The role of equity analysts' forecasts in the pricing of CDS Spreads*

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Abstract

We analyse the determinants of both the levels of, and changes in, US corporate credit default swap (CDS) spreads. In addition to structural determinants consisting of equity returns, equity volatility and risk-free interest rates, we show that CDS spreads are impacted by both the expected value and the dispersion of equity analysts' price targets. Broader market-based S&P500 index return also contains valuable information about spreads. An analysis of determinants through the financial crisis shows that equity analyst information featured more prominently in the pricing of CDS spreads enhancing the explanatory power of the regression model.

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1. Introduction

The assessment of credit risk, generally defined as the uncertainty of a counterparty meeting its financial obligations in accordance with agreed terms, has become an increasingly important area of research. From the accounting-based information models of Altman (1968) and Ohlson (1980) to the market-based structural model of Merton (1974), academics have strived to indentify the drivers of credit risk (see, for example Blanco Brennan and Marsh, 2005; Das, Hanouna and Sarin, 2009; and Ericsson, Jacobs and Oviedo, 2009). Recent market events have again highlighted the importance of a timely and accurate estimation of credit risk, with many financial institutions incurring significant losses stemming from counterparty defaults. Moreover, with the Basel III's advanced approach requiring credit value adjustments arising from changes in credit spreads to be incorporated into market risk capital calculations, the identification of factors affecting credit risk is now receiving increased attention from practitioners and regulators.

Credit risk which captures the excess return of a corporate bond over a sovereign bond is measured with bond credit spreads or more recently with credit default swap (CDS) spreads.[1] Both instruments are economically comparable and thus, should closely reflect the financial position of a corporation and the likelihood that it will default on its obligations (Ericsson, Jacobs and Oviedo, 2009). However, corporate bonds compensate for both default risk and illiquidity and require the selection of a benchmark risk-free interest rate (Longstaff, Mithal and Neis, 2005). Consequently, the changes in the credit quality of the underlying

[1] A CDS is an over-the-counter contract that allows two counterparties to isolate and separately trade the credit risk of a third-party entity. A protection buyer pays a fixed periodic fee to the protection seller in exchange for a contingent payment by the seller upon a specific credit event by the reference entity. The majority of contracts are standardised according to the International Swaps and Derivatives Association (ISDA) definitions.

reference entity are reflected more accurately in the CDS premium than in the bond yield spread (Houwelling and Vorst, 2005). Changes in the credit quality of the underlying reference entity are also reflected faster in the CDS spread (Blanco, Brennan, and Marsh, 2005). Ericsson, Reneby, and Wang (2006) show that the CDS market leads the bond market and contributes around 80% of the price discovery of credit risk. Consequently, CDS spreads have become the preferred indicators of credit risk for financial analysts and traders involved in hedging, speculation or arbitrage activities (Blanco, Brennan, and Marsh, 2005).

One of the first economic insights into the drivers behind the probability of default was provided by Merton (1974). Using the contingent claim framework developed by Black and Scholes (1973), Merton showed that the value of each claim can be determined by the dynamics of firm value, which although unobservable, is a function of the firm leverage, equity volatility and the risk-free rate.[2] Duffie, Saita and Wang (2007), Alexander and Kaeck (2008), Das, Hanouna and Sarin (2009), and Ericsson, Jacob and Oviedo (2009) have shown that, in addition to these structural determinants, CDS spreads are also influenced by economy-wide variables including equity index returns and volatility.

However, structural models implicitly assume that investors can observe the inputs to the model, whereas Giesecke (2005) argues that investors only have incomplete information about the inputs. When creditors are unable to value assets with precision they will demand a jump-risk premium (Duffie and Lando, 2001). By examining the proportion of financial assets whose values were determined from inactive markets or based on unobservable inputs, Arora, Richardson and Tuna (2010) empirically verified that asset measurement uncertainty

[2] This model underpins many commercially successful structural models used to predict the probability of default, including CreditGrades and Moody's KMV.

in financial institutions increased credit spreads. However, one limitation of their approach is that it does not apply to non-financial firms.

This study examines the determinants of CDS spreads in the U.S. and explicitly incorporates the link between asset value uncertainty and the pricing of these spreads. We utilise an alternative measure of asset value uncertainty that is widely available for a broader sample of companies – cross-sectional variation in equity analysts' 1-year ahead price targets. By using the standard deviation of analysts' price targets to capture the uncertainty surrounding firms' prospects, we can empirically test the ability of this variable to explain a greater share of the CDS spread variation compared to traditional models utilising only firm-specific and broader equity index indicators. In addition to capturing analyst uncertainty surrounding firm value, the consensus analyst price target also provides information on the expected equity appreciation over the subsequent year. In light of the findings by Ederington and Goh (1998) that equity analysts convey new information to the market, equity analysts' forecasts should provide valuable information about pricing CDS spreads.

The role of equity analysts in CDS markets has received scant attention in the literature to date. Guntay and Hackbarth (2010) establish a negative relation between spreads and dispersion of analysts' earnings forecasts but their results are based on bond spreads rather than credit spreads. Callan, Livnat and Segal (2009) find mixed evidence that earnings surprises are negatively related to CDS spread changes around announcements. Using annual data, Melgarejo (2010) finds that the narrowing of analysts' earnings forecast dispersion reduces CDS spreads. Furthermore, he finds that firms beating analysts' earnings, cash flow and revenue forecasts also have lower spreads.

