The Drivers of European Credit Spread Changes

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This paper examines the determinants of European credit default swap (CDS) spreads and corporate bond spreads. In line with extant research, a principal components analysis suggests a single large explanatory variable drives much of the spread variation. Our findings based on a combined analysis on a unique date set over a volatile period supports the view that market tradable proxies can explain in excess of 70% of the spread variation. We found that credit ratings were a poor proxy for spread variation./

Key Words: Credit Derivatives, Corporate Bond, Credit Risk

1 Introduction

The yields of corporate bonds are driven by changes in the general bond market and by a credit spread above default free instruments. Credit Risk is one of a number of factors that drive the difference between corporate yields and comparable maturity Treasury yields. Liquidity issues, asymmetric tax status and conversion features are other factors. From an idiosyncratic point of view, the spread itself and what drives it is the subject of much practitioner and academic interest. Movements in corporate bond spreads are important to many investors and potentially informative forward-looking metrics of market sentiment.

In the wake of the credit crisis that began in 2007, we investigate the determinants of credit spread changes in the European Corporate Bond market and to the Euro Credit Default Swap (CDS) market. Our empirical analysis utilizes established proxies for default rates in addition to other market tradeable proxies (e.g. LIBOR-OIS spreads) for default and liquidity. The use of tradable proxies has important implications for bond traders and risk managers. The corporate bond market in the euro zone is very large with a gross outstanding amount of some €7 Trillion in 2009[1]. This is slightly larger than the amount of government debt outstanding in the region and somewhat comparable to the €13 Trillion of outstanding US Corporate Debt[2]. The creation of the single European market in 1999 with one currency and one interest rate has lead to a large increase in the issuance of European corporate bonds. The move from disparate

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economies and regulatory environments has required less of a top-down macroeconomic valuation process and more of a bottom-up relative value analysis. Yet despite these market changes, there appears to be a dearth of quantitative analysis in this market, relative to the US corporate bond market. Indeed, it may be that this paucity of quantitative analysis is a factor in the relative under performance of the European corporate bond funds in recent years (Dietze et al., 2009)

Our work offers several ameliorations over existing literature in this area. We focus on European corporate bond and CDS data, an area that has been under researched at this time. The joint analysis of corporate bonds and CDSs in itself offers new insights into the dynamics of these related markets. This is an important consideration given the perceived close relationship between the two asset types and regulatory concern about the credit derivative market[3]. The data covers a six year period before, during and after the credit crisis. This timeframe tested credit spreads to the extreme and therefore provides a unique opportunity to study the determinants of credit movements. As with previous studies, we carry out linear regressions to determine the relationship between credit spreads, CDS spreads and contemporaneous economic and financial data. By focusing on market traded determinants, we seek to not only provide explanations for credit spread movements but also to demonstrate possible risk management and/or trading opportunities. A principal components analysis (PCA) of the corporate bond credit spread and CDS levels afford a comparative analysis.

Our PCA results show a single factor dominates the spread variations accounting for over 80% of the changes. However, a baseline regression using leverage, volatility and spot interest rates cannot explain more than 60% of the changes. We found that by using tradable proxies, in particular the VIX index, the DJ Stoxx 50 index and LIBOR-OIS spreads, in excess of 70% of the variation could be explained. We also found that rating agency classifications did not explain more than 20% of the spread variation.

2 Literature Review

Structural models (Merton, 1974) view debt, equity, and other claims issued by a firm as contingent claims on the firm's asset value. The moment that a firm defaults is assumed to occur when the value of the firm falls below a certain low threshold. A structural analysis of credit spreads or, the excess interest rate that would be earned if the corporation does not default and the investor holds the bond to maturity, should be a straightforward exercise. Subtract the yields from a large number of corporate bonds from equivalent-maturity default free bonds. The resultant differences reflect the relative health of the underlying firms. These systematic differences should be explainable by general prevailing market conditions. In practice however, it has proven exceptionally difficult.

Investigations of corporate bond yield changes have had some success. Early investigations (Kwan, 1996) found that while Treasury yield changes and stock returns can explain some 60% of investment grade bond yield changes, their explanatory power falls to 5% in explaining credit spread changes. Since the start of the millennium, efforts have been made to investigate the determinants of credit spread changes. Further work (Duffee, 1998) found two commonly used proxies for default and liquidity, the level and slope of the yield curve, could not explain more than 20% of variation in the credit spread. Several financial proxies were examined (Collin-Dufresne et al., 2001) to explain credit spread changes in US corporate bonds. Provokingly, although a single common systematic component was found, none of the candidate proxies could explain more than 25% of this systematic component. Others (Campbell and Taksler, 2003) concluded that firm specific equity volatility is an important determinant of the corporate bond spread and that the economic effects of volatility are important. Recently is has been argued (Cremers et al., 2008) that option-based volatility contains information useful for this type of analysis that is different from historical volatility.

