	-0.75	-0.56	-0.31	-0.08	-0.08	-0.19	-1.02	-0.35
	STD	0.90	0.81	0.60	0.48	0.36	0.33	0.39	0.86	0.50
	MED	-0.44	-0.56	-0.50	-0.24	-0.01	-0.03	-0.12	-0.89	-0.27
	SKEW	-0.93	-1.06	-1.27	-1.70	-2.29	-2.33	-1.79	-0.78	-1.74
	KURT	0.42	1.07	3.17	6.39	12.27	13.63	7.65	0.57	7.72

Table 2.2: The CDS-Bond Basis and Bond Characteristics

The table reports the relation between the basis and various bond characteristics, such as rating, maturity, age, coupon, size, duration and convexity. Panel A reports summary information of the basis and bond characteristics. Bond ratings are categorized from 1 to 10 for all investment grade bonds (S&P ratings AAA to BBB-). We use the S&P ratings whenever available, followed by Moodys (Aaa to Baa3) and Fitchs ratings. Coupon is in percentage terms. Issue size is the natural logarithm of issuance amount in billions. Maturity, age and duration are all in years. Panel B reports the mean and standard deviation of CDS spread, Z-spread, and the bond characteristics broken down in groups, including ratings, maturity, age, coupon, issue size, duration and convexity. Maturity group 1 to 5 are defined for bonds with 1-3 years, 3-5 years, 5-7 years, 7-10 years and more than 10 years to maturity respectively. Age groups 1 to 5 are defined for bonds that are less than 3 years, 3-5 years, 5-7 years, 7-10 years and more than 10 years old. Coupon is defined from 1 to 5 to represent bonds with annual coupon of 0-5.5, 5.5-6.5, 6.5-7, 7-8 and more than 9 (in percentage terms). Issue is defined from 1 to 5 to represent bonds with the amount of issuance of 0-0.2, 0.2-0.3, 0.3-0.5, 0.5-0.6 and more than 0.6 billions of dollars. Duration groups 1 to 5 are defined for bonds with duration of 0-3 years, 3-5 years, 5-7 years, 7-10 years and more than 10 years respectively. Convexity is defined from 1 to 5 to represent bonds with convexity of 0-10, 10-30, 30-50, 50-70 and more than 70. The sample period is from January 2001 to December 2008.

PANEL A: Summary Information of the Basis and Bond Characteristics

	N	MEAN	STD	MIN	MAX	MED	SKEW	KURT
CDS-Bond Basis	392,914	-0.35	0.64	-3.71	0.98	-0.17	-1.91	4.99
Rating	392,914	6.80	2.21	1.00	10.00	7.00	-0.39	-0.46
Maturity	392,914	8.51	7.62	1.00	30.00	5.76	1.36	0.72
Age	392,914	5.25	3.95	0.00	47.90	4.38	1.12	1.76
Coupo	392,914	6.25	1.35	0.25	11.75	6.40	-0.28	0.20
Isse Size	392,914	13.10	12.88	8.57	14.91	12.77	2.56	9.14
Duration	392,914	5.55	3.43	0.91	15.01	4.75	0.75	-0.46
Convexity	392,914	59.43	73.96	1.30	336.54	27.42	1.60	1.43

Table 2.2 – *Continued from previous page*

PANEL B: CDS Spread, Z-Spread, and the Basis by Bond Characteristics Groups								
Characteristics	Groups	N	CDS Spread		Z-Spread		CDS-Bond Basis	
			MEAN	STD	MEAN	STD	MEAN	STD
Ratings	AAA	9,441	0.16	0.17	0.23	0.54	-0.07	0.46
	AA	45,155	0.32	0.51	0.49	0.79	-0.16	0.51
	A	172,022	0.45	0.74	0.78	1.07	-0.33	0.60
	BBB	166,296	0.86	0.94	1.31	1.29	-0.45	0.69
Maturity	1	92,690	0.31	0.79	0.53	1.15	-0.22	0.66
	2	80,772	0.51	0.84	0.75	1.17	-0.24	0.61
	3	57,108	0.62	0.79	0.90	1.08	-0.29	0.56
	4	70,675	0.79	0.83	1.18	1.16	-0.40	0.62
	5	91,669	0.83	0.79	1.43	1.09	-0.60	0.62
Age	1	136,966	0.67	0.88	0.93	1.21	-0.27	0.59
	2	80,530	0.55	0.79	0.84	1.09	-0.29	0.57
	3	61,910	0.57	0.78	0.95	1.14	-0.38	0.63
	4	66,072	0.50	0.72	0.89	1.09	-0.40	0.68
	5	47,436	0.69	0.93	1.32	1.33	-0.63	0.73
Coupon	1	95,535	0.47	0.79	0.59	1.07	-0.12	0.52
	2	93,878	0.61	0.84	0.93	1.20	-0.32	0.63
	3	83,010	0.64	0.78	1.06	1.12	-0.42	0.62
	4	73,766	0.69	0.86	1.19	1.17	-0.50	0.64
	5	46,725	0.67	0.92	1.21	1.26	-0.55	0.72
Issue Size	1	72,228	0.58	0.89	1.01	1.22	-0.43	0.67
	2	55,707	0.54	0.79	0.89	1.14	-0.35	0.63
	3	103,146	0.60	0.78	0.93	1.13	-0.32	0.63
	4	65,704	0.54	0.71	0.80	1.06	-0.27	0.61
	5	96,129	0.70	0.93	1.09	1.28	-0.39	0.63
Duration	1	108,834	0.35	0.82	0.58	1.18	-0.23	0.66
	2	97,950	0.55	0.86	0.80	1.16	-0.25	0.58
	3	78,683	0.79	0.92	1.19	1.25	-0.40	0.63
	4	44,472	0.81	0.81	1.29	1.17	-0.49	0.68
	5	62,975	0.75	0.52	1.34	0.82	-0.58	0.54
Convexity	1	101,415	0.33	0.80	0.56	1.16	-0.23	0.66
	2	104,083	0.54	0.85	0.79	1.16	-0.25	0.59
	3	55,031	0.75	0.91	1.13	1.25	-0.39	0.63
	4	40,650	0.76	0.72	1.12	1.02	-0.36	0.59
	5	91,735	0.81	0.74	1.40	1.05	-0.59	0.61

Table 2.3: The CDS-Bond Basis and Future Individual Bond Returns

The table reports the predicting power of the CDS-Bond basis for future individual bond returns. We run a standard Fama-Macbeth regression on future individual bond returns at k-day horizon (where k = 20, 40, 60) from day t onwards. Future return is the excess return of the holding period return for each bond by subtracting the risk-free return. In addition to the basis, we consider the following bond characteristics: rating, maturity, age, duration, coupon, issue size, and liquidity on day t. $INDLIQ_k$ is the sum of the turnover of the individual bond defined as the total trading volume divided by the total number outstanding for the bond from day $t-k$ to t. We use the demeaned value of coupon and $INDLIQ_k$. Bond ratings are numbered from 1 to 10 for investment grade bonds (S&P ratings, AAA to BBB-). The basis is in percentage terms. Maturity, age, and duration are in years. The standard errors are Newey-West standard errors. An ***, **, and * denotes significance at the 1%, 5%, and 10% level, respectively. The sample period is from January 2001 to December 2008.