Motivated by the recent volatility in the markets, we then proceed to examine the explanatory power of CDS spread determinants throughout the financial crisis. Alexander and Kaeck (2008) utilise a Markov switching model to demonstrate that there are distinct shifts in regimes in the CDS market. However, their sample period ends in June 2007, prior to the onset of the crisis. Furthermore, they conduct their analysis at the index level, rather than firm level. In contrast to their regime switching approach, we employ an objective and data-free method to classify the recent financial crisis into sub-periods to ascertain if and how the determinants of CDS spreads are impacted during times of market turbulence. To our knowledge there are no other studies examining how these determinants have been affected by the financial crisis.

Using weekly data of single-name investment-grade U.S. corporate CDS spreads, we make two important contributions to literature. First, we observe that in addition to being impacted by the expectations of market-based idiosyncratic and systematic factors, CDS spreads are also sensitive to the perceived uncertainty in these estimates. Using the distribution of analysts' target prices as a proxy of asset uncertainty, we find a positive relationship between changes in equity value uncertainty and changes in CDS spreads.

Our second contribution is in the analysis of the time variation in the estimates throughout the financial crisis. We find that during times of market turmoil, forward looking equity- and economy-based indicators are much more important in pricing CDS spreads compared to backward looking leverage.

The remainder of this paper is structured as follows. Section 2 reviews the determinants of CDS spreads while Section 3 describes the data. Section 4 presents the results on the CDS spread determinants and their time-varying behaviour. Section 5 concludes the paper.

2. Determinants of CDS spreads

Determinants of CDS spreads can be generally classified as either accounting-based or market-based. Das, Hanouna and Sarin (2009) show that at the quarterly frequency accounting-based models based on variables such as return on assets and interest coverage, perform similarly to market-based models. However, given the high volatility during the recent crisis, quarterly measures are unlikely to reflect information in a timely manner. We consider the determinants of CDS spreads at a higher frequency than at which accounting data is released and as such we naturally focus on market-based factors. The choice of market-based determinants is also appealing as these variables are forward-looking and take into account the market's expectation. The idiosyncratic and systematic market-based variables that have been hypothesised to influence CDS spreads at the weekly level are discussed below.

2.1 Observed Changes in the Value of Equity

Equity can be considered the first loss tranche when a company defaults. Consequently, we anticipate a strong inverse relationship between CDS premium and stock returns, particularly as the company approaches the default barrier. Although Norden and Weber (2009) find that the correlation between investment-grade CDS spread changes and stock returns is generally weak at the daily level, it does become stronger when measured weekly.

2.2 Expected Changes in the Value of Equity

In addition to the current share price, equity analysts' target price forecasts also convey information about firm's expected value. Although literature is yet to identify the impact of analyst price target forecasts on CDS spreads, we hypothesise that an increase in expected firm value will lead to lower CDS spreads. We scale the price target forecast (*Raw Target*) by the current share price to make the magnitudes comparable across firms. This variable can also be interpreted as a 1-year ahead expected return. The target variable (*Target*) is calculated as the mean target across the K analysts covering stock i at the end of each week t:

$$Target_{it} = \frac{\frac{1}{K}\sum_{k=1}^{K} Raw\ Target_{kit}}{Price_{it}} \times 100 \tag{1}$$

When estimating the determinants of CDS spread changes, the percentage change in the target price is defined as follows:

$$\Delta Target_{it} = \left(\frac{\frac{1}{K}\sum_{k=1}^{K} Raw\ Target_{kit}}{\frac{1}{K}\sum_{k=1}^{K} Raw\ Target_{kit-1}} - 1 \right) \times 100 \tag{2}$$

We expect that the percentage change in the mean price target will be negatively related to the change in CDS spreads.

Duffie and Lando (2001) provide a framework for the term structure of credit spreads under information uncertainty and show that increased uncertainty leads to higher credit spreads. Arora, Richardson and Tuna (2010) verify these claims empirically using a sample of financial firms. We capture the uncertainty in asset values by the distribution of analysts' target price forecasts. As information contained in analysts' forecasts reduces information asymmetry between the market and the firm, we hypothesise that greater uncertainty among equity analysts will reduce transparency in pricing securities, leading to higher CDS spreads. We define analyst uncertainty as the cross-sectional standard deviation of analyst price targets for each stock *i*, across *K* equity analysts in week *t* deflated by the average target price in week *t*:

$$\text{StDTarget}_{\text{it}} = \sqrt{\frac{\sum_{k=1}^{K}\left(\text{Raw Target}_{kit} - \frac{1}{K}\sum_{k=1}^{K}\text{Raw Target}_{kit}\right)^2}{K-1}} \Bigg/ \text{Target}_{\text{it}} \quad (3)$$

A percentage change in the cross-sectional price target standard deviation (*ΔStDTarget*) is also expected to vary inversely with changes in CDS spreads, as increases in uncertainty should entail higher credit risk.

2.3 Leverage

To model leverage, we adopt the methodology by Hull, Nelken and White (2004) and use the reported total liabilities obtained from consolidated balance sheet data divided by market capitalisation of the firm. Structural models of default indicate that CDS spreads will vary positively with leverage. Most studies including Campbell and Taksler (2003), Ericsson, Jacobs and Oviedo (2009) and Norden and Weber (2009) exclude financial firms from their analysis due to the way they fundamentally differ in the way they use capital for business operating purposes. We account for the differential effect of leverage of these firms and retain them in our sample.