CDSs provide an effective vehicle to trade credit risk. Many corporate bonds are bought by investors who simply hold them to maturity (Alexander et al., 2000). It has also been noted (Schultz, 2001) that secondary market liquidity is often poor, thereby making the purchase of large amounts of credit risk in the secondary cash market difficult and costly. Shorting credit risk is even more difficult in the cash market. Credit derivatives, especially CDSs, allow investors to short credit risk over a longer period of time at a known cost by buying protection.

Relative to the corporate bond market, there is little structural modelling of CDSs but from 2005, researchers (Berndt et al., 2005) used CDS data to study default risk premia finding a strong variation over time in risk premia based on their sample set. A set of simple reduced-form models on market swap quotes and corporate bond quotes was implemented (Houweling and Vorst, 2005) and it was found that bond residuals are strongly relayed with liquidity proxies but this is not the case for CDS residuals. The differences between CDS spreads and corporate bond yield spreads were documented (Longstaff et al., 2005), using various risk-free benchmarks. Assuming that CDS spreads do not contain a liquidity component, they observed that the majority of the corporate bond spread is due to default risk and that the non-default components is time varying and relates to bond specific liquidity issues.

3 Methodology

Model

According to the literature discussed, the credit spread on corporate bonds and on CDS spreads should be driven, at least in part, by the leverage of the underlying firm, the volatility of the underlying share price and the riskless spot

rate. To these variables, we also include an aggregate credit rating index of the European iTraxx constituents, an implied correlation index, the LIBOR-OIS (Overnight Index Swap) Spread, a broad-based European equity index and the Chicago Board Options Exchange (CBOE) Volatility Index (VIX).

Denoting the CDS spread of the i^{th} company at time t by $S_{i,t}$, we conduct a multi-linear regression of the responses in $S_{i,t}$ on the predictors.

$$S_{i,t} = \alpha_i + \sum_{j=1}^{n} \beta_i^j P_{i,t}^j + \varepsilon_{i.t}$$

where α_i is the intercept, β_i^j is the estimated coefficient for the j^{th} predictor on the i^{th} company, $P^j_{i,t}$ is the j^{th} predictor on the i^{th} company and $\varepsilon_{i,t}$ is the error term.

A Principal Components Analysis (PCA) was conducted at various stages of the regressions. We conducted a PCA on the levels of the CDS spreads and the Corporate Bond Spreads. This analysis provides a baseline indication of the scale of the impact of undefined factors on the two asset classes. The objective of this analysis is to find possible candidate proxies from a single regression that would fit the components suggested by the PCA.

Data

We present a summary of data statistics in Table 1 below. The linear correlation coefficients (of the levels) on the right hand side of the table provide some preliminary discussion points. We note the 78.1% correlation between the CDS spreads and the corporate bond spread. The low credit rating correlation is also noteworthy and suggests, at least over the data period, that credit rating agencies might not have been in step with market implied expectations.

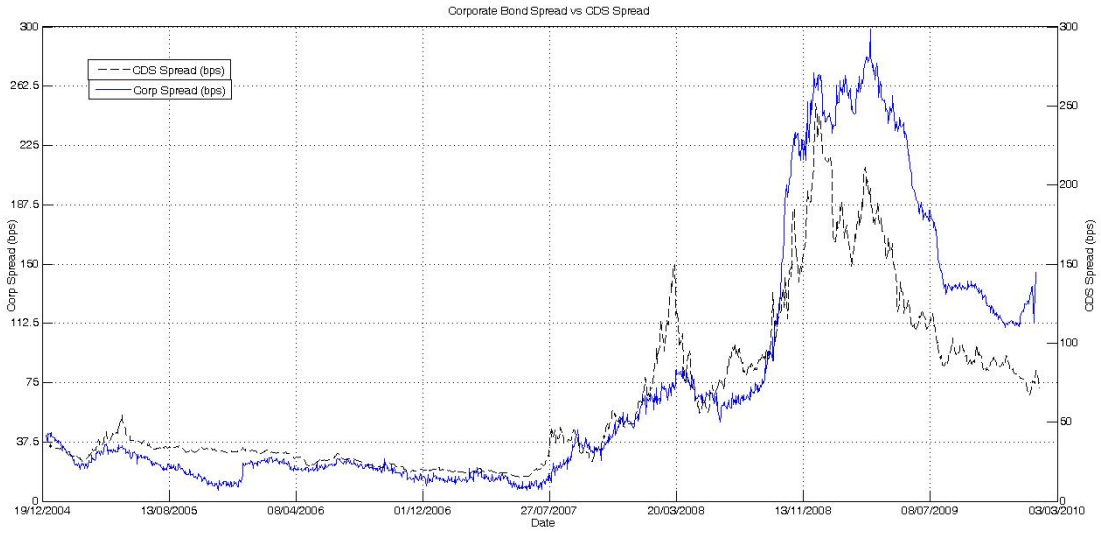
Table 1 - Summary Statistics for all data. The data covers the period Jan 2000 to Jan 2010. Data source: Datastream/Thompson Reuters.

