Original Article

Determinants of credit default swaps spreads in European and Asian markets

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ABSTRACT **This article re-examines the determinants of credit default swaps (CDS) spreads in the United States, Europe and Asia-Pacific markets with new data set using linear regressions. These determinants are categorized into two groups: firm-level and macroeconomic variables. We also include two non-traditional moment risk variables in the analysis as we suspect that these measures may capture the effects of possible extreme downside risk, or extreme negative scenarios, in the underlying credit valuation process. Our findings from the United States and abroad confirm the existing evidence on the significant relationship between theoretical determinants of default risk and actual market pricing of CDS. In addition, we provide additional evidence on the importance of the**

interaction between macroeconomic and firm-specific variables, which is common throughout the world.

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Keywords: credit default swap; credit risk; CDS spreads; market conditions

INTRODUCTION

A single-name credit default swap (CDS) is an insurance-like contractual agreement to transfer the default risk of one or more reference entities from one party to the other. In principle, CDS contracts allow financial institutions and investors to manage their investment portfolios of credit risks more efficiently. Over the last decade, the market for CDS has ballooned and a great deal of this demand has been fueled by commercial banks, investment banks, insurance companies and speculative investors as they try to hedge their underlying risky bond and loan exposures at a lower cost, or to take advantage of the short-term price movement. According to Greenspan, 'the new instruments of risk dispersion have enabled the largest and most sophisticated banks in their credit-granting role to divest themselves of much credit risk by passing it to institutions with far less leverage' (Greenspan, 2004).

Furthermore, the CDS market has been largely unregulated – no standard contract, no standard capital requirement, no uniform methodology of valuating securities, and detailed transactions are not required to be disclosed publicly – that will change since the former US Treasury Secretary Tim Geithner spearhead the effort to put trading in the CDS and other over-the-counter derivatives markets on the same footing as stocks (Geithner, 2009). The rapid development and the current lax regulation of the CDS market contributed to the recent financial crisis and also raised a number of policy concerns about the market stability. These issues have a significant impact on the evaluation of investors' portfolio risk and, hence, the pricing performance of CDS contracts, or the CDS spreads.

Presently, the literature on pricing of CDS has not been consistently documented. In a macroeconomic sense, we look at risk exposures to changes in aggregate and fundamental economic factors as a whole, or the financial markets and the banking sector in particular. If the execution of CDS is triggered by credit events, then, on a macro scale, we might want to consider what would be more likely to influence the incidence of these events (Weithers, 2007). Many papers have considered aggregate economic variables as potential explanatory variables of credit conditions. For example, they incorporate the aggregate level of interest rates, leverage, inflation, unemployment, consumer confidence, aggregate measures of indebtedness, nominal and real GDP growth rates, changes in GDP growth rates, national savings rates, market liquidity premiums, the ratio of high yield debt to total debt outstanding, and returns as well as volatility of equity indices (Imbierowicz, 2009; Pu and Zhao, 2010; Tang and Yan, 2008).

In addition, these variables are examined in conjunction with a number of firm-specific factors as well as industry-, sector- and/or geography-fundamentals, such as the degree of corporate leverage, the ratio of free operating cash flow to total debt, Earnings Before Interest and Taxes/Earnings Before Interest, Taxes, Depreciation and Amortization (EBIT/EBITDA), Return On Assets (ROA), Return On Equity (ROE), dividend payout, interest coverage multiples, earning forecast, industrial production percentage, liquidity, treasury yields, option-implied volatility, jump risk, systematic risk, default probability and credit rating (Ericsson *et al*, 2004; Hull *et al*, 2004; Longstaff *et al*, 2005; Tang and Yan, 2006; Cremers *et al*, 2008; Li, 2007; Imbierowicz, 2009; Pu and Zhao, 2010; Tang and Yan, 2008; Zhang *et al*, 2009).

Interestingly, results of the empirical importance of macroeconomic and firm-specific variables on CDS market have been mixed. Altman *et al* (2005) find that firm-specific variables add little in terms of explanatory power or incremental statistical significance to the CDS spread. On the other hand, Tang and Yan (2006) investigate the dynamics of firm-level credit spreads by highlighting the role of a firm's cash flow beta that measures its exposure to the macroeconomic risk. They show that incorporating macroeconomic influence on firms' cash flow process significantly helps improve the fit of default probabilities and credit spreads, even in the absence of a complicated preference structure and a jump component in the firm's cash flow process. Furthermore, Ericsson *et al* (2004) find that theoretical determinants of default risk such as firm leverage, volatility and the riskless interest rate explain around 60 per cent of CDS spreads. Zhang *et al* (2009) focus on the effects of equity volatility and jump risks on CDS spreads. They find that volatility risk alone predicts 50 per cent of the variation in CDS spreads, while jump risk alone forecasts 19 per cent. Cremers *et al* (2008) instead rely on option-implied jump risk measures and find some positive evidence.