	$k = 20$		$k = 40$		$k = 60$	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
BASIS	-0.0206***	-0.0099	-0.0314***	-0.0282***	-0.0201***	-0.0223***
	[-6.10]	[-0.62]	[-3.43]	[-5.66]	[-6.40]	[-16.33]
RATING	0.0008	0.0011	-0.0014	0.0004	-0.0008	-0.0020*
	[0.68]	[0.59]	[-0.45]	[0.18]	[-1.05]	[-1.63]
MATURITY	0.0021		-0.0011		0.0093	
	[1.13]		[-1.19]		[0.91]	
AGE	0.0043		0.0051		0.0088	
	[1.60]		[0.97]		[0.87]	
DURATION		0.0004		0.0008		-0.0001
		[0.56]		[0.84]		[-0.21]
COUPON	-0.1498	-0.1673	-0.4686	-0.0026	0.0264	-0.2192**
	[-0.81]	[-1.24]	[-1.49]	[-0.01]	[0.18]	[-2.46]
ISSUE SIZE	-0.0005	0.0029	0.0397	0.0003	-0.0007	0.0030***
	[-0.20]	[1.36]	[1.02]	[0.28]	[-0.19]	[3.16]
INDLIQ_K	-0.0476	0.0458	0.0651	0.0016	-0.0055	0.0077
	[-1.04]	[1.60]	[0.88]	[0.20]	[-0.41]	[0.71]
INTERCEPT	-0.0307	-0.0597*	-0.5253	-0.0134	-0.0811	-0.0284**
	[-1.12]	[-1.73]	[1.02]	[-0.61]	[-0.69]	[-2.02]
N	343,491	343,491	337,437	337,437	332,707	332,707
R2	24.92	25.39	30.42	30.53	33.02	34.28

Table 2.4: Returns of the Quintile Basis Portfolios

The table reports the average holding period returns (HPR) of five basis portfolios sorted on past 60-day basis. We delete trading days with less than five bonds traded, and our sample period is shortened to the period between July 2002 and December 2008. The quintile portfolios are sorted from the lowest (quintile 1) to the highest (quintile 5) basis. For each quintile, we compute the holding period returns for k = 20-, 40- and 60-day horizons. All portfolios are rebalanced daily and are equal-weighted (in Panel A) or value-weighted (in Panel B) by market capitalization, which is calculated from the last available transaction price of the bond. To be included in the quintile portfolios, bonds must have more than 20 trades in past 60 trading days. When computing the holding period return for the basis portfolio, we use the starting price from the formation date t whenever available, followed by the latest price with a five-day window prior to the formation date. We use the end transaction price on day $t+k$ (where k= 20, 40, 60 respectively) whenever available, followed by the last available transaction price within five day before day $t+k$. Bonds without the starting and ending prices are eliminated from the analysis. There are 258,514, 252,850, and 252,540 observations for 20 day, 40 day, and 60 day HPR, respectively. We report both raw and excess returns for three different holding periods. The row 1-5 refers to the difference in returns between basis portfolio 1 and 5. Basis and returns are in percentage terms. There are about 35 bonds in each quintile portfolio. The t-statistics are reported in square bracket. An ***, **, and * denotes significance at the 1%, 5%, and 10% level, respectively.

PANEL A: EW Quintile Portfolios Sorted on CDS-Bond Basis

Rank	Basis	k=20		k=40		k=60	
		Raw	Excess	Raw	Excess	Raw	Excess
1	-0.75	0.4244	0.2382	0.7961	0.4205	1.0452	0.4771
2	-0.42	0.3513	0.1651	0.5914	0.2158	0.836	0.268
3	-0.26	0.28	0.0938	0.5134	0.1379	0.6979	0.1299
4	-0.10	0.3398	0.1536	0.6335	0.2579	0.8784	0.3103
5	0.18	0.1428	-0.0433	0.3104	-0.0651	0.3996	-0.1684
$1-5$		0.2815***		0.4857***		0.6455***	
		[6.74]		[8.32]		[9.69]	

PANEL B: VW Quintile Portfolios Sorted on CDS-Bond Basis

Rank	Basis	k=20		k=40		k=60	
		Raw	Excess	Raw	Excess	Raw	Excess
1	-0.72	0.3586	0.1725	0.7273	0.3517	0.9771	0.4091
2	-0.42	0.3119	0.1258	0.5586	0.1831	0.7899	0.2219
3	-0.26	0.2623	0.0761	0.4539	0.0783	0.6197	0.0516
4	-0.10	0.314	0.1278	0.5908	0.2152	0.8182	0.2502
5	0.12	0.1398	-0.0463	0.3227	-0.0528	0.4509	-0.117
$1-5$		0.2188**		0.4045***		0.5262***	
		[5.06]		[6.59]		[7.59]	

Table 2.5: The Basis Risk Factor and Bond Characteristics

The table reports the relation between the basis risk factor and bond characteristics, such as rating, maturity, age, coupon, issue size, duration, and convexity. We first sort bonds into the characteristics groups. Then we construct a zero-investment basis portfolio by using the bonds in each characteristic group. We name this portfolio as LOW-minus-HIGH (LMH) portfolio because we long the LOW (quintile 1) basis portfolio and short the HIGH (quintile 5) basis portfolio by sorting the bonds within each characteristic group based on their past 60-day average basis. We report the profits of this LMH strategy by year in Panel A, by rating in Panel B, by maturity in Panel C, by age in Panel D, by coupon in Panel E, and by issue size in Panel F, by duration in Panel G, and by convexity in Panel H. We report both equal- and value-weighted HPR of the LMH portfolio. Definitions of the bond characteristics groups are the same as that in Table 2. Basis and returns are in percentage terms. The t-statistics are reported in square bracket. An ***, **, and * denotes significance at the 1%, 5%, and 10% level, respectively. The sample period is from July 2002 to December 2008 as we delete the trading days with less than five bond transactions. From Panel A through Panel F, there are 258,514, 252,850, and 252,540 observations for 20 day, 40 day, and 60 day HPR, respectively.

	k=20		k=40		k=60	
	EW	VW	EW	VW	EW	VW
			Panel A: Year			
2002	0.1157	0.1329	0.6561*	0.7292**	1.1591***	1.2140***
	[0.52]	[0.62]	[1.94]	[2.21]	[3.43]	[3.73]
2003	0.6110***	0.5581***	1.2927***	1.2157***	1.7473***	1.6369***
	[5.60]	[4.87]	[7.88]	[6.91]	[9.36]	[8.03]
2004	0.6085***	0.5963***	1.2535***	1.2378***	1.8132***	1.7542***
	[7.65]	[7.40]	[9.71]	[9.37]	[11.13]	[10.54]
2005	0.5794***	0.5190***	0.6868***	0.6313***	0.8570***	0.8002***
	[9.69]	[7.79]	[9.02]	[7.47]	[10.26]	[8.37]
2006	0.1810***	0.1120**	0.2848***	0.1559**	0.4277***	0.2730***
	[4.11]	[2.26]	[4.55]	[2.16]	[5.67]	[3.15]
2007	0.0188	-0.1361***	-0.081	-0.3440***	-0.2965***	-0.8342***
	[0.40]	[-2.64]	[-1.57]	[-5.23]	[-5.03]	[-8.44]
2008	-0.3043	-0.3737*	-0.8682***	-0.8852***	-1.4920***	-1.3224***
	[-1.57]	[-1.86]	[-3.59]	[-3.44]	[-5.73]	[-5.33]
			Panel B: Ratings			
AAA	0.2289***	0.2216***	0.4258***	0.4225***	0.6021***	0.5897***
	[2.93]	[2.85]	[4.80]	[4.78]	[6.64]	[6.54]
AA	0.7957***	0.6385***	1.4147***	1.1463***	1.6894***	1.2886***
	[8.86]	[7.81]	[12.25]	[10.73]	[13.91]	[11.91]
A	0.2624***	0.2588***	0.3124***	0.3342***	0.4272***	0.406***
	[5.74]	[5.77]	[5.21]	[5.67]	[6.23]	[6.05]
BBB	0.3002***	0.1695***	0.4991***	0.3122***	0.7023***	0.4383***
	[5.43]	[3.03]	[6.99]	[4.04]	[8.34]	[4.85]
			Panel C: Maturity			
1	0.4195***	0.2837***	0.5827***	0.3130***	0.4273***	0.2059***
	[8.82]	[7.67]	[10.43]	[7.40]	[10.18]	[5.54]
2	0.2940***	0.3028***	0.4341***	0.4946***	0.6174***	0.6568***
	[6.03]	[5.29]	[7.02]	[6.89]	[9.47]	[8.48]
3	-0.1419*	-0.1556**	-0.2960***	-0.2553***	-0.1854*	-0.1403
	[-1.76]	[-2.06]	[-2.73]	[-2.64]	[-1.69]	[-1.46]
4	0.0706	0.0104	0.0065	-0.0788	-0.1687**	-0.2784***
	[1.44]	[0.18]	[0.10]	[-1.14]	[-2.37]	[-3.53]
5	0.4553***	0.5063***	0.7668***	0.8802***	1.1403***	1.1820***
	[5.46]	[7.05]	[7.59]	[9.93]	[9.83]	[11.41]