When examining spread changes, we follow Blanco, Brennan and Marsh (2005) and approximate the changes in the firm's leverage with the firm's movements in equity value. Although this is only an approximation, financial information is reported infrequently with changes in leverage primarily driven by the changes in equity. Additional advantage of using equity returns to proxy for changes in leverage is that they can be applied to both financial and non-financial firms. As stock price falls and the underlying entity approaches the default barrier we expect CDS premiums to rise.

2.4 Volatility

In the contingent claims framework, debt is equivalent to a combination of a risk-free loan and a short put option on the assets of the firm. Out-of-the-money put options are thus naturally suited to assess asset volatility, particularly considering their sensitivity to jump risk (Cremers et al., 2008). Although some studies, most notably Campbell and Taksler (2003) and Das, Hanouna and Sarin (2009) utilise historical firm-specific equity volatility Benkert (2004), Cremers et al. (2008), Alexander and Kaeck (2008) and Cao, Yu and Zhong (2010) found that option-implied volatility has a stronger impact on the variation in CDS spreads.

Buraschi and Jackwerth (2001) show that due to the inherent demand from institutional investors for portfolio protection put volumes significantly exceed call volumes on the S&P500 index. Accordingly, we select 3-month put option contracts to calculate the proxy of asset volatility. Since higher volatility increases the option value, we expect volatility to be positively related to spreads. The significance of volatility was demonstrated by Zhang, Zhou and Zhu (2009) who showed that firm-level stock volatility can explain about 50% of the variation in the level of CDS spreads.

2.5 Risk Free Rate

The risk-free interest rate determines the risk-adjusted drift of firm’s value and therefore should be inversely related to the credit spread (Alexander and Kaeck, 2008). Although Government bond yields are commonly used as risk-free proxies (e.g. Ericsson, Jacobs and Oviedo, 2009), swap rates have a number of advantages including greater liquidity and constant maturity (Houweling and Worst, 2005; Blanco, Brennan, and Marsh, 2005). Moreover, Houweling and Vorst (2005) find a stronger impact of the swap rate on the CDS market than that of the Treasury rate. Hull, Predescu and White (2004) attribute this to the difference between the opportunity cost between bond traders and derivative traders. Bond traders tend to regard the Treasury zero curve as the risk-free rate while derivative traders tend to use the swap zero curve. To match the expectations on the U.S. economic and credit environment to the life of the CDS swap contract, we approximate the risk-free rate by the 5-year swap rate.

2.6 Market Conditions

Blanco, Brennan and Marsh (2005) showed that besides firm-specific variables that capture changes in the probability of default, spreads are also impacted by changes in the expected recovery amount. Acharya, Bharath and Srinivasan (2007) demonstrated that expected recovery is a function of overall market conditions, with an improving economy associated with narrower credit spreads. Consistent with Blanco, Brennan and Marsh (2005) we consider the return of the S&P500 equity index as a proxy for the changes in the expected recovery rate.

3. Data

The CDS dataset is extracted from Markit Partners and consists of end of the day mid-point quotes of 57 constituents of the US CDX NA IG CDS Indices from 3 Jan 2005 to 30 Dec 2011. The index is updated semi-annually and comprises investment grade CDS contacts. All spreads are quoted in basis points and constructed from a number of market makers. We focus on issuers that have remained part of the index throughout its revisions as they comprise the most liquid contacts. We only consider senior debt 5-year CDS contracts, as they represent over 85% of the single-name CDS traded volume (Trutwein, Ramchander and Schiereck, 2011). To reduce noise in the daily CDS prices we examine the CDS determinants at the weekly level.

The analysts' consensus target price forecasts are obtained from IBES/Thomson Reuters via WRDS and adjusted for splits. Target prices not updated within three months are classified as inactive and removed from the sample. Stock returns, market index returns and leverage are obtained from CRISP, firm put option-implied volatility and 5-year swap rates are sourced from Bloomberg.

4. Empirical Analysis

In section 4.1 we analyse the factors that impact the level of CDS spreads, followed by the changes in CDS spreads discussed in Section 4.2. Factors that affect changes in spreads are of particular interest as they provide a strong test of the contingent claims pricing theory (Ericsson, Jacobs and Oviedo, 2009). In light of evidence by Alexander and Kaeck (2008) that CDS spreads display pronounced regime switching behaviour, in section 4.3 we investigate the stability of CDS spread determinants during the financial crisis by dividing the sample into three sub-periods.

4.1 Determinants of CDS Spread Levels

Descriptive statistics for the variables measured in levels are contained in Table 1. The average CDS spread across the sample is 79 basis points, ranging from a minimum of 6 to a maximum of 3688 basis points. The price target (*Target*) is on average 0.57% higher than the current price, with the extremes ranging from -0.85% to 437%. The mean cross-sectional standard deviation of analysts' price targets deflated by the target price (*StD Target*) is 11.66, with a median of 9.73. The mean leverage ratio is 0.55. The 5-year swap rate averages 3.57%, varying from 1.13% to 5.74%. Stock-level implied volatilities is 31.34% on average.