Moreover, some researchers investigate how macroeconomic variables affect business default risk. Carling *et al* (2007) find that the output gap, the yield curve and consumers' expectations of future economic development can help to explain firms' default risk. In contrast, Duffie *et al* (2007) find that default intensity is significantly negatively related to the short-term interest rate and positively related to the S&P 500 index. They also find that Treasury yield, Aaa-Baa bond yield spread, personal income growth, GDP growth rate and industry-average time to default are not significant in predicting defaults. Couderc and Renault (2005) find that default intensity is positively related to market volatility, the term spread, the spread of Bbb bond over Treasury bond and Aaa-Baa bond yield spread, and negatively related to the market return, Treasury yield, GDP growth rate, industrial production growth rate, inflation and personal income growth. Their findings on market return are intuitive but different from Duffie *et al* (2007) and Lando and Nielsen (2010). However, their findings of negative relations between default intensity and both BBB spread and inflation are counterintuitive. A summary of the above literature review is presented in Table 1.

To address these inconclusive findings, we propose a novel empirical approach to explain the CDS premiums, using already proven variables that have been consistently found in several studies along with two non-traditional moment risk measures – equity kurtosis as defined in Dittmar (2002) and equity skewness as defined in Harvey and Siddique (2000). This article specifically contributes to the

Table 1: A summary of literature review on the determinants of CDS spreads

Study	*Findings*
Hull *et al* (2004)	The theoretical relationship between credit default swap (CDS) spreads and bond yield spreads holds fairly well
Blanco *et al* (2005)	CDS prices are better integrated with firm-specific variables in the short run and with market variables in the long run
Ericsson *et al* (2004)	Firm leverage, volatility and riskless interest rate are statistically and economically significant determinants of CDS spread whether you estimate on levels or differences and regardless of the econometric methodology
Longstaff *et al* (2005)	The paper uses CDS data to obtain direct measures of the size of the default and non-default components in corporate spreads and finds that the majority of the corporate spread is due to default risk. This result holds for all rating categories and the riskless curve
Altman *et al* (2005)	Firm-specific variables add little in terms of explanatory power or incremental statistical significance to the CDS spread
Tang and Yan (2006)	The paper constructs liquidity proxies to capture various aspects of CDS liquidity and examines its impact with adverse selection and inventory constraints. They find that both liquidity level and liquidity risk are significant factors in determining CDS spreads
Cremers *et al* (2008)	Option-implied jump risk measures explain a significant part of observed credit spread as measured by CDS spread
Tang and Yan (2008)	Macroeconomic conditions have a significant impact on CDS spreads. Also, it provides further evidence on the importance of the interaction between market conditions and firm-specific characteristics
Imbierowicz (2009)	The paper suggests that portfolio positions have to be evaluated constantly and related to their truly fundamental value, otherwise you risk mispricing, and that present structural pricing models do not capture all important factors on CDS and that we must consider the importance of forward-looking macro-indicators as well as liquidity measures and the incorporation of implied volatilities
Li (2007)	Systematic risk proportion has a negative and significant effect on the CDS spreads after including variables that are suggested by theories of default risk and the extant empirical evidence. In other words, the composition of the total risk does matter for CDS pricing
Pu and Zhao (2010)	Linear combination of observable variables at the firm, industry and market level, as well as macroeconomic variables, cannot fully explain the correlation in credit risk. However, inclusion of higher-order and interactive terms of the observable variables can fully eliminate the correlation in regression residuals. Thus, the relation between observable variables and credit risk is nonlinear
Zhang *et al* (2009)	Volatility and jump risk measures as well as macroeconomic conditions and firm's balance sheet information have significant impact on CDS spreads

literature of CDS spreads in four ways. First, we reinvestigate the theoretical determinants of CDS premiums that appeared in numerous studies and make a sound judgment only on those variables that have been consistently documented. Second, we incorporate two non-traditional moment risk variables in our analysis to explain CDS spread variation. We suspect that these measures may capture the effects of possible extreme downside risk (EDR), or extreme negative scenarios, in the underlying credit valuation process. Third, we examine, compare and interpret empirical results from the United States, Europe and Asia-Pacific markets. Last, we extend the CDS data to more recent periods from Thomson-Reuters.