	mean	Stddev	5th percentile	95th percentile	Correlation	
					CDS	Corp. Bond
CDS (bps)	59.96	48.37	18.67	173.54	1.000	0.781
Corp Spd (bps)	55.39	61.06	10.87	234.49	0.798	1.000
Levg. (%)	47.78%	8.43%	37.70%	60.97%	0.482	0.424
GARCH σ	32.62%	7.90%	25.87%	49.47%	0.615	0.335
Rating	20.08%	1.77%	17.25%	23.96%	-0.210	-0.193
Correlation	54.19%	9.84%	39.27%	69.26%	0.795	0.860
VIX	20.26%	8.33%	11.42%	34.82%	0.894	0.743
EU OIS	0.22%	0.31%	0.05%	0.84%	0.818	0.746
DJ STOXX	2,502.31	1,140.19	966.79	4,530.98	-0.752	-0.640
2YR SWP	3.497%	1.021%	1.804%	5.236%	-0.249	-0.444

The most widely traded European CDS index is the iTraxx Europe index and is composed of the most liquid 125 CDS referencing European investment grade

credits. We collected 1 to 10 year CDS spreads on all names from 2004 to 2010. The constituents of the indices are changed every six months, by inference, these are then the most active European CDS names. For the same reference names, we collected data on Euro-denominated non-callable, non-putable zero or fixed coupon bonds. Price data was collected on all issues from the first accrual date up to six month before maturity. The credit spread was calculated as the excess yield of the corporate bond above the 5-year swap rate. The 5-year corporate bond yield was interpolated from our data set where at least two prices existed, one for a maturity greater than 5 years and one for a maturity less than five years. Figure 1 below shows the average corporate bond 5-year spread against the average 5-year CDS spread for the sampled period.

Figure 1 - Historical average CDS spread versus average Corporate Bond Spread



We define the leverage of a company as

$$\frac{\text{Book Value of Debt}}{\text{Market Value of Equity} + \text{Book Value of Debt}}$$

We retrieved these values for all companies in the sample period. Book Values are only available from quarterly reports or, more commonly in Europe, yearly reports, so we use linear interpolation to achieve daily figures.

We used both VIX and forecasted volatility as proxies for idiosyncratic volatility. VIX is the ticker symbol for the Chicago Board Options Exchange (CBOE) Volatility Index, a popular measure of the implied volatility of S&P 500 index options. Often referred to as the fear index, it represents one measure of the market's expectation of volatility over the next 30 day period. The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is a popular model for estimating stochastic volatility.

We use the 2 Year Interest Rate Swap level as a proxy for the default free spot rate. Government securities within the EU suffer liquidity risk which is proportionally related to the size of the public debt when compared to that of Germany (Bernoth et al., 2004). The use of repo rates for CDS (reduced form) valuation is also recommended (Duffie, 1999). The 2 Year rate was chosen as, anecdotally, this is one of the more actively traded terms. We use the CBOE S&P 500 Implied Correlation Index as a diversification proxy. The implied volatility of an index option does not necessarily change in conjunction with corresponding changes in the implied volatility's of index components options. There are times when index option implied volatility moves and there is no corresponding shift in implied volatility's of options on those components. This outcome is due to the market's changing views on correlation.

We constructed a credit rating index for the constituents of the iTraxx index. This was completed by assigning a numeric value to the credit rating of a company The LIBOR-OIS spread is the difference between the LIBOR and the overnight index swap (OIS) rate, and is related to the amount of perceived credit risk in the interbank lending market. The LIBOR-OIS spread is regarded as a good measure of credit risk because the difference between the two rates shows the amount of the interest rate that is being charged for the credit risk. Finally, we used the DJ STOXX 50 Equity Index of European Companies as an broad indicator of market sentiment. This index includes a broad range of European countries and sectors and includes large capitalization companies.

4 Findings

In line with contemporaneous research (Zhang et al., 2009; Ericsson et al., 2009; Cao et al. 2009) we regressed on the levels. Our data has high Durbin-Watson statistics relative to the R-squared values and a commonly presented "rule of thumb" suggests that spurious regressions are accompanied by low Durbin-Watson statistics and high adjusted R-squared values. We first conducted a PCA analysis on the levels of the CDS spreads and the Corporate Bond Spreads with results displayed in Table 2 below. These preliminary results are very much in line with prevailing findings (Collin-Dufresne et al. 2001) in demonstrating a single large determinant dominating the changes in levels.