[Insert Table 1 here]

Table 2 shows that most of the determinants are strongly correlated with the CDS spread levels, as well as with each other. All associations between the variables and the CDS spreads are as expected, except the target price. We anticipated that a lower target price, relative to current share price levels would be inversely correlated to the CDS spread as it signals an expected deterioration in firm performance.

[Insert Table 2 here]

We adopt the conventional approach to quantifying the impact of credit risk determinants and use them as explanatory variables in a linear regression model. Following the work of Collin-Durfesne, Goldstein and Martin (2001), Ericsson, Jacobs and Oviedo (2009), and Guntay and Hackbarth (2010) we construct a panel regression model of all reference entities. The pooled regression specification is estimated using OLS:[3]

$$\begin{aligned} CDS_{it} = \beta_0 + \beta_1 \mathrm{Target}_{\mathrm{it}} + \beta_2 \mathrm{StDTarget}_{\mathrm{it}} + \beta_3 Leverage_{it} + \beta_4 \mathrm{Leverage}_{\mathrm{it}} \times D_i + \beta_5 \mathrm{5ySwap}_{\mathrm{t}} \\ + \beta_6 \mathrm{Vol}_{\mathrm{it}} + u_{it}, \end{aligned} \quad (4)$$

where *Target* is the equity analyst consensus target price divided by the current stock price, or expected return, and *StDTarget* is the cross-sectional standard deviation of equity analysts' price targets deflated by the target price at the end of each week. *Leverage* is based on

[3] A panel unit root test shows that the CDS spread level is stationary as the null hypotheses of a unit root is rejected at the 1% level. Individual firm tests also reject the null of a unit root in the CDS spread level.

quarterly book values as a percent of weekly market capitalisation. Empirical evidence by Alexander and Kaeck (2008) suggests that CDS on financial firms behave quite differently from CDS on non-financial firms. Since banks and other authorised deposit-taking institutions have access to sources of funding not available to other non-banking institutions, it is likely that leverage will have a different impact on the CDS spread of financial firms. We address this difference with the inclusion of a joint interaction variable. D_i is a dummy variable equal to one if the firm is in the financial sector (SIC code between 6000 and 6999) and zero otherwise. The 5-year swap rate is a proxy for the risk-free rate. *Vol* is the firm-level put option implied volatility. The regression is estimated with and without firm fixed effects to assess the impact of any unobserved heterogeneity that may explain the level of CDS spreads. Clustered standard errors are utilised to adjust for correlation across firms and time.

The regression results for the determinants of levels are contained in Table 3. Columns 1-3 show three model specifications without fixed effects. The remaining three columns include fixed effects.

[Insert Table 3 here]

The most significant determinants of spread levels are the expected stock return, the standard deviation of the target price, the 5-year swap rate and the stock volatility. The expected stock return and the standard deviation of the target price alone explain close to 50% of the CDS spread levels. All coefficients in the third specification have the predicted association with the CDS spreads. Consistent with our hypothesis analyst dispersion has a robust and positive impact on CDS spreads. A one standard deviation increase in the dispersion in analysts' price targets leads to a 24 basis point increase in the CDS premium. One percentage point decrease in the swap rate leads to around 11 basis point increase in spreads, on average, while each percentage point increase in stock volatility increases spreads by 3.3 basis points. The results do not materially change using fixed effect (Columns 4 to 6). All three coefficients are significant at the 1% level. Leverage is positively related to spread levels, though this relationship is only significant at the 10% level. The results also show that the financial firm interaction variable is negative but not significant, indicating that leverage has no impact on spread levels for financial firms. Overall, the addition of analysts' expectations increases the explanatory power of the model to between 68 and 74% of the variation in spread levels. This exceeds the explanatory power of previous studies.

4.2 Determinants of CDS Spread Changes

In this section we explain the relative importance of factors on the changes in the CDS spreads. We use first differences for all variables measured in percent and use percentage changes in all variables that are measures in either levels or dollar values. The descriptive statistics for the CDS spread changes and the hypothesised determinants are contained in Table 4.

The results show that the mean and median CDS spread changes are close to zero yet display extreme movements ranging from a decline of 1997 basis points to an increase of 868 basis points within one week. The median value of Δ*Target* and Δ*StdTarget* are both zero, indicating that these variables change values in fewer than half of the weeks in our sample. Despite the fact that weekly means and medians are somewhat small, the standard deviations and extreme values for the analyst price target, volatility and equity return variables indicate substantial volatility over this interval.

[Insert Table 4 here]

Table 5 shows the correlation between the theoretical determinants and the changes in CDS spreads. The observed signs of most coefficients are as predicted by structural default probability models and are statistically significant at the 1% level, excluding the returns on the S&P500 index which has a positive association with the spreads.