We confirm the existing evidence from the United States and abroad on the significant relationships between theoretical determinants of default risk and actual market pricing of CDS. Also, we provide additional evidence on the importance of the interaction between macroeconomic and firm-specific variables, which is common throughout the world.

The remainder of the article proceeds as follows. The section 'CDS mechanics and risks' provides a brief description of credit default swaps (CDS) and risks associated with trading in the CDS market. The section 'Determinants of CDS spreads: theoretical and empirical evidence' discusses the extent of theoretical and empirical impacts of changes in the macroeconomic and firm-specific variables on the determinants of CDS. We describe the data in the section 'Data' and the empirical models in the section 'The models'. We analyze the statistical results in the section 'Analysis of results' and conclude the paper in the section 'Conclusions'.

CDS MECHANICS AND RISKS

How CDS work?

CDS, insurance-like contractual agreement that guarantees to cover losses on specific securities in the event of a default, allow the transfer of default risks of one or more reference entities[1] from one party to the others (Figure 1 shows how CDS are often likened to 'financial credit insurance' (Weithers, 2007)). Mengle (2007) simply describes how CDS work as follows: one party, the protection buyer, pays premiums to the other party, the protection seller, until the maturity date of the CDS contract or until a credit event (for example, restructuring, bankruptcy, default and/or credit rating downgraded) of the reference entity occurs. This periodic payment, in basis points, is called the CDS spread. *Ceteris paribus*, a company with a higher CDS spread is considered more

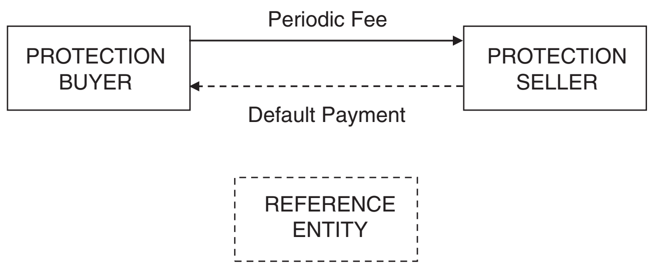

Figure 1: Credit default swap.

likely to default by the market, as a higher fee is being charged to protect against default risk. If the reference entity defaults, declares bankruptcy or experiences rating downgrade, the protection seller guarantees to pay compensation to the protection buyer for the loss by means of a specified settlement procedure (for example, cash and/or physical settlement[2]). The protection buyer is entitled to protection on a specified face value, or the notional amount, of reference entities' debt securities. The protection seller essentially provides the 'insurance' and compensates the buyer for losses. The reference entity is not necessarily a party to the CDS contract, and the buyer or seller does not need to obtain the reference entity's permission to enter into the agreement.

Risks associated with CDS

Mengle (2007) explains CDS risks as follows. Similar to options, there exists an asymmetrical risk in CDS taken on by the protection buyer and protection seller. By insuring that losses will be covered if a default happens, the protection buyer takes on a short position in the credit risk of the reference entity, thus effectively relieving the exposure to default. In addition, by giving up reference entity credit risks, the protection buyer in effect foregoes the opportunity to profit from exposure to the reference entity. In return, the buyer takes on counterparty risks[3]; more specifically, (i) counterparty default exposure to simultaneous default by the reference entity and the protection seller, also called double default, and (ii) counterparty replacement risk of the protection seller's default. Furthermore, the protection buyer assumes basis risk to the extent that the reference entity specified in CDS does not precisely match the hedged asset. For example, a bank hedging a loan might buy protection on a bond issued by the borrower instead of negotiating a more customized and less liquid CDS-linked loan.

On the other hand, the protection seller takes on a long position in the credit risk of the reference entity, which is comparable to taking on the default risk of a loan lending directly to the reference entity. The protection seller also assumes counterparty credit risk because the seller will lose expected premium income if the protection buyer defaults.

Other risks to consider are business cycle risk, rating agency risk and settlement risks (Gibson, 2007). Business cycle risk poses a problem when it turns after the peak period of low interest rates, greater availability of credit supply and lessened lending requirements that follows the contraction period. Consequently, as default rates increase and values of debt securities fall rapidly, investors will question whether those parties holding CDS insurance would have the financial resources to pay up in the event of mass defaults. The CDS market is also sensitive to credit ratings. Rating agencies provide credit ratings for investors as an efficient and cost-effective way to evaluate their investment alternatives and for issuers as independent assessors of credit worthiness of companies' debt securities. Yet, some firms invested significantly in the credit market despite understanding very little how rating agencies assign ratings to specific debt instruments and what circumstances would trigger a recommendation to downgrade ratings. Besides, there is an issue with which risk measure used by rating agencies is superior. Clearly, credit rating agency is a double-edged sword. In addition to the aforementioned risks, there is a challenge when the amount of CDS protection