Table 2.5 – *Continued from previous page*

			Panel D: Age			
1	0.1935***	0.1123**	0.2935***	0.1895***	0.3921***	0.2742***
	[4.10]	[2.31]	[4.61]	[2.88]	[5.16]	[3.55]
2	0.2411***	0.2807***	0.3044***	0.3931***	0.4484***	0.4874***
	[3.89]	[5.16]	[3.66]	[5.33]	[5.09]	[5.85]
3	0.1221**	0.1299**	0.2230***	0.2590***	0.3747***	0.4129***
	[2.52]	[2.41]	[3.84]	[3.82]	[5.62]	[5.76]
4	0.6576***	0.4930***	0.9431***	0.7351***	1.1050***	0.8665***
	[8.97]	[7.53]	[10.25]	[8.53]	[10.43]	[8.87]
5	0.2430***	0.1476*	0.4285***	0.2670***	0.6357***	0.4232***
	[2.84]	[1.81]	[4.52]	[2.78]	[5.36]	[3.55]
			Panel E: Coupon			
1	0.1501***	0.1735***	0.1411**	0.1649***	0.1646**	0.2180***
	[3.23]	[3.77]	[2.19]	[2.75]	[2.40]	[3.39]
2	0.1321***	0.0867**	0.1264**	0.02	0.2088***	0.0225
	[3.06]	[2.14]	[2.32]	[0.39]	[3.41]	[0.38]
3	0.1191**	0.0261	0.2579***	0.0497	0.4471***	0.139
	[2.01]	[0.42]	[3.53]	[0.60]	[5.42]	[1.52]
4	0.2353***	0.0035	0.3357***	0.0186	0.3671***	-0.0508
	[3.25]	[0.05]	[3.60]	[0.18]	[3.05]	[-0.41]
5	0.8093***	0.8501***	1.4169***	1.3688***	1.5893***	1.4975***
	[7.64]	[7.53]	[12.17]	[10.49]	[12.63]	[10.83]
			Panel F: Issue Size			
1	0.5399***	0.5514***	0.7633***	0.7713***	1.0944***	1.0831***
	[3.82]	[3.95]	[5.42]	[5.57]	[7.24]	[7.32]
2	0.2803***	0.2715***	0.2118**	0.2272***	0.054	0.0949
	[3.96]	[4.31]	[2.49]	[2.88]	[0.54]	[1.02]
3	0.2171***	0.1991***	0.2887***	0.2556***	0.4824***	0.4256***
	[3.27]	[3.24]	[3.59]	[3.27]	[5.41]	[4.83]
4	0.3319***	0.2988***	0.4479***	0.4171***	0.4528***	0.4441***
	[7.68]	[7.28]	[8.17]	[8.05]	[7.12]	[7.34]
5	0.1731***	0.1465***	0.3150***	0.2852***	0.4590***	0.4090***
	[3.38]	[2.96]	[4.52]	[4.20]	[5.75]	[5.24]
			Panel G: Duration			
1	0.4156***	0.2914***	0.5582***	0.3286***	0.4867***	0.2853***
	[9.93]	[8.74]	[11.96]	[8.90]	[13.57]	[9.07]
2	0.1290**	0.1767***	0.1461*	0.2265***	0.3464***	0.3963***
	[2.17]	[2.88]	[1.81]	[2.83]	[4.50]	[4.99]
3	0.0558	0.0461	-0.1156**	-0.1218*	-0.2570***	-0.3034***
	[1.14]	[0.88]	[-1.97]	[-1.87]	[-3.68]	[-4.33]
4	0.4020***	0.3670***	0.5770***	0.5186***	0.5610***	0.2733*
	[4.11]	[3.97]	[4.75]	[4.46]	[3.80]	[1.88]
5	0.4570***	0.3497***	0.9769***	0.8048***	1.5890***	1.3392***
	[6.11]	[4.86]	[10.45]	[9.17]	[16.44]	[14.27]
			Panel H: Convexity			
1	0.4099***	0.2795***	0.5796***	0.3404***	0.4784***	0.2666***
	[9.15]	[8.00]	[11.56]	[8.66]	[12.81]	[8.15]
2	0.1437**	0.1707***	0.2030***	0.2615***	0.3897***	0.4266***
	[2.58]	[2.93]	[2.77]	[3.57]	[5.13]	[5.48]
3	0.1680***	0.1482**	0.0524	0.0336	-0.1558*	-0.1496
	[3.10]	[2.22]	[0.75]	[0.38]	[-1.75]	[-1.44]
4	0.021	0.0723	-0.0074	0.0173	-0.1334*	-0.1957***
	[0.39]	[1.37]	[-0.13]	[0.29]	[-1.96]	[-2.86]
5	0.4925***	0.5202***	0.7413***	0.8476***	1.1764***	1.2270***
	[6.06]	[7.22]	[7.51]	[9.68]	[10.44]	[11.97]

Table 2.6: Asset Pricing Tests with the Basis Risk Factor

The table reports asset pricing tests using the basis factor as a new risk factor. Panel A reports correlations between the basis factors and other systematic risk factors over the same time horizons. The existing risk factors are MKT_k, SMB_k, HML_k, $TERM_k$, DEF_k, LIQ_k, AMH_k, and PS_k. We compute the value of these risk factors for a time horizon of k (where k = 20, 40, and 60, respectively). MKT_k is the cumulative excess daily market return from day $t-k$ to t (from Kenneth Frenchs website). SMB_k and HML_k are defined similarly. $TERM_k$ is the difference between the daily return of the Barclays long-term government bond index from Datastream and the daily T-bill return (from Kenneth Frenchs website). DEF_k is the daily difference between the return of the Barclays long-term corporate bond index and that of the Barclays long-term government bond index from Datastream. LIQ_k is the sum of the turnover defined as the total trading volume divided by the total number outstanding for all corporate bonds from day $t-k$ to t. AMH_k is the Amihud (2002) bond market liquidity risk factor, in which k (= 20, 40, or 60) represents the number of days used to calculate the price impact relative to the volume. PS_k is the Pastor-Stambaugh (2003) bond market liquidity risk factor. We demeaned all risk factors. All factors except for LIQ_k factors are in percentage terms. We construct three basis factors ($BASIS_k$, where k = 20, 40, 60) by forming the LMH portfolio as specified in Table 4 and use the LMHs HPR from day $t-k$ to t for the value-weighted portfolios of test assets. We use all the systematic risk factors from day $t-k$ to t to price the twenty portfolios for their future returns from day t to $t+k$ (where k = 20, 40, and 60, respectively) as a proxy for the expected returns of the portfolios. Panel B reports summary statistics of the basis risk factors, which are all in percentage terms. Panel C and D report regressions of twenty rating/maturity portfolios for sub-period 2002-2006 and 2007-2008, respectively. When estimating the betas, we employ the standard Fama-MacBeth procedure with a 180-day rolling window. The standard errors are Newey-West standard errors. An ***, **, and * denotes significance at the 1%, 5%, and 10% level, respectively.