Table 2 - Principal components analysis on CDS and Corporate Bond levels. The data shown here represents the mean values for analysis conducted on all reference names

Principal Component	CDS	CBS
1	82.44%	78.08%
2	6.25%	5.93%
3	4.65%	3.14%
>3	6.66%	12.85%

A statistical regression was then conducted using only one explanatory variable. These regressions were conducted against each company using the specific

company Leverage, GARCH Volatility, etc. The results are displayed in Table 3 below. We note the consistent performance between CDSs and corporate bond spreads with perhaps the more decisive impact of swap rates on bond spreads. We also note the relatively low impact of credit ratings on spreads while the VIX index, despite the different market, seems to have had a key role in explaining spread variation.

Table 3 - Single Regression Analysis

	Levg.	Garch	Rating	Corr	VIX	L-OIS	Stoxx	Swap
Regression on CDS Levels								
P-val	0.000	0.000	0.052	0.019	0.000	0.000	0.001	0.001
R^2	41.%	47.9%	21.6%	50.9%	63.7%	54.6%	48.6%	7.60%
Nobs	1,365	1,467	1,463	763	1,496	1,471	1,496	1,494
Regression on Corporate Bond Spreads								
P-val	0.0110	0.0011	0.0327	0.0169	0.0037	0.0025	0.0047	0.040
R^2	30.9%	37.5%	19.0%	53.0%	53.7%	45.2%	47.3%	18.4%
Nobs	1,002	1,050	1,083	1,036	1061	1083	1086	1077

We next present results on a baseline case of a regression using leverage, volatility and spot interest rates (Table 4 below). These explanatory variables are often used in extant literature and our purpose here is to gauge their combined strength in the European debt and credit derivative markets. We note that the combined R-squared does not significantly exceed that of the best single explanatory regressions in Table 3.

Table 4 - Baseline Regression using Leverage, Forecasted Volatility and Spot Interest Rates

		CDS	Corp Bond
Baseline Regression			
Coefficients	Constant	-2.0446	-3.4356
	Levg.	41.5428	28.5378
	Garch	2.3384	2.7253
	Swap	-7.5256	-19.0288
t-Stats	Constant	-12.685	-6.836
	Levg.	13.678	9.086
	Garch	16.031	15.629
	Swap	-3.346	-11.056
R^2		**66.31%**	**61.39%**
nobs		1364	998

Based on the tradable nature of the explanatory variables and their R-squared values as single explanatory regressions in Table 3, we conducted a multi-variable regression using VIX, LIBOR-OIS rates and the DJ Stoxx 50 index. The results are presented in Table 5 below. These variables achieved an R-squared value some 10 points higher than the baseline regression. This is particularly significant given that these variables are tradable in option or futures format.

Table 5 - Regression using VIX, LIBOR-OIS Spreads and the DJ Stoxx 50 index

Baseline Regression

		CDS	Corp Bond
Coefficients	Constant	1.2159	1.7962
	VIX	0.0160	0.0170
	L-OIS	0.3360	0.7212
	STOXX	-0.0003	-0.0006
t-Stats	Constant	17.512	17.328
	VIX	7.319	9.137
	L-OIS	9.037	11.378
	STOXX	-20.626	-21.643
R^2		**73.08%**	**72.37%**
nobs		1471	1086

5 Conclusions

The significance of this research lies in the unique comparison of the determinants of both corporate bond spreads and CDS spreads with an emphasis on tradable explanatory variables. The use of a European data set over a prolonged and volatile period adds to the result collection. In line with contemporaneous research, a principal components analysis of both CDS spreads and corporate bond spreads points to a large (>80%) single factor dominating the variation in spread changes.

We found that forecasted (GARCH) idiosyncratic volatility and/or the aggregate implied volatility (VIX) provide a significant explanatory power. It may be that the particularly volatile trading period over which the data was analyzed exacerbated the effect in this case. We also noted that the LIBOR-OIS spread exhibited a noteworthy interpretive value on both the CDS and corporate bond spread. The credit rating variable was quite a weak factor in determining spreads of both asset classes. This may be of particular significance and suggests that, particularly in credit/liquidity crises, market variables have a better ability to imply company credit worthiness.

This paper examined the potential of tradable proxies to explain the variations in CDS spreads and corporate bond spreads. We found that the VIX, LIBOR-OIS Spreads and the DJ Stoxx 50 index were able to explain more than 70% of the variation of CDS and corporate bond spreads. These variables are tradable in option or futures format and their combination exceeds accepted explanatory variables in similar analysis.

EndNotes

1. Source: ECB Statistics. See www.ecb.int

2. Source: Financial Industry Regulatory Authority. See www.finra.org

3. In August 2009, the European Central Bank (ECB) issued a report critical of the CDS market and proposed regulatory and market controls. See: www.ecb.int/pub/pdf/other/creditdefaultswapsandcounterpartyrisk2009en.pdf

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