[Insert Table 5 here]

The impact of structural determinants and economy-wide factors on changes in CDS spreads is assessed using a regression analysis. Consistent with Ericsson, Jacobs and Oviedo (2009), we specify raw changes in CDS spreads as our dependant variable. One criticism of such methodology is that it does not adjust for differences in level of spreads across issuers (Micu, Remolona and Wooldridge, 2006). Alternatively, one can adopt the methodology of Hull, Predescu and White (2004) and adjust each spread observation by subtracting the appropriate spread index constructed from the various credit ratings. However, as our sample only spans investment-grade rated entities we use unadjusted spread changes. In each period, the following equation is estimated using OLS:

$$\begin{aligned}\Delta CDS_{it} = \beta_0 + \beta_1 \Delta \text{Target}_{\text{it}} + \beta_2 \Delta \text{StDTarget}_{\text{it}} + \beta_3 S\text{P500Return}_{\text{t}} + \beta_4 S\text{tockReturn}_{\text{it}} \\ + \beta_5 \Delta \text{5ySwap}_{\text{t}} + \beta_6 \Delta \text{Vol}_{\text{it}} + v_{it},\end{aligned} \tag{5}$$

where ΔCDS is the first difference in the weekly CDS spread, $\Delta Target$ is the percentage change in equity analyst consensus target price forecast, $\Delta StDTarget$ is the percentage change in cross-sectional standard deviation of equity analysts' price targets deflated by the target price, *S&P500Return* is the return on the S&P500 index, *StockReturn* is the return on each individual stock, and $\Delta 5ySwap$ is the first difference of the 5-year swap rate. ΔVol is the change in equity volatility. We use clustered standard errors to account for correlation across firms and weeks but do not report results using fixed effects as they do not alter the results.

The results from the estimation of Equation 5 show that both idiosyncratic as well as market-wide factors have an effect on CDS spread changes, with stock volatility being the most statistically significant (Table 6). When individual stock returns are negative or analysts' target prices are lowered, credit spreads widen. Although the size of the coeffients is similar only the target price change is significant. As hypothesised, shifts in price targets that increase the cross-sectional dispersion in analyst price targets lead to a widening of CDS spreads. A one standard deviation increase in *StDTarget* increases CDS spreads by 3.1 basis points, while a one standard deviation increase in *vol* increases CDS spreads by 6.7 basis point, on average.

We find strong evidence that the risk-free interest rate is an important determinant of CDS spreads with large changes in the swap rate inducing larger changes in the CDS spreads. A one percentage point decline in the 5-year swap rate leads to a 6.8 basis point increase in CDS spreads.

[Insert Table 6 here]

4.3 The Impact of the Financial Crisis on CDS Spreads

In this section we examine time-variation in CDS spread determinants by dividing the sample into three sub-periods: Pre-crisis, Crisis I and Crisis II. Both Yu (2006) and Alexander and Kaeck (2008) indicate that single-name CDS spreads may behave quite differently during volatile periods and may be driven by different factors compared with their behaviour in low volatility periods. Rather than relying on data-based methods to isolate periods of market stress, we use objective break points proposed by Ivashina and Scharfstein (2010) to identify the pre-crisis and the two separate crisis periods.

The summary statistics for selected variables across the three sub-periods are provided in Table 7. The Pre-crisis period, characterised by a benign economic environment and rising equity markets occurs before the onset of the subprime crisis in August 2007. The historically low interest rates allowed companies to increase profits as firms and consumers increased leverage to expand and consume. During this period, the credit derivatives market experienced an enormous growth spurt in both size and liquidity as the notional amount outstanding increased significantly. A combination of ever-increasing liquidity in the CDS market combined with low volatility in the equity markets and historically low corporate default rates led to low and stable credit spreads until mid-2007.

[Insert Table 7 here]

The first crisis period (Crisis I) is characterised by the deterioration of macroeconomic fundaments which impacted the sub-prime segment of the US housing market in mid-2007. Consequently, we mark the start of the first crisis as the 31 July 2007. As noted by Brunnermeier (2009), a number of relevant events occurred in late July and early August 2007, including a number of negative information events relating to the sub-prime mortgage market, sharp reductions in the value of collaterised debt obligations based on sub-prime mortgages and heavy losses reported by hedge funds. The subsequent repricing of risk forced companies to reduce leverage, liquidate assets, depressing their respective values and increasing volatility in the CDS spreads. This period marks the peak in both the equity market and interest rates in our sample. The average level of CDS spreads in this period increased from 30 to 64, with the weekly change increasing from 0.01 to 1.16 basis points. During the first crisis the weekly changes in target prices and equity returns are both negative.

The second crisis period (Crisis II) covers the banking crisis triggered by the failure of Lehman Brothers on 15 September 2008.[4] This period is marked by steep declines in equity markets and interest rates, steepening of the yield curve slope and a substantial increase in CDS spreads and their volatility. The average CDS spread rises to an average of 123 basis points during this period. Uncertainty about asset value (*StDTarget*) and leverage is also higher, on average.

4.3.1 Time-varying Shifts in CDS spread Levels

The results of the sub-period level regressions using Equation 4 provide additional insight into the time variation in spread determinants (Table 8). In the pre-crisis period, leverage helps to explain the level of CDS spreads and it is important explanatory variable for financial firms. The results clearly show that equity analyst information has little impact on CDS spreads during periods of lower volatility.

Leverage continues to be an important determinant of CDS spreads for non-financial firms in Crisis I. As leverage and equity volatility increases default becomes a real possibility and CDS spreads rise rapidly. Consistent with expectations, the price target is negatively correlated with spreads. Stock volatility significant in the pre-crisis period and the magnitude increases as the crisis develops. In Crisis I, a coefficient of 2.3 implies that a one standard deviation increase in stock vol increases spread by 19 basis points.