PANEL A: Factor Correlations

	MKT_{20}	SMB_{20}	HML_{20}	DEF_{20}	$TERM_{20}$	LIQ_{20}	AMH_{20}	PS_{20}
$BASIS_{20}$	0.16***	0.08**	0.23***	0.12***	0.41***	0.05**	0.18***	0.05**
	MKT_{40}	SMB_{40}	HML_{40}	DEF_{40}	$TERM_{40}$	LIQ_{40}	AMH_{40}	PS_{40}
$BASIS_{40}$	0.30***	0.11***	0.23***	0.23***	0.45***	0.09***	0.18***	0.24***
	MKT_{60}	SMB_{60}	HML_{60}	DEF_{60}	$TERM_{60}$	LIQ_{60}	AMH_{60}	PS_{60}
$BASIS_{60}$	0.36***	0.10***	0.18***	0.31***	0.38***	0.17***	0.13***	0.17***

PANEL B: Summary Statistics of Risk Factors

	N	MEAN	STD	MIN	MAX
$BASIS_{20}$	1541	0.21	1.68	-11.02	10.93
MKT_{20}	2236	-0.19	4.87	-32.76	19.56
SMB_{20}	2236	0.31	2.26	-8.92	7.26
HML_{20}	2236	0.48	2.50	-10.74	12.95
DEF_{20}	2236	-0.20	2.00	-15.83	5.47
$TERM_{20}$	2236	-1.27	2.89	-10.55	15.66
LIQ_{20}	2236	2.02	0.68	0.68	3.67
AMH_{20}	2196	0.00	1.00	-8.94	5.59
PS_{20}	1768	0.00	0.18	-1.09	1.56
$BASIS_{20}$	1522	0.39	2.33	-10.51	27.84
MKT_{20}	2216	-0.41	7.10	-46.88	19.24
SMB_{20}	2216	0.60	3.20	-10.31	9.53
HML_{20}	2216	0.95	3.77	-14.18	20.18
DEF_{40}	2216	-0.40	3.06	-21.83	7.79
$TERM_{40}$	2216	-2.67	4.18	-15.30	21.43
LIQ_{40}	2216	2.02	0.64	0.87	3.51
AMH_{40}	2136	0.00	1.00	-7.82	3.23
PS_{40}	1921	0.00	0.20	-1.27	0.76
$BASIS_{60}$	1505	0.52	2.69	-17.13	26.37
MKT_{60}	2196	-0.49	8.48	-53.90	20.24
SMB_{60}	2196	0.92	3.91	-12.27	12.51
HML_{60}	2196	1.38	4.40	-12.36	23.29
DEF_{60}	2196	-0.59	3.96	-23.26	7.79
$TERM_{60}$	2196	-4.13	4.97	-16.33	18.17
LIQ_{60}	2196	2.03	0.62	0.95	3.49
AMH_{60}	2076	0.00	1.00	-6.55	2.17
PS_{60}	2049	0.00	0.09	-0.76	0.20

Table 2.6 – *Continued from previous page*

	PANEL C: Pre-crisis Period: 2002-2006											
	k=20				k=40				k=60			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Intercept	-0.0001	-0.0004	0.0005*	0.0003	-0.0009**	-0.0007*	-0.0010***	-0.0008**	-0.0014***	-0.0012***	-0.0014***	-0.0010**
	[-0.47]	[-1.36]	[1.65]	[0.96]	[-2.41]	[-1.79]	[-2.73]	[-1.99]	[-3.35]	[-2.83]	[-3.09]	[-2.40]
$BASIS_k$			0.3434***	0.3101***			0.4021***	0.5398***			0.4074**	0.3563**
			[4.19]	[3.82]			[3.19]	[4.41]			[2.46]	[2.11]
MKT_k	0.8911***	0.9235***	0.6393*	0.7986**	0.4964	0.9183**	0.4473	0.9249**	1.5329***	1.5320***	1.8012***	1.6068***
	[2.67]	[2.71]	[1.93]	[2.35]	[1.31]	[2.39]	[1.17]	[2.44]	[3.18]	[3.00]	[3.59]	[3.13]
SMB_k	0.8904***	0.6573***	0.9297***	0.8060***	0.7010**	0.7876***	0.6319**	0.8344***	-0.2747	0.1675	-0.1141	0.3177
	[3.56]	[2.66]	[3.61]	[3.08]	[2.35]	[2.87]	[2.15]	[3.04]	[-0.98]	[0.53]	[-0.40]	[0.95]
HML_k	0.2622	0.4281**	-0.1388	0.0826	0.1240	0.4999**	0.0599	0.5518**	0.9392***	1.0735***	0.7258***	0.7348***
	[1.37]	[2.28]	[-0.72]	[0.43]	[0.63]	[2.55]	[0.27]	[2.37]	[4.00]	[4.83]	[3.14]	[3.16]
DEF_k	0.2179***	0.2333***	0.1386	0.2166**	0.2409***	0.2147**	0.2587***	0.2261**	0.2280**	0.2126**	0.2162**	0.2402**
	[2.77]	[2.67]	[1.53]	[2.49]	[2.79]	[2.37]	[2.68]	[2.28]	[2.08]	[2.04]	[2.02]	[2.17]
$TERM_k$	0.0607	0.1034	-0.0776	-0.0814	0.2954	0.2756	0.2466	0.1299	0.3175	0.3899	0.3093	0.3875
	[0.37]	[0.60]	[-0.46]	[-0.47]	[1.23]	[1.12]	[0.97]	[0.5]	[1.13]	[1.43]	[1.10]	[1.41]
LIQ_k	0.1557***	0.0405	0.1269*	0.0666	0.0018	0.0522	0.0089	0.0508	-0.0199	-0.0162	-0.0126	-0.0076
	[2.83]	[0.72]	[1.75]	[1.09]	[0.06]	[1.46]	[0.24]	[1.36]	[-0.79]	[-0.66]	[-0.50]	[-0.31]
AMH_k	-0.1860		-0.2288		-0.1940**		-0.0833		0.0145		0.0224	
	[-1.43]		[-1.55]		[-1.97]		[-0.84]		[0.10]		[0.14]	
PS_k		0.0100		0.0128		0.0810***		0.0508*		-0.0003		0.0040
		[0.55]		[0.70]		[3.50]		[1.91]		[-0.05]		[0.56]
N	27,133	27,133	27,133	27,133	26,865	26,865	26,865	26,865	26,568	26,568	26,568	26,568
R^2	0.4995	0.4837	0.5114	0.496	0.5696	0.5732	0.5877	0.5862	0.6474	0.6530	0.6564	0.6594