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outstanding far exceeds the supply of referencing debts. A problem could arise if a series of a credit event were to occur simultaneously and the ability of protection buyers to deliver traditional physical settlement, or bonds, in exchange for par comes into question. Since a settlement must occur within a fixed time frame after a default, if a buyer fails to achieve a physical settlement by the deadline, the CDS contract expires worthless. This situation has the potential to affect the price of CDS before a credit event, making CDS less attractive as a risk-shifting instrument and distorting the price signals that CDS provides to the market. As a result, some market participants try to avoid this settlement risk by considering cash settlement as an alternative, especially for cases of index trades (Mengle, 2007). However, the fact that different auctions use different designs to determine a post-default market value of debt securities, cash settlement generated in an auction can vary greatly.

DETERMINANTS OF CDS SPREADS: THEORETICAL AND EMPIRICAL EVIDENCE

This article analyzes the theoretical determinants of CDS premiums using linear regressions. These determinants are categorized into two groups: firm-level and macroeconomic variables. At the firm level we have leverage, equity volatility, ROE, dividend payout and credit rating. Using macroeconomic conditions, we analyze the effect of inflation, consumer sentiment, implied volatility, index return and the short-term interest rate on CDS pricing. In addition, we include two EDR variables, equity kurtosis and equity skewness, to account for the extreme nature of CDS. The theoretical predictions of the effects of explanatory variables on CDS premiums are summarized in Table 2.

We first discuss the most commonly observed firm-level variables as mentioned previously. A firm with significantly more debt than equity on its balance sheet is considered to be highly leveraged, thus the more levered the firm, the higher the probability of default. Similarly, we expect a higher dividend payout ratio to translate to higher default risk as it reflects a decrease in asset value. The volatility of the underlying assets indicates the uncertainty of the security's value, thus higher equity volatility means higher default risk. The opposite is true for the firm's stock return, as a higher growth in firm earnings implies the lower probability of default. The credit rating information is another important factor in determining CDS spreads (Cossin and Hricko, 2001). Tang and Yan (2008), however, use Moody's KMV Expected Default Frequency (EDF), instead of Moody's and S&P credit ratings, as a measure of default probability. They claim that EDF has the advantage of being frequently updated of credit conditions as the indicator is based on the stock price of the reference firm.

For the time-series macroeconomic data, we expect that CDS spreads are decreasing with the consumer sentiment. We also include inflation among our list of macroeconomic variables. As inflation triggers a brake on real activity, we expect a positive relation between inflation and credit spread. These predictions are consistent with the empirical evidence that credit spreads increase during economic downturns and decrease during the upturns and that credit spreads depend on investors' risk attitude and their uncertainty about

Table 2: Theoretical predictions of the effects of structural variables on CDS spreads

Variable	*Sign*	*Intuition*	*Data source*
Firm-level leverage	+	A firm with significant debt on its balance sheet is considered to be highly leveraged, thus the more levered the firm, the higher the default risk	Compustat
Firm's equity volatility	+	The volatility of the underlying assets reflects the uncertainty of the security's value, thus higher equity volatility means higher default risk	The Center for Research in Security Prices (CRSP)
Firm's ROE	−	A higher profitability in firm implies the lower probability of default	Compustat
Dividend payout	+	A higher dividend payout ratio to translate to higher default risk as it reflects a decrease in asset value	Compustat
Credit rating	−	Better credit rating means lower default probability	S&P Rating
Inflation	+	Inflation triggers a brake on real activity, thus we expect a positive relation between inflation and CDS spread	Federal Reserve Board (FRB)/ ECB/World Databank
Consumer sentiment	−	Credit spreads depend on investors' risk attitude and their uncertainty about the prospect of the economy	University of Michigan
Implied volatility	+	Economic conditions are improved when market volatility is low	Chicago Board Options Exchange/ECB/World Databank
Index return	−	Economic conditions are improved when market return is high	CRSP/Morgan Stanley Capital International (MSCI) Barra/ World Databank
Short-term interest rate	+/−	The theoretical model of credit risk usually predicts a negative relationship between short-term interest rate and default risk, indicating an improving economic activity. However, an increase in short-term risk-free rate could mean a tightened monetary policy, and therefore default risk increases	FRB/ECB/World Databank
Equity skewness	−	Harvey and Siddique (2000) show that more negative equity skewness is rewarded with higher average return, hence narrower credit spreads	CRSP
Equity kurtosis	+	Dittmar (2002) observes higher kurtosis with more extreme movements in equity return, suggesting a positive relationship	CRSP

Notes: This table outlines the hypothesized relationship of the determinants of CDS spreads used in this article.