[4] We acknowledge that it is difficult to determine the date on which the second crisis period ends, but believe given events in financial markets between 2009 and 2011 that is reasonable to assume that credit risk in financial markets has not returned to ‘normal’ levels.

In Crisis II, this impact increases to 73 basis points, highlighting the increased credit risk and higher probability of default. The forecast dispersion also becomes more economically significant with a one standard deviation increase translating to 40 basis points increase in spread levels. Both coefficients are significant at the 1% level. The swap rate is only statistically significant while leverage is not, which is somewhat surprising given the increased focus on gearing during this period.

Comparing the two crisis periods to the pre-crisis period, it is apparent that the forward-looking market factors have a stronger effect during times of heightened credit risk, whereas the non-market related backward-looking leverage is more important in explaining spread variations in calm, orderly credit markets. Similarly, as our model is based primarily on market-based data its explanatory power is greater during volatile periods relative to those in a benign economic environment.

[Insert Table 8 here]

4.3.2 Time-varying Shifts in CDS Spread Changes

To understand how spread determinants impact changes in CDS spreads we estimate Equation 5 across the three sub-periods. The analysis of spread changes is shown in **Error! Reference source not found.**. In the benign pre-crisis economic environment spreads are characterised by small spread changes with stock volatility having the only significant impact on credit spreads. The model has a low explanatory power with an adjusted R^2 of less than 4%.

Interestingly, the correlation between changes in CDS spreads and equity returns is positive during this period. While this may seem counterintuitive and in direct violation of the contingent claims framework, the relationship can be explained using the risk-return relationship between debt and equity. Although higher leverage increases CDS spreads, when the risk of default is low increased leverage also boosts profits by raising the return on equity. Provided the value of assets is much larger than the value of the debt, and the asset volatility remains low, stock price changes will not impact on CDS spreads as the call option is far out of the money and there is little chance it will be exercised. Therefore, during low volatility periods stocks with low capital base may outperform the less risky ones.

From the onset of Crisis I market-based variables become increasingly more prominent in pricing CDS spreads. Once the volatility in the market increases, we see that changes in the uncertainty of equity values (*StDTarget*) become significant. In Crisis II the coefficient becomes more economically and statistically significant. Chnaegs in the target price and S&P500 return also become statistically significant, with the hypothesised signs. Together, these factors can explain over 26% of the variation in CDS spread changes during Crisis I and 7.5% during Crisis II.

[Insert Table 9 here]

Comparing the two crisis periods, the market factors have a stronger effect during the crisis period than in the pre-crisis period. In the crisis periods the spreads were more volatile and the explanatory power was higher. Consistent with Alexander and Kaeck (2008), we observe that CDS spread changes are more sensitive to stock volatility during periods of CDS market turbulence. However, our results show that equity analyst information is equally important in volatile periods.

5. Conclusion

The recent financial crisis spawned a substantial body of empirical literature devoted to investigating factors affecting the pricing of CDS and their effectiveness in hedging idiosyncratic credit risk. We employ a dataset of single-name U.S. corporate CDS spreads to investigate the relationship between CDS spread levels and changes and their theoretical market-based determinants at a weekly frequency. Besides examining firm-specific and macro-based variables commonly quoted in the literature, we contribute to the existing literature by including equity analysts' consensus forecasts and their cross-sectional standard deviation as a proxy for uncertainty. Additionally, we decompose the sample into three sub-periods to assess the relative importance of these factors during the financial crisis.

Our results show that market-based variables explain up to 72% of the variation CDS spreads and 27% of the variation in CDS spread changes. Our proxy of the uncertainty of asset values is a robust and significant determinant of CDS spread levels in the full sample, with higher uncertainty leading to higher spreads. Similarly, when examining changes in CDS spreads, increases in uncertainty also lead to higher spreads. We thus provide evidence that equity analyst forecasts are an additional source of information that can be used to explain credit spreads.

Our findings on the variation in the determinants of CDS spreads indicate that leverage conveys information about credit risk during benign market periods. Once markets become volatile following the sub-prime crisis and collapse of Lehman Brothers, leverage does not contain useful information that aids the determination of CDS spreads. During these crisis periods, market-linked variables, such as equity returns, interest rates, volatility and analyst information, become more informative. Interestingly, most of these market-based variables do not assist in understanding how CDS premia change during benign economic conditions. These results indicate that market condition is an important consideration in determining the appropriate CDS spread pricing factors.

Table 1
Descriptive Statistics: Levels

This table contains descriptive statistics for a sample of 57 single-name 5-year U.S. corporate CDS contracts and their hypothesised determinants from 3 Jan 2005 to 30 Dec 2011, measured at a weekly frequency. *CDS* is credit default swap spread, *Target* is the median equity analyst target price divided by its current stock price, *StD Target* is the cross-sectional standard deviation of equity analyst price targets divided by the average target price in that week. *Leverage* is long-term debt as a percent market capitalisation, *Swap Rate* is the 5-year swap rate, *Stock Vol* is the 3-month put option implied volatility.