Table 2.6 – *Continued from previous page*

	PANEL D: Crisis Period: 2007-2008											
	k=20				k=40				k=60			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Intercept	0.0017	0.0010	0.0019	0.0038**	0.0021	0.0038**	0.0011	0.0004	0.0014	0.0033***	0.0012	0.0030***
	[1.59]	[0.81]	[1.38]	[2.39]	[1.33]	[2.50]	[0.63]	[0.23]	[0.93]	[2.63]	[0.79]	[2.59]
$BASIS_k$			-0.4605	-0.1959			-1.1202***	-0.9690***			-0.9009*	-1.4408***
			[-1.42]	[-0.63]			[-3.17]	[-2.98]			[-1.94]	[-3.52]
MKT_k	-4.0705***	-3.9148***	-3.0556***	-3.6194***	-3.4784***	-4.7253***	-3.3215***	-3.5656***	-4.3248***	-4.2714***	-3.8620***	-4.4035***
	[-4.03]	[-3.95]	[-3.47]	[-3.76]	[-3.74]	[-5.48]	[-4.05]	[-4.12]	[-4.56]	[-4.96]	[-4.03]	[-4.72]
SMB_k	2.0357***	1.3772**	1.4994***	0.8027	2.6760***	1.7842***	3.2132***	2.4129***	2.0039**	1.2572*	2.4012***	1.5752**
	[2.71]	[2.00]	[2.76]	[1.36]	[3.95]	[2.72]	[5.00]	[3.45]	[2.37]	[1.66]	[3.12]	[2.11]
HML_k	-1.2575**	-1.4003**	-0.7405	-1.1355**	-1.2158	-1.6198**	-1.3914*	-1.1606*	-2.7276***	-1.5854**	-1.8329**	-1.7871**
	[-2.27]	[-2.34]	[-1.30]	[-2.02]	[-1.61]	[-2.02]	[-1.84]	[-1.72]	[-3.98]	[-2.09]	[-2.54]	[-2.29]
DEF_k	-1.3087***	-1.3624***	-1.4398***	-1.8336***	-1.6605***	-1.7301***	-2.5431***	-2.4904***	-3.9740***	-4.1098***	-3.9405***	-3.7994***
	[-4.12]	[-4.13]	[-3.71]	[-4.6]	[-3.43]	[-3.45]	[-5.37]	[-4.68]	[-8.75]	[-8.21]	[-8.15]	[-8.41]
$TERM_k$	0.5290	0.7086	0.0560	0.3167	-0.6025	-0.6021	0.3305	0.1176	-0.0638	0.1530	0.0376	-0.1259
	[1.20]	[1.61]	[0.12]	[0.70]	[-1.34]	[-1.35]	[0.68]	[0.28]	[-0.12]	[0.26]	[0.07]	[-0.21]
LIQ_k	-0.0578	-0.0843	-0.0940	-0.1000	-0.0833	-0.0355	-0.1229**	-0.0949*	0.0849	-0.0164	0.0748	-0.0609
	[-0.58]	[-0.87]	[-1.02]	[-1.06]	[-1.58]	[-0.62]	[-2.08]	[-1.67]	[1.19]	[-0.26]	[1.04]	[-0.90]
AMH_k	0.0230		0.1633		-0.4516		-0.5200		0.7675		0.7530	
	[0.05]		[0.29]		[-1.27]		[-1.37]		[0.95]		[1.03]	
PS_k		0.0909		-0.1316		0.2557**		0.3916***		0.0222		-0.0059
		[0.83]		[-1.20]		[2.06]		[2.59]		[0.51]		[-0.16]
N	27,133	27,133	27,133	27,133	26,865	26,865	26,865	26,865	26,568	26,568	26,568	26,568
R^2	0.5042	0.5069	0.5445	0.5594	0.5060	0.5111	0.5975	0.5743	0.5797	0.5904	0.5983	0.5949

Table 2.7: The Basis Risk Factor versus Other Risk Factors

The table reports the regression analysis between value-weighted basis risk factor $BASIS_k$ and the systematic risk factors, such as MKT_k, SMB_k, HML_k, $TERM_k$, DEF_k, LIQ_k, AMH_k, TED_k, $FINRET_k$, and VIX_k, and $k = 20$, 40, and 60. The rest of the risk factors are defined in Table 6. TED_k is the average of 3-month uncollateralized LIBOR rate minus 3-month T-bill rate from day $t-k$ to t, $FINRET_k$ is the cumulative excess return of value-weighted financial firms equity returns from day $t-k$ to t, VIX_k is the average of SP500 option volatility from day $t-k$ to t. The standard errors are Newey-West standard errors. The sample period is from 2002 to 2008. An ***, **, and * denotes significance at the 1%, 5%, and 10% level.

	k=20				k=40				k=60			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	0.04	-0.02	-0.02	-0.00	0.02	-0.06	-0.06	0.01	0.04	-0.07	-0.06	0.04
	[0.39]	[-0.17]	[-0.18]	[-0.04]	[0.12]	[-0.28]	[-0.31]	[0.06]	[0.16]	[-0.29]	[-0.25]	[0.18]
MKT_k	0.03	0.08	0.03	0.04	0.08**	0.04	0.04	-0.05	0.07*	0.09	0.03	-0.01
	[1.10]	[1.30]	[0.81]	[0.59]	[2.51]	[0.50]	[1.16]	[-0.64]	[1.77]	[1.01]	[0.62]	[-0.16]
SMB_k	-0.02	-0.00	-0.02	-0.02	-0.05	-0.04	-0.03	-0.06	-0.05	-0.04	-0.03	-0.05
	[-0.37]	[-0.06]	[-0.56]	[-0.53]	[-1.05]	[-0.92]	[-0.69]	[-1.23]	[-0.93]	[-0.65]	[-0.57]	[-0.89]
HML_k	0.14**	0.16**	0.07	0.08	0.11**	0.13**	0.06	0.03	0.08	0.10	0.04	0.02
	[2.00]	[2.26]	[0.97]	[0.99]	[2.18]	[2.10]	[1.07]	[0.45]	[1.34]	[1.55]	[0.69]	[0.3]
DEF_k	0.02	0.06	0.08	0.05	-0.06	0.04	0.07	0.03	0.02	0.12	0.16	0.08
	[0.14]	[0.45]	[0.55]	[0.36]	[-0.38]	[0.32]	[0.51]	[0.18]	[0.16]	[1.06]	[1.57]	[0.55]
$TERM_k$	0.27***	0.27***	0.34***	0.33***	0.31***	0.31***	0.37***	0.38***	0.32***	0.33***	0.37***	0.36***
	[4.43]	[3.74]	[7.97]	[7.23]	[5.05]	[4.27]	[7.98]	[7.41]	[5.52]	[5.58]	[7.85]	[6.89]
LIQ_k	0.29**	0.44***	0.01	0.01	0.56**	0.78***	0.16	-0.01	0.88**	1.19***	0.46	0.17
	[2.01]	[3.29]	[0.07]	[0.05]	[1.99]	[2.97]	[0.55]	[-0.02]	[2.04]	[3.19]	[0.93]	[0.37]
AMH_k	-0.07	-0.03	-0.12	-0.13	0.11	0.20	-0.12	-0.10	0.11	0.18	-0.15	-0.20
	[-0.63]	[-0.27]	[-1.41]	[-1.53]	[0.92]	[1.55]	[-0.78]	[-0.77]	[0.50]	[0.76]	[-0.58]	[-0.89]
TED_k	-0.61*			-0.17	-0.98			-0.71	-1.34			-1.20
	[-1.90]			[-0.66]	[-1.48]			[-1.07]	[-1.37]			[-1.20]
$FINRET_k$		-0.03		-0.01		0.03		0.07		-0.01		0.03
		[-0.80]		[-0.21]		[0.59]		[1.49]		[-0.29]		[0.67]
VIX_k			-0.07***	-0.06***			-0.11***	-0.11***			-0.13**	-0.13**
			[-3.91]	[-3.74]			[-2.69]	[-2.81]			[-1.99]	[-2.40]
N	1536	1536	1536	1536	1522	1522	1522	1522	1505	1505	1505	1505
R^2	0.3031	0.2816	0.3519	0.3531	0.4322	0.4107	0.4554	0.4792	0.4733	0.4507	0.4795	0.4983

Table 2.8: Horse-race of the Basis Risk Factor versus Other New Risk Factors

The table reports asset pricing tests for alternative explanations. The risk factors $BASIS_k$, MKT_k, SMB_k, HML_k, $TERM_k$, DEF_k, LIQ_k, and AMH_k are defined in Table 6 where $k = 20$, 40 and 60. TED_k, $FINRET_k$ and VIX_k are defined in Table 7. Panel A reports the results from 2002 to 2006. Panel B reports the results from 2007 to 2008. The standard errors are Newey-West standard errors. The sample period is from 2002 to 2008. An ***, **, and * denotes significance at the 1%, 5%, and 10% level.