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the prospects for the economy (Imbierowicz, 2009; Pu and Zhao, 2010; Tang and Yan, 2008; Zhang *et al*, 2009). Moreover, we predict that credit spreads are positively related to the option-implied volatility and market leverage, and negatively related to market index return (as measured by the NYSE/AMEX/NASDAQ value-weighted returns). These are also consistent with empirical results (Ericsson *et al*, 2004; Pu and Zhao, 2010; Tang and Yan, 2008; Zhang *et al*, 2009), and indicate that economic conditions are improved when market volatility and leverage are low and market return is high.

To observe an industry effect, a few studies incorporate industry-level variables as determinants of CDS spreads. Although these studies hypothesize that industry effects may be partially responsible for credit spreads, there has yet to be conclusive evidence in the issue. Though, Pu and Zhao (2010) confirm the existence of an industry effect and find that it can only be responsible for less than 1 per cent of the correlation in CDS spread changes. Some industry variables that have been used in determining CDS premiums are changes in industry volatility, changes in industry leverage and changes in aggregate industry returns. Similar to the market level, the same intuition can be applied at the industry level if there is an industry effect.

In addition, the level of short-term interest rate has a significant impact on the security's value. An increase in this variable will tend to decrease risk-adjusted default probabilities and also credit spreads as it proxies for business economic cycles. The theoretical model of credit risk usually predicts a negative relationship between short-term interest rate and default risk. For example, an increase in short-term risk-free rate could mean a tightened monetary policy, and therefore default risk increases. Moreover, although the short-term interest rate is critical in many structural models, the process that establishes the spot rate may depend on other factors such as the slope of the term structure (Ericsson *et al*, 2004).

Finally, among the traditional firm-specific and macroeconomic variables, we incorporate two moment risk measures to be used in capturing catastrophic risks, or EDR: (i) equity skewness constructed according to Harvey and Siddique (2000) and (ii) equity kurtosis as defined in Dittmar (2002). Harvey and Siddique (2000) show that more negative equity skewness is rewarded with higher average return, and hence narrower credit spreads. Dittmar (2002) observes higher kurtosis with more extreme movements in equity return, suggesting a positive relationship. However, a high kurtosis with a 'peaked distribution' should indicate infrequent extreme deviations. Thus, if an equity kurtosis is high in a given month, investors should be more confident in that stock price due to less movement, suggesting a negative relationship with the CDS premium.

DATA

In our analysis using only foreign CDS quarterly data, we include only those 5-year CDS terms having at least 1 year of CDS premium data, excluding banks and financial services firms. We assign countries relevant to their geographic locations into two regions: Europe and Asia-Pacific. Europe has 116 firms from Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherland, Norway, Portugal, Spain, Sweden, Switzerland

Table 3: Region analysis – Europe and Asia-Pacific

REGION	*COUNTRIES*	*Number of companies*
Europe	Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherland, Norway, Portugal, Spain, Sweden, Switzerland and UK	116
Asia-Pacific	Australia, China, Hong Kong, Indonesia, Japan, New Zealand, Philippines, Singapore and South Korea	44

Notes: Two categories are designed for the regression analysis of the foreign CDS data. The first region contains European countries. The second region covers most Asia-Pacific countries. The total number of companies included in each region is also presented.

and United Kingdom. Asia-Pacific has 44 firms from Australia, China, Hong Kong, Indonesia, Japan, New Zealand, Philippines, Singapore and South Korea. We obtain firm-specific data (leverage, equity volatility, ROE, dividend payout, equity skewness and equity kurtosis) from CRSP and Compustat. Foreign macroeconomic variables[4] (inflation, implied volatility, index return and short-term interest rate) are acquired from European Central Bank's (ECB) Statistical Data Warehouse, World Databank and MSCI Barra websites. However, we do not include consumer sentiment as an independent variable in this analysis as there is no reliable and sufficient data for the majority of those countries. Table 2 summarizes all data definition and data sources. Table 3 presents countries and number of companies assigned to each region.