	Mean	Std Dev	Med	Min	Max
CDS	79.19	115.97	48.83	6.21	3688.34
Target	0.57	6.66	0.12	-0.85	437.21
StD Target	11.66	8.76	9.73	1.23	157.33
Leverage	0.55	3.06	0.27	0.00	161.74
Swap Rate	3.57	1.35	3.77	1.13	5.74
Stock Vol	31.34	16.39	27.33	10.47	283.34

Table 2
Correlation: Levels

This table contains the Pearson correlation coefficients for the variables defined in Table 1. The sample covers 57 single-name 5-year U.S. corporate CDS contracts from 3 Jan 2005 to 30 Dec 2011, measured at a weekly frequency. *** indicates a significant correlation at the 1% level.

	Target	StD Target	Leverage	Swap Rate	Stock Vol
CDS	0.394***	0.692***	0.558***	-0.329***	0.744***
Target		0.440***	0.753***	-0.001	0.310***
StD Target			0.592***	-0.168***	0.663***
Leverage				-0.071***	0.392***
SwapRate					-0.280***

Table 3
Determinants of CDS Levels

This table reports the results of an OLS regression of Equation 1 for a sample of 57 single-name 5-year U.S. corporate CDS contracts from 3 Jan 2005 to 30 Dec 2011, measured at a weekly frequency. Fin Dummy equals one for financial companies (SIC code between 6000 and 6999), and zero otherwise. Absolute values of t-statistics based on firm- and week-clustered standard errors are contained in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-24.935*	-21.060**	-30.263*	12.745	10.246	-5.988
	(1.66)	(2.13)	(1.82)	(0.55)	(0.56)	(0.22)
Target		1.946***	-0.838***		1.397**	-1.114***
		(2.80)	(3.17)		(2.56)	(7.35)
StD Target		8.505***	2.768***		8.835***	2.826***
		(8.53)	(3.23)		(9.32)	(3.46)
Leverage	48.957**		39.507*	85.290***		63.884**
	(2.28)		(1.87)	(2.94)		(2.18)
Leverage × Fin dum	-36.550*		-28.898	-74.448***		-54.500*
	(1.73)		(1.42)	(2.60)		(1.93)
Swap Rate	-10.985***		-11.140***	-10.048***		-10.155***
	(7.13)		(6.51)	(7.19)		(6.16)
Stock Vol	4.029***		3.299***	3.899***		3.292***
	(7.63)		(7.20)	(6.56)		(7.26)
Firm Fixed Effects	No	No	No	Yes	Yes	Yes
Obs.	20234	20586	20231	20234	20586	20231
Adj. R^2	0.662	0.488	0.682	0.721	0.564	0.738

Table 4
Descriptive Statistics: Changes

This table contains descriptive statistics for a sample of 57 single-name 5-year U.S. corporate CDS contracts and their hypothesised determinants from 3 Jan 2005 to 30 Dec 2011, measured at a weekly frequency. *ΔCDS* is the change in the credit default swap spread, *ΔTarget* is the percentage change in the median equity analyst target price, *ΔStDTarget* is the change in the cross-sectional standard deviation of equity analyst price targets divided by the target price in that week, *S&P500 Return* is the return on the S&P500 equity index, *Stock Return* is the return on each individual stock, *ΔSwap Rate* is the change in the 5-year swap rate and *ΔStock Vol* is the change in the 3-month put option implied volatility for each security,.

	Mean	Std Dev	Med	Min	Max
ΔCDS	0.27	29.08	-0.05	-1996.63	867.57
ΔTarget	0.07	2.33	0.00	-58.80	46.88
ΔStDTarget	0.00	1.99	0.00	-94.83	68.41
S&P500 Return	-0.01	1.16	0.08	-5.03	6.32
Stock Return	0.02	2.17	0.00	-30.83	102.36
ΔSwap Rate	-0.01	0.14	-0.01	-0.54	0.58
ΔStock Vol	0.02	4.36	-0.05	-98.12	98.69

Table 5
Correlation: Changes

The Pearson correlation coefficients for weekly changes in CDS spreads and hypothesised determinants from 3 Jan 2006 to 31 Dec 2010 are contained in this table. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

	ΔTarget	ΔStD Target	S&P500 Return	Stock Return	ΔSwap Rate	ΔStockVol
ΔCDS	-0.064***	0.12***	0.018***	-0.042***	-0.065***	0.241***
ΔTarget		-0.151***	-0.01	0.015**	0.047***	-0.046***
ΔStDTarget			-0.013*	-0.002	-0.031***	0.053***
S&P500 Return				0.55***	0.159***	-0.088***
Stock Return					0.084***	-0.137***
ΔSwap Rate						-0.155***

Table 6
Determinants of Changes in CDS Spreads

This table reports the results of an OLS regression of Equation 2 statistics for a sample of 57 single-name 5-year U.S. corporate CDS contracts from 3 Jan 2005 to 30 Dec 2011. Absolute values of t-statistics based on firm- and week-clustered standard errors are contained in parentheses. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)	(4)
Constant	0.203	0.308	0.239	0.216
	(0.62)	(0.70)	(0.73)	(0.66)
ΔTarget		-0.593**	-0.448**	-0.459**
		(2.45)	(2.45)	(2.55)
ΔStD Target		1.644**	1.561**	1.551**
		(2.17)	(2.00)	(2.05)
S&P500 Return	1.740**		1.755**	1.109**
	(2.34)		(2.19)	(2.10)
Stock Return	-0.622		-0.634	
	(1.01)		(0.92)	
ΔSwap Rate	-7.678**		-6.823*	-6.650*
	(2.07)		(1.92)	(1.88)
ΔStock Vol	1.580***		1.535***	1.564***
	(4.17)		(3.89)	(4.14)
Obs.	20038	20528	20034	20034
Adj. R^2	0.062	0.016	0.075	0.074

Table 7
Descriptive Statistics: Crisis Analysis

This table contains descriptive statistics for CDS spreads and their first difference and a selection of their hypothesised determinants across three sub-periods of the sample. The sample contains 57 single-name 5-year U.S. corporate CDS contracts from 3 Jan 2005 to 30 Dec 2011. Pre-crisis is from 3 Jan 2005 until 31 July 2007, Crisis I is from 1 August 2007 until 15 September 2008 and Crisis II is from 16 September 2008 until 30 December 2011.