PANEL A: Pre-Crisis Period: 2002-2006												
	k=20				k=40				k=60			
	Model 5	Model 6	Model 7	Model 8	Model 5	Model 6	Model 7	Model 8	Model 5	Model 6	Model 7	Model 8
Intercept	0.0008**	0.0004	0.0006*	0.0004	-0.0006	-0.0012***	-0.0006*	-0.0003	-0.0007	-0.0012***	-0.0009**	-0.0005
	[2.57]	[1.19]	[1.96]	[1.32]	[-1.62]	[-3.27]	[-1.75]	[-0.87]	[-1.48]	[-2.65]	[-2.14]	[-1.02]
$BASIS_k$	0.2899***	0.3800***	0.2939***	0.2784***	0.4043***	0.2821**	0.4108***	0.2416*	0.4652***	0.4559***	0.4021**	0.5137***
	[3.35]	[4.62]	[3.57]	[2.95]	[3.21]	[2.13]	[3.12]	[1.77]	[2.72]	[2.80]	[2.44]	[2.99]
MKT_k	0.5907	0.7654**	0.8841**	0.7183*	0.3753	0.5424	0.5383	0.8754*	1.8665***	2.2717***	1.7424***	1.8664***
	[1.62]	[2.38]	[2.57]	[1.75]	[0.94]	[1.36]	[1.35]	[1.74]	[3.67]	[4.33]	[3.35]	[3.04]
SMB_k	0.8843***	0.8399***	0.9861***	1.2191***	0.5724*	0.3682	0.5507*	0.3425	-0.3875	0.1863	-0.1780	-0.1176
	[3.33]	[3.38]	[3.74]	[3.84]	[1.83]	[1.17]	[1.72]	[0.88]	[-1.24]	[0.61]	[-0.56]	[-0.33]
HML_k	-0.2569	-0.0496	-0.3563*	-0.2969	0.1753	0.0228	0.0663	0.4970	0.6889**	0.2538	0.5242**	0.0855
	[-1.25]	[-0.23]	[-1.76]	[-1.22]	[0.75]	[0.10]	[0.26]	[1.54]	[2.48]	[0.90]	[2.02]	[0.29]
DEF_k	0.1982**	0.1515*	0.1211	0.1261	0.2743***	0.1688*	0.2373**	0.3050***	0.1978*	0.2299**	0.2074**	0.0975
	[2.02]	[1.87]	[1.24]	[1.36]	[2.62]	[1.67]	[2.36]	[2.69]	[1.73]	[2.09]	[1.97]	[0.82]
$TERM_k$	-0.1132	-0.0862	-0.0601	0.0315	0.1512	0.4231*	0.1677	0.1286	0.1703	0.2053	0.2813	0.2046
	[-0.65]	[-0.51]	[-0.36]	[0.18]	[0.61]	[1.66]	[0.67]	[0.51]	[0.59]	[0.71]	[0.98]	[0.69]
LIQ_k	0.0929	0.1668**	0.1233	0.1845***	0.0468	-0.0157	0.0605	0.1082**	0.0331	-0.0051	0.0044	0.0740**
	[1.24]	[2.52]	[1.54]	[2.91]	[1.20]	[-0.43]	[1.59]	[2.32]	[1.10]	[-0.20]	[0.17]	[2.30]
AMH_k	-0.2031	-0.3095**	-0.1762	-0.4779**	-0.0787	0.0514	-0.0914	-0.0263	-0.1148	0.0374	-0.0607	-0.2107
	[-1.21]	[-2.27]	[-1.04]	[-2.53]	[-0.79]	[0.41]	[-0.87]	[-0.21]	[-0.71]	[0.19]	[-0.38]	[-1.27]
TED_k	0.0051			-0.0078	0.0048			-0.0006	0.0090**			0.0107***
	[0.49]			[-0.91]	[0.88]			[-0.07]	[2.40]			[2.88]
$FINRET_k$		0.9432		1.5678**		1.3807**		1.1702		3.7739***		3.7208***
		[1.60]		[2.54]		[2.20]		[1.25]		[5.33]		[4.25]
VIX_k			-0.0737	-0.4757			0.0544	-0.0206			-0.2376	-0.4847**
			[-0.26]	[-1.34]			[0.26]	[-0.09]			[-1.11]	[-2.07]
N	27,133	27,133	27,133	27,133	26,865	26,865	26,865	26,865	26,568	26,568	26,568	26,568
R^2	0.5374	0.5382	0.5280	0.5735	0.6010	0.6020	0.6069	0.6408	0.6643	0.6783	0.6795	0.7034

Table 2.8 – *Continued from previous page*

PANEL B: Crisis Period: 2007-2008	k=20				k=40				k=60			
	Model 5	Model 6	Model 7	Model 8	Model 5	Model 6	Model 7	Model 8	Model 5	Model 6	Model 7	Model 8
Intercept	0.0010	0.0009	0.0015	0.0012	0.0019	-0.0023	0.0012	0.0008	0.0012	0.0012	0.0020*	0.0028**
	[0.79]	[0.79]	[0.99]	[0.82]	[1.02]	[-1.20]	[0.60]	[0.44]	[0.96]	[0.84]	[1.91]	[2.51]
$BASIS_k$	-0.4846	-0.3782	-0.3626	-0.2177	-1.1632***	-0.9373***	-0.8696***	-0.3996	-0.8526**	-0.7909*	-1.0133**	-1.2970***
	[-1.62]	[-1.04]	[-1.08]	[-0.59]	[-3.29]	[-2.71]	[-2.69]	[-1.25]	[-2.01]	[-1.71]	[-2.20]	[-2.78]
MKT_k	-2.9635***	-3.3634***	-2.6955***	-4.4167***	-3.0005***	-4.1981***	-2.5855**	-3.7435***	-2.4581**	-4.7613***	-3.8692***	-4.9116***
	[-2.99]	[-3.11]	[-2.73]	[-3.43]	[-3.67]	[-4.73]	[-2.54]	[-3.15]	[-2.38]	[-4.39]	[-3.82]	[-3.24]
SMB_k	1.0729*	0.7295	1.1718	-0.0994	0.6701	2.2699***	3.6125***	1.7278*	-0.9761	1.1188	1.3282*	-1.3884
	[1.87]	[1.32]	[1.59]	[-0.13]	[0.84]	[3.10]	[4.48]	[1.88]	[-1.13]	[1.54]	[1.73]	[-1.61]
HML_k	-1.2411**	-0.7539	-1.0810	-1.7939*	-2.5242***	-2.0667**	-1.4819	-2.1483**	-1.9487***	-1.9286***	-3.8807***	-3.7955***
	[-2.21]	[-1.21]	[-1.57]	[-1.9]	[-2.64]	[-2.15]	[-1.57]	[-2.01]	[-2.92]	[-3.02]	[-3.74]	[-4.15]
DEF_k	-1.3340***	-1.3306***	-1.3540***	-1.5565***	-2.5884***	-2.0545***	-2.9056***	-2.8630***	-3.9508***	-3.3767***	-3.4181***	-3.4268***
	[-3.58]	[-3.22]	[-3.84]	[-3.84]	[-5.38]	[-4.55]	[-5.58]	[-5.11]	[-9.03]	[-7.54]	[-8.67]	[-7.77]
$TERM_k$	0.4546	0.1771	0.1843	0.7009	0.1341	0.3038	0.4786	0.8730*	0.0307	-0.2055	-0.2724	-0.3658
	[0.96]	[0.36]	[0.37]	[1.36]	[0.27]	[0.62]	[1.04]	[1.83]	[0.06]	[-0.40]	[-0.44]	[-0.62]
LIQ_k	-0.1045	-0.0600	-0.2474***	-0.2340**	-0.1151**	-0.1515***	-0.0926	-0.1449**	0.0378	0.0355	-0.0115	-0.1905**
	[-1.24]	[-0.65]	[-2.69]	[-2.29]	[-2.01]	[-2.64]	[-1.49]	[-2.29]	[0.51]	[0.53]	[-0.17]	[-2.23]
AMH_k	-0.2360	-0.9494	-0.5627	-1.3943*	-0.9542***	0.0320	0.3233	-0.4876	0.4929	-0.1121	0.5365	-0.6449
	[-0.43]	[-1.20]	[-0.87]	[-1.77]	[-3.11]	[0.07]	[0.53]	[-0.99]	[0.65]	[-0.20]	[0.80]	[-0.86]
TED_k	-0.3630***		-1.5343	-0.2668*	-0.1973**		-2.2889**	0.0254	-0.1843**		0.1451	-0.1673**
	[-2.67]		[-1.50]	[-1.74]	[-2.44]		[-2.58]	[0.19]	[-2.43]		[0.20]	[-2.02]
$FINRET_k$		-9.8572***		-12.715***		-14.660***		-15.303***		-16.277***		-15.436***
		[-3.51]		[-3.71]		[-5.25]		[-5.37]		[-5.26]		[-3.89]
VIX_k			-1.5343	-0.7575			-2.2889**	-0.7825			0.1451	0.4465
			[-1.50]	[-0.73]			[-2.58]	[-0.87]			[0.20]	[0.49]
N	27,133	27,133	27,133	27,133	26,865	26,865	26,865	26,865	26,568	26,568	26,568	26,568
R^2	0.5830	0.5750	0.5693	0.6209	0.6197	0.6152	0.6237	0.6650	0.6302	0.6237	0.6197	0.6678

Table 2.9: The Pricing of Basis Risk Factor in High-Yield Bonds

The table reports asset pricing tests for high-yield corporate bond portfolios. The risk factors $BASIS_k$, MKT_k, SMB_k, HML_k, $TERM_k$, DEF_k, LIQ_k, AMH_k and PS_k are defined in Table 6 where $k = 20$, 40 and 60. TED_k, $FINRET_k$ and VIX_k are defined in Table 7. Panel A reports the results from 2002 to 2006. Panel B reports the results from 2007 to 2008. The standard errors are Newey-West standard errors. The sample period is from 2002 to 2008. An ***, **, and * denotes significance at the 1%, 5%, and 10% level.