THE MODELS

Fixed-effect and OLS regressions

We carry out both the fixed-effect and OLS regressions to determine the association and significance of theoretical determinants of CDS premiums. The function is given below:

$$
\begin{aligned}
CDS_{premium} = f(&Firm - Level\ Leverage,\\
&Firm - Level\ Volatility,\ ROE,\\
&Dividend\ Payout,\ Credit\ Rating,\\
&Inflation,\ Consumer\ Sentiment,\\
&Implied\ Volatility,\ Index\ Return,\\
&Short - Term\ Interest\ Rate,\\
&Equity\ Skewness\ and\ Equity\ Kurtosis), \quad (1)
\end{aligned}
$$

Firm-Level Leverage is the leverage ratio. Firm-Level Equity Volatility is the firm's monthly equity volatility (percentage) computed from historical daily stock prices calculated over each year during our study period. ROE is a firm's monthly total return on security. Dividend Payout is dividend payout ratio. Credit Rating is obtained from S&P and assigned a numerical value (see Table 4 for the conversion from letter to numerical scale). Inflation is a percentage change in Consumer Price Index (CPI). Implied Volatility is S&P 500 implied volatility. Index Return is a percentage change in NYSE return (as all the indices have a high correlation, we avoid a multicollinearity problem by choosing the index with the highest correlation to the CDS premium). Short-term interest rate is 3-month Treasury bill rate. Equity

Table 4: S&P Ratings – conversion from letter to numeric scale

S&P Rating conversion	
Investment grade	*Numerical grade*
AAA	22
AA+	21
AA	20
AA−	19
A+	18
A	17
A−	16
BBB+	15
BBB	14
BBB−	13
BB+	12
BB	11
BB−	10
B+	9
B	8
B−	7
CCC+	6
CCC	5
CCC−	4
CC	3
C	2
D	1

Notes: The sovereign ratings issued by S&P are converted to a numerical scale, with 1 denoting the lowest investment grade to 22 denoting the highest.

skewness and equity kurtosis are monthly figures computed from historical daily stock prices.

Table 5: Cross-sectional analysis of CDS premiums (Europe) using OLS

	CDS premium	
	Coefficient	*t-stat*
Firm-Level Leverage	1.11	3.36*
Firm-Level Volatility	4.48	3.29*
Firm-Level ROE	−7.89	−2.11**
Dividend Payout	3.64	2.15**
Credit Rating	−3.71	−2.69*
Inflation	0.20	1.48
Implied Volatility	0.95	1.95
Index Return	−2.57	−2.02**
Short-Term Interest Rate	−3.18	−2.38**
Equity Skewness	−4.78	−1.71
Equity Kurtosis	1.89	1.28

* and ** indicate significance at 1 per cent and 5 per cent levels, respectively.

Notes: The table reports the results of a regular OLS regression based on quarterly data for 116 European firms from 1 January 2003 to 1 May 2009. Firm-Level Leverage is the leverage ratio. Firm-Level Equity Volatility is the firm's quarterly equity volatility (%) computed from daily stock prices. ROE is a firm's quarterly total return on security. Dividend Payout is dividend payout ratio. Credit Rating is obtained from S&P and assigned a numerical value. Inflation is a weighted-average percentage change in CPI. Implied Volatility is Eurex Generic 1st RX Futures (Euro implied bond volatility). Index Return is a percentage change in MSCI Europe Index. Short-term interest rate is the ECB short-term rate. Equity skewness and equity kurtosis are quarterly figures computed from daily stock prices.

ANALYSIS OF RESULTS

Tables 5 and 6 present the results from the Europe region using OLS and fixed-effect techniques accordingly. Tables 7 and 8 report the results from the Asia-Pacific region using OLS and fixed-effect techniques accordingly.

We first analyze CDS markets in the Europe region using OLS in Table 5. We observe a

Table 6: Cross-sectional analysis of CDS premiums (Europe) using fixed-effect regression

	CDS premium	
	Coefficient	*t-stat*
Firm-Level Leverage	2.66	4.49*
Firm-Level Volatility	3.74	3.72*
Firm-Level ROE	−6.75	−2.08**
Dividend Payout	2.47	2.07**
Credit Rating	−2.26	−3.27*
Inflation	1.57	1.99**
Implied Volatility	0.75	2.56*
Index Return	−2.01	−2.67*
Short-Term Interest Rate	−3.18	−2.49*
Equity Skewness	−2.18	−1.37
Equity Kurtosis	2.07	1.78

* and ** indicate significance at 1 per cent and 5 per cent levels, respectively.