	Pre-Crisis		**Crisis I**		**Crisis II**	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Panel A: Levels						
CDS	29.98	16.50	64.12	47.68	122.70	153.59
Target	0.43	3.00	0.69	3.82	0.64	9.04
StDTarget	9.73	4.37	9.73	4.86	13.80	11.43
Leverage	0.27	0.20	0.29	0.26	0.85	4.42
Swap Rate	4.94	0.44	4.18	0.55	2.31	0.64
Stock Vol	22.88	5.61	32.29	8.34	37.48	20.53
Panel B: Changes						
ΔCDS	0.01	3.21	1.16	12.40	0.18	41.51
ΔTarget	0.31	1.57	-0.13	1.91	-0.05	2.87
ΔStDTarget	-0.01	1.07	0.05	1.63	-0.01	2.56
Stock Return	0.03	1.29	-0.09	2.08	0.06	2.69
S&P500 Return	-0.00	0.62	-0.11	1.38	0.01	1.39
ΔSwap Rate	0.01	0.10	-0.03	0.16	-0.02	0.16
ΔStock Vol	0.05	1.48	0.19	3.00	-0.06	5.90

Table 8
Determinants of CDS Spread Levels: Crisis Analysis

The results of three regressions of Equation 1 across three sub-periods are contained in this table. Pre-crisis is from 3 Jan 2005 until 31 July 2007, Crisis I is from 1 August 2007 until 15 September 2008 and Crisis II is from 16 September 2008 until 30 December 2011. Absolute value of t-statistics based on firm- and week-clustered standard errors are contained in parentheses, with *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Pre-Crisis: OLS	Crisis I: OLS	Crisis II: OLS	Pre-Crisis: FE	Crisis I: FE	Crisis II: FE
Constant	38.142***	74.977***	-15.350	22.643**	8.317	87.989***
	(3.87)	(3.77)	(0.95)	(2.19)	(0.35)	(3.19)
Target	-0.014	-1.730***	-1.502***	-1.406	-7.368*	-0.083
	(0.06)	(2.76)	(4.20)	(1.00)	(1.88)	(0.33)
StD Target	0.560*	0.540	3.535***	0.313*	0.399	2.974***
	(1.89)	(1.18)	(4.04)	(1.72)	(1.27)	(4.13)
Leverage	23.046***	69.201***	44.138*	15.002*	204.148***	67.897*
	(2.78)	(2.61)	(1.76)	(1.69)	(4.62)	(1.92)
Leverage x Fin dum	-21.367***	14.489	-34.105	-0.252	-84.466*	-62.049*
	(2.62)	(0.63)	(1.41)	(0.03)	(1.70)	(1.80)
5-year Swap Rate	-7.435***	-26.250***	-28.416***	-8.607***	-22.142***	-24.139***
	(4.79)	(7.51)	(6.65)	(6.22)	(6.47)	(6.62)
Stock Vol	0.771***	2.293***	3.600***	1.353***	2.783***	3.267***
	(3.64)	(5.09)	(6.71)	(6.01)	(6.64)	(6.22)
Fixed Effects	No	No	No	Yes	Yes	Yes
Obs.	7352	3191	9688	7352	3191	9688
Adj. R^2	0.255	0.597	0.664	0.694	0.788	0.744

Table 9
Determinants of Changes in CDS Spreads: Crisis Analysis

This table contains the results of estimating Equation 2 across three sub-periods in our sample. Pre-crisis is from 3 Jan 2005 until 31 July 2007, Crisis I is from 1 August 2007 until 15 September 2008 and Crisis II is from 16 September 2008 until 30 December 2011. Absolute value of t-statistics based on firm- and week-clustered standard errors are contained in parentheses, with *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

	Pre-crisis	Crisis I	Crisis II
Constant	0.030	0.790	0.073
	(0.27)	(0.91)	(0.12)
ΔTarget	-0.054	-0.423*	-0.562**
	(1.31)	(1.87)	(2.33)
ΔStD Target	-0.020	0.177	1.909**
	(0.42)	(1.14)	(2.30)
S&P500 Return	-0.155	0.989	2.313**
	(0.79)	(1.03)	(2.37)
Stock Return	0.067	-0.260	-0.844
	(1.01)	(0.68)	(1.05)
ΔSwap Rate	-1.724	-0.097	-9.372*
	(1.37)	(0.02)	(1.80)
ΔStock Vol	0.371***	2.159***	1.516***
	(3.54)	(3.92)	(3.19)
Obs.	7214	3189	9631
Adj. R^2	0.034	0.267	0.075

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