PANEL A: Pre-Crisis Period: 2002-2006

	k=20				k=40				k=60			
	Model 3	Model 4	Model 8	Model 9	Model 3	Model 4	Model 8	Model 9	Model 3	Model 4	Model 8	Model 9
Intercept	-0.0498*	-0.0176	-0.0001	0.2757	0.0110	-0.0100	0.0823	0.0242	-0.0054	0.0080	0.0129**	-0.0031
	[-1.66]	[-1.05]	[0.00]	[0.91]	[1.59]	[-0.39]	[1.10]	[1.24]	[-0.10]	[0.29]	[2.14]	[-0.17]
$BASIS_k$	0.5999	0.1954	-1.3069	7.4559	-0.4356	-1.3549	-3.4577	-3.4078	8.1726	-3.3114	-0.2024	3.9532
	[0.41]	[0.16]	[-0.37]	[1.01]	[-0.55]	[-1.00]	[-1.30]	[-1.15]	[1.25]	[-1.08]	[-0.21]	[0.72]
MKT_k	6.4542***	3.0165	7.0576	-3.9636	-1.4769	-2.8491	-7.5529	-17.083	-2.4383	-11.407	0.7702	2.0254
	[3.04]	[1.15]	[1.33]	[-0.42]	[-0.95]	[-0.62]	[-0.88]	[-0.91]	[-0.47]	[-1.59]	[1.10]	[1.49]
SMB_k	3.4432	-0.1438	0.7543	-4.3976	-0.5374	-3.8894	-16.548	0.6426	-3.7245	-0.1941	0.0800	0.6708
	[0.80]	[-0.08]	[0.28]	[-0.57]	[-0.36]	[-1.25]	[-0.99]	[0.81]	[-1.06]	[-0.22]	[0.10]	[0.95]
HML_k	5.8361	0.1125	2.8877*	-10.693	2.1717*	-2.2614	0.7064	1.1990***	1.0547*	0.8963	-1.5768	1.5275
	[0.98]	[0.16]	[1.71]	[-0.9]	[1.90]	[-0.52]	[0.79]	[2.93]	[1.70]	[1.38]	[-1.40]	[1.33]
DEF_k	1.1407	0.8800	3.5009	-7.7214	-0.1368	1.4904	-0.1037	-0.3023	-0.3377**	-0.7036***	-0.2797	-0.8756***
	[1.01]	[1.17]	[1.02]	[-1.14]	[-1.10]	[0.90]	[-0.38]	[-1.17]	[-1.97]	[-3.16]	[-0.86]	[-2.72]
$TERM_k$	-0.4165*	-0.0745	-0.1424	-0.1090	0.0738	-1.6919	-0.0924	1.3197**	0.1796	-0.8748**	-1.0166	1.9844**
	[-1.66]	[-0.25]	[-0.17]	[-0.21]	[0.17]	[-0.77]	[-0.13]	[2.42]	[0.25]	[-2.04]	[-0.90]	[2.29]
LIQ_k	0.0168	-0.0475	-0.0794	-0.1477	0.0762	0.0166	0.0738	0.0490	0.0849***	0.0516*	0.2898***	0.0755
	[0.36]	[-0.90]	[-1.06]	[-1.26]	[1.27]	[0.40]	[0.94]	[0.71]	[4.10]	[1.67]	[2.88]	[1.14]
AMH_k	-0.1100		0.1987		0.7335**		0.4794		1.0432***		1.3126***	
	[-0.90]		[0.99]		[2.44]		[1.42]		[4.94]		[3.06]	
PS_k		-0.0365		-0.0023		0.2633***		0.1348**		-0.0279		-0.0434*
		[-1.07]		[-0.04]		[4.48]		[2.56]		[-1.59]		[-1.66]
TED_k			0.0117	0.0324***			0.0266**	0.0140			-0.0252***	-0.0043
			[1.32]	[2.67]			[2.32]	[1.20]			[-2.89]	[-0.52]
$FINRET_k$			1.3005**	2.3703***			0.7437	1.3806**			3.2258**	2.5879*
			[2.02]	[2.77]			[0.95]	[2.01]			[2.32]	[1.90]
VIX_k			-0.1664	-0.4575***			0.1468	0.2098			-0.3061***	-0.2767***
			[-1.10]	[-3.57]			[1.22]	[1.62]			[-3.46]	[-2.99]
N	16,024	16,024	16,024	16,024	15,763	15,763	15,763	15,763	15,503	15,503	15,503	15,503
R^2	0.5388	0.5545	0.6579	0.6577	0.5685	0.5303	0.6486	0.6507	0.6483	0.6485	0.7051	0.7046