Notes: The table reports the results of a fixed-effect regression based on quarterly data for 116 European firms from 1 January 2003 to 1 May 2009. Firm-Level Leverage is the leverage ratio. Firm-Level Equity Volatility is the firm's quarterly equity volatility (%) computed from daily stock prices. ROE is a firm's quarterly total return on security. Dividend Payout is dividend payout ratio. Credit Rating is obtained from S&P and assigned a numerical value. Inflation is a weighted-average percentage change in CPI. Implied Volatility is Eurex Generic 1st RX Futures (Euro implied bond volatility). Index Return is a percentage change in MSCI Europe Index. Short-term interest rate is the ECB short-term rate. Equity skewness and equity kurtosis are quarterly figures computed from daily stock prices.

Table 7: Cross-sectional analysis of CDS premiums (Asia-Pacific) using OLS

	CDS premium	
	Coefficient	*t-stat*
Firm-Level Leverage	1.68	1.31
Firm-Level Volatility	1.39	2.56*
Firm-Level ROE	−2.21	−1.38
Dividend Payout	0.01	0.88
Credit Rating	−2.16	−1.17
Inflation	0.46	2.17**
Implied Volatility	0.25	1.36
Index Return	−2.62	−2.45**
Short-Term Interest Rate	−1.34	−2.69*
Equity Skewness	−1.07	−0.26
Equity Kurtosis	0.91	0.05

* and ** indicate significance at 1 per cent and 5 per cent levels, respectively.

Notes: The table reports the results of a regular OLS regression based on quarterly data for 44 Asia-Pacific firms from 1 January 2003 to 1 May 2009. Firm-Level Leverage is the leverage ratio. Firm-Level Equity Volatility is the firm's quarterly equity volatility (%) computed from daily stock prices. ROE is a firm's quarterly total return on security. Dividend Payout is dividend payout ratio. Credit Rating is obtained from S&P and assigned a numerical value. Inflation is a weighted-average percentage change in CPI. Implied Volatility is a weighted-average volatility computed from non-guaranteed long-term debt from bonds that are privately placed in each country. Index Return is a percentage change in MSCI Pacific Index. Short-term interest rate is a weighted-average lending interest rate from each country. Equity skewness and equity kurtosis are monthly figures computed from daily stock prices.

positive and significant effect at the 1 per cent level from firm-level leverage ratio and equity volatility with CDS premiums. Dividend payout ratio is positively significant at the 5 per cent level. Furthermore, we detect a negative and significant effect at the 1 per cent level only from

Table 8: Cross-sectional analysis of CDS premiums (Asia-Pacific) using fixed-effect regression

	CDS premium	
	Coefficient	*t-stat*
Firm-Level Leverage	1.23	1.94
Firm-Level Volatility	1.07	2.48*
Firm-Level ROE	−1.75	−2.02**
Dividend Payout	0.74	1.71
Credit Rating	−1.11	−2.60*
Inflation	0.20	2.26**
Implied Volatility	0.68	1.76
Index Return	−1.36	−2.57*
Short-Term Interest Rate	−3.73	−2.49*
Equity Skewness	−0.84	−0.18
Equity Kurtosis	1.03	0.47

* and ** indicate significance at 1 per cent and 5 per cent levels, respectively.

Notes: The table reports the results of a fixed-effect regression based on quarterly data for 44 Asia-Pacific firms from 1 January 2003 to 1 May 2009. Firm-Level Leverage is the leverage ratio. Firm-Level Equity Volatility is the firm's quarterly equity volatility (%) computed from daily stock prices. ROE is a firm's quarterly total return on security. Dividend Payout is dividend payout ratio. Credit Rating is obtained from S&P and assigned a numerical value. Inflation is a weighted-average percentage change in CPI. Implied Volatility is a weighted-average volatility computed from non-guaranteed long-term debt from bonds that are privately placed in each country. Index Return is a percentage change in MSCI Pacific Index. Short-term interest rate is a weighted-average lending interest rate from each country. Equity skewness and equity kurtosis are monthly figures computed from daily stock prices.

credit rating and at the 5 per cent level from ECB short-term interest rate and index return. On the other hand, after running a regression using a fixed-effect procedure, in Table 6, we notice an increase in positive significance at 1 per cent and 5 per cent levels for firm-level leverage, equity volatility, inflation and implied volatility (proxied by Eurex Generic 1st RX Futures). In addition, there is an increase in negative significance at the 1 per cent level for credit rating, short-term interest rate and index return (proxied by MSCI Europe Index). The predicted signs on coefficients of these significant variables are consistent with theoretical hypotheses. In both regressions, though, EDR variables provide no statistical significance. We notice that firm-level ROE, dividend payout and inflation are significant at the 5 per cent level in the European region. Thus, we derive in the case of Europe that at the firm level, leverage, volatility, ROE, dividend payout and credit rating variables do help explain CDS premiums. And at the macro level, there is a strong impact on CDS premiums via short-term interest rate, index return, implied volatility and inflation.