Table 2.9 – *Continued from previous page*

PANEL B: Crisis Period: 2007-2008												
	k=20				k=40				k=60			
	Model 3	Model 4	Model 8	Model 9	Model 3	Model 4	Model 8	Model 9	Model 3	Model 4	Model 8	Model 9
Intercept	0.0014	0.0002	0.0001	0.0044	-0.0055	-0.0046	-0.0051	-0.0023	-0.0118*	-0.0104	0.0069*	-0.0038
	[0.33]	[0.06]	[0.03]	[0.99]	[-1.10]	[-1.01]	[-1.23]	[-0.57]	[-1.91]	[-1.60]	[1.67]	[-0.65]
$BASIS_k$	-0.2022	-0.0843	0.8083	-0.1062	-0.8402	-1.4854**	-1.6868**	-2.1330***	0.5620	0.9909	1.6176*	-0.7958
	[-0.47]	[-0.18]	[1.48]	[-0.22]	[-1.54]	[-2.45]	[-2.24]	[-2.63]	[0.89]	[1.17]	[1.76]	[-0.68]
MKT_k	-0.1788	0.3944	-4.6648***	-3.2770**	-2.2676**	-2.0342*	0.3239	-2.3877	-2.8915**	-2.3620**	-3.7492**	-5.7323***
	[-0.28]	[0.50]	[-3.69]	[-2.12]	[-2.36]	[-1.91]	[0.17]	[-1.44]	[-2.22]	[-2.00]	[-2.58]	[-3.86]
SMB_k	-0.5250	-0.3859	-0.3017	-0.7092	0.9265	0.7383	0.1795	-1.1692	-0.3823	0.7056	-4.4418***	0.5151
	[-1.20]	[-0.86]	[-0.40]	[-0.81]	[1.30]	[0.98]	[0.14]	[-1.31]	[-0.54]	[1.01]	[-3.58]	[0.36]
HML_k	0.0341	0.3377	-0.4767	0.2619	-0.7249	-1.4314**	-1.7615*	-1.4062	-0.5430	-0.2312	-1.7248**	-0.4901
	[0.04]	[0.35]	[-0.48]	[0.24]	[-0.99]	[-2.02]	[-1.91]	[-1.58]	[-0.78]	[-0.34]	[-2.05]	[-0.43]
DEF_k	-2.2950***	-1.9882***	-1.5931**	-2.6666***	-0.8459*	-1.0153**	-0.5316	-1.2622*	-4.1389***	-4.4508***	-4.0302***	-2.9305***
	[-3.88]	[-3.22]	[-2.50]	[-3.76]	[-1.70]	[-2.04]	[-0.60]	[-1.76]	[-6.92]	[-7.00]	[-7.28]	[-3.83]
$TERM_k$	-0.1402	-0.4075	1.6511	0.0657	-0.8820	-0.6836	-0.1802	-1.4353	0.4841	-1.3040	-4.2394**	-5.6133***
	[-0.15]	[-0.43]	[1.23]	[0.04]	[-0.84]	[-0.69]	[-0.09]	[-0.88]	[0.51]	[-1.65]	[-2.25]	[-3.33]
LIQ_k	-0.5080***	-0.4291***	-0.2236	-0.5322***	-0.2138***	-0.2240***	-0.2938**	-0.0882	-0.1144**	-0.1608***	-0.0948	-0.0458
	[-4.68]	[-3.70]	[-1.58]	[-3.51]	[-2.82]	[-3.44]	[-2.29]	[-0.93]	[-2.08]	[-3.41]	[-1.32]	[-0.70]
AMH_k	-0.4681		0.8870*		-0.2695		0.0251		-0.8506*		-1.6434**	
	[-1.17]		[1.66]		[-0.55]		[0.03]		[-1.87]		[-2.00]	
PS_k		-0.1740*		-0.1991		-0.2785**		0.0304		0.1011***		0.0515
		[-1.77]		[-0.86]		[-2.13]		[0.17]		[2.70]		[0.92]
TED_k			0.2805**	0.6957***			0.2968*	0.0576			-0.0811	-0.1480**
			[2.09]	[3.67]			[1.66]	[0.37]			[-1.24]	[-2.06]
$FINRET_k$			-3.5072	-1.3459			9.5154*	3.7923			-11.416***	-13.314**
			[-1.32]	[-0.44]			[1.95]	[0.88]			[-3.02]	[-2.17]
VIX_k			4.2139***	7.6179***			4.3500***	2.1995***			-0.2090	0.7846
			[2.85]	[4.19]			[4.28]	[2.86]			[-0.40]	[1.53]
N	16,024	16,024	16,024	16,024	15,763	15,763	15,763	15,763	15,503	15,503	15,503	15,503
R^2	0.3223	0.3486	0.3486	0.3617	0.4011	0.3964	0.4419	0.4540	0.3186	0.3661	0.4529	0.4652

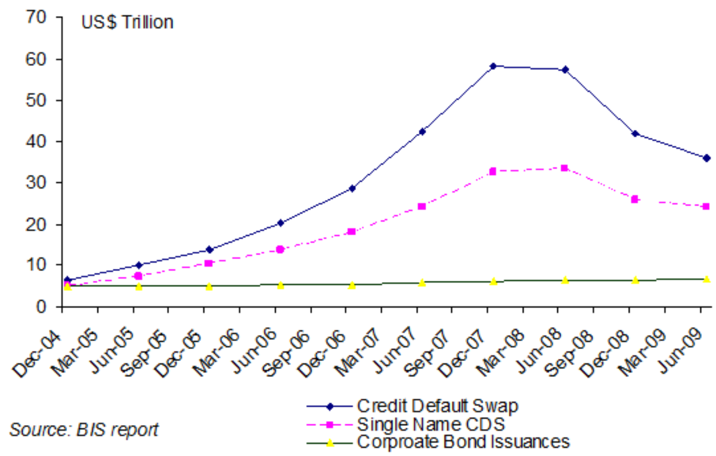
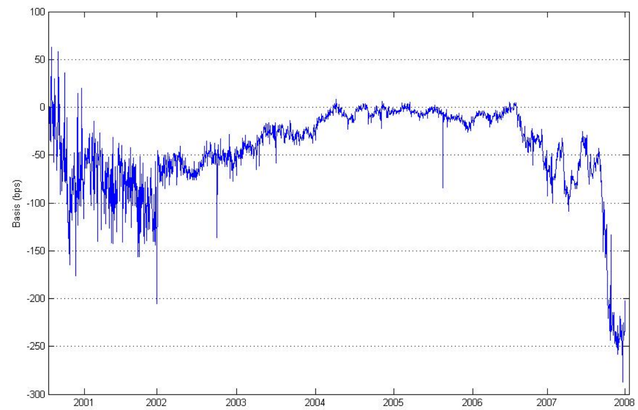
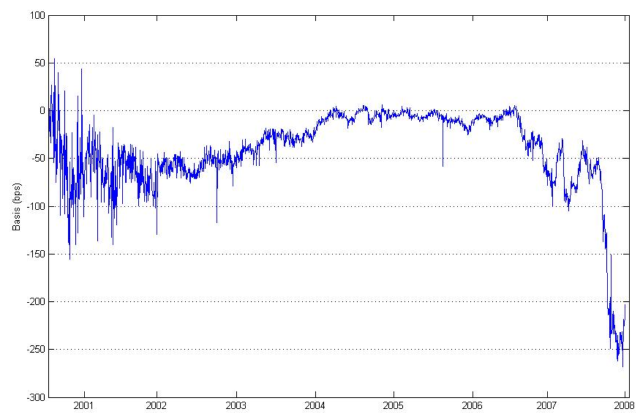


Figure 2.1: The Size of CDS and Corporate Bond Market

This figure displays the time trend of the outstanding notional amount of the credit default swap (CDS) and Corporate Bond market from December 2004 to June 2009 from Bank of International Settlement. The three data series represent the amount of the CDS contracts, the single-name CDS contracts and the corporate bonds respectively.



(a) Equal-weighted Basis Index



(b) Value-weighted Basis Index

Figure 2.2: Equal- and Value-Weighted Investment Grade CDS-Bond Basis Indices

This figure provides time series plots of equal- and value-weighted CDS-Bond basis indices constructed from our sample of investment grade bonds between 2001 and 2008. The CDS-Bond basis is the difference between the CDS spread of a reference firm and the Z-spread of the corresponding firms cash corporate bond. Panel A contains the equal-weighted basis index, and Panel B contains the value-weighted index.

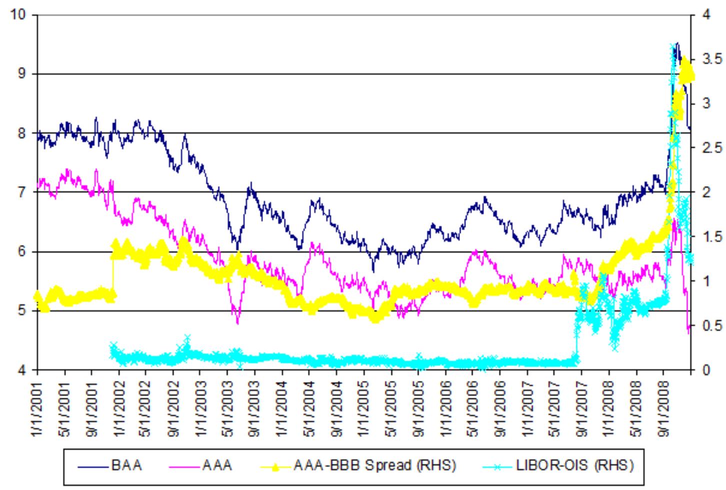


Figure 2.3: The Corporate Bond Spread and LIBOR-OIS Spread from 2001 to 2008

This figure provides time series plots of corporate bond yields and LIBOR-OIS spread from 2001 to 2008. The left Y-axis is in percentage point for AAA and BAA bond yields in solid lines. The right Y-axis is in percentage point for BAA-AAA spread and LIBOR-OIS spread in solid lines with asterisks. LIBOR-OIS spread is the difference between 3-month LIBOR and the overnight indexed swap rate. The data sources are from the Federal Reserve Bank of St Louis and Bloomberg.

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