Next we analyze a smaller segment of CDS markets in the Asia-Pacific region. From Table 7, an OLS regression shows that equity volatility is the only firm-specific variable that has a positive significant relationship at the 1 per cent level with CDS premiums. Using macroeconomic conditions, we find that weighted-average inflation and percentage change in index return (proxied by MSCI Pacific Index) are significant at the 5 per cent level and that weighted-average short-term interest rate is significant at the 1 per cent level, consistent with their hypothesized signs, in explaining the CDS premium. We further run a more robust regression procedure using a fixed-effect technique in Table 8, and find similar results with the exception of ROE and credit rating variables now become negatively significant at 5 per cent and 1 per cent levels, respectively. We observe no change in the level of significance for inflation and weighted-average short-term interest rate in the fixed-effect regression; however, a percentage change in index return is proved to be more significant at the 1 per cent level. Again, both EDR variables do not have statistically significant effect on CDS pricing in the region.

In the case of Europe region, firm leverage, dividend payout and implied volatility are also important in determining CDS pricings but the same cannot be said for Asia-Pacific. Those measures that are significant at the 1 per cent level in explaining CDS premiums in the Asia-Pacific region are firm-level equity volatility, credit rating of firms, percentage change of weighted-average index return and weighted-average short-term interest rate. These observations may suggest the stronger influence of foreign investors in emerging markets as they give more weight on macroeconomic conditions and credit risk of firms based on equity volatility as well as credit rating.

CONCLUSIONS

This article empirically investigates the theoretical determinants of CDS spreads in Europe and Asia-Pacific markets with an extended CDS data set and incorporates those proven variables from various studies in linear regressions. These determinants are categorized into two groups: firm-level and macroeconomic variables. At the firm level we have leverage, equity volatility, ROE, dividend payout and credit rating. Using macroeconomic conditions, we analyze the effect of inflation, implied volatility, index return, and short-term interest rate on CDS pricing. In addition, we include two EDR variables, equity kurtosis and equity skewness, to account for the extreme nature of CDS.

We look at the relationship between CDS spreads and theoretical determinants in the Europe and Asia-Pacific region. We find that certain firm-specific characteristics, such as equity volatility, ROE and credit rating, and macroeconomic indicators, such as inflation, index return and short-term interest rate, do help explain CDS pricing. Again, both EDR variables do not have statistically significant effect on CDS premiums in the region. The macroeconomic conditions and credit risk of firms based on equity volatility as well as credit rating play a more important role in determining CDS premiums in Europe and Asia-Pacific region.

Our findings from the international market confirm the existing evidence on the significant relationship between theoretical determinants of default risk and actual market pricing of CDS. Also, we provide additional evidence on the importance of the interaction between macroeconomic and firm-specific variables, which is common throughout the world. Therefore, serving as a reference for future CDS pricing research this article suggests that a linear combination of observable determinants at the firm- and macro-level can help explain CDS premiums. Finally, we show that different markets will require a different set of independent variables to be incorporated in an empirical analysis.

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NOTES

1 Reference entities, also known as a basket, are risky corporations on which credit protections are written.

2 If the contract calls for physical settlement, the protection buyer delivers to the protection seller the reference entity's defaulted debt security with a face value equal to the notional amount specified in CDS. In return, the protection seller pays to the buyer the par value, or the face amount, of the debt.
If the contract calls for cash settlement, the protection seller is obligated to pay the difference between the par value and the post-default market value of the reference entity's defaulted bonds (Mengle, 2007).
An auction of the defaulted bonds will determine the post-default market value.

3 Counterparty credit risk is the risk that the party on the other side of the derivative will fail to perform on the term of the contract (Gibson, 2007).

4 Europe region (quarterly): 'Inflation' is a weighted-average percentage change in CPI. 'Implied Volatility' is Eurex Generic 1st RX Future (Euro implied bond volatility). 'Index Return' is a percentage change in MSCI Europe Index. 'Short-term interest rate' is the ECB short term rate. Asia Pacific region (quarterly): 'Inflation' is a weighted-average percentage change in CPI. 'Implied Volatility' is a weighted-average volatility computed from non-guaranteed long-term debt from bonds that are privately placed in each country. 'Index Return' is a percentage change in MSCI Pacific Index. 'Short-term interest rate' is a weighted-average lending interest rate from each country.

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