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FUNDACIÓN DE LAS CAJAS DE AHORROS
DOCUMENTO DE TRABAJO
Nº 736/2013

De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

ISSN: 1988-8767

La serie **DOCUMENTOS DE TRABAJO** incluye avances y resultados de investigaciones dentro de los programas de la Fundación de las Cajas de Ahorros.
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DETERMINANTS OF EUROPEAN BANK CDS SPREADS IN TIMES OF CRISIS

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Abstract

Since the beginning of the financial crisis, the credit default swap (CDS) spreads of the European banks have severely increased. This paper empirically analyzes the determinants of CDS spreads of a sample of 45 European banks over the 2004-2010 period. We use variables related to accounting- and market-based data, an indicator of liquidity in the CDS market and several proxy variables for the macroeconomic environment in which these financial institutions operate. These variables were also analyzed during the pre-crisis period (2004-2006) and the crisis period (2007-2010). The primary conclusions are that the market variables and the variable that captures contract liquidity have the greatest explanatory power, whereas the accounting and macroeconomic variables included in our regression do not seem to play a significant role. Additionally, we find that the explanatory power of the model is considerably higher during the crisis period than during the pre-crisis period. This finding could be explained by a lower sensitivity of CDS spreads during periods of economic stability.

Keywords: credit default swaps; European Banks; CDS spreads; bank risk; accounting, market and macroeconomic information; liquidity.

JEL classification: C52; G21; G33; M41.

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Acknowledgments: We would like to thank the *Fundación de la Universidad de Cantabria para el Estudio y la Investigación del sector Financiero (UCEIF)*, the Santander Group and the Regional Government of Andalusia [Project SEJ-141] for their financial support. We also acknowledge the helpful comments and suggestions of participants in the 2013 International Risk Management Conference (IRMC). The usual disclaimer applies.

1. Introduction

Among the various credit derivative instruments, credit default swaps (CDSs) are the most widely traded (Alexander and Kaeck, 2008; Forte and Peña, 2009; among others) and are some of the best instruments currently available to assess the market's perception of the financial situation of institutions such as states, companies and banks (Annaert *et al.,* 2013).

According to the British Bankers Association (2009), the CDS has become increasingly popular over time.[1] Between 2004 and 2011, the outstanding gross national volumes increased from less than USD 2 trillion in 2004 to nearly USD 60 trillion in 2007. Then, the market decreased to nearly USD 30 trillion in 2011(Bank of International Settlements (BIS), 2011).

The growth of the CDS market has resulted in the opening of several lines of research. For example, Hull *et al*. (2004) analyze the relationship between CDS spreads and bond yields as well as the capacity of CDS spreads to anticipate rating changes. Blanco *et al*. (2005) study the relationship between CDS spreads and investment-grade bonds and their potential for arbitrage. Forte and Peña (2009) analyze market efficiency as a function of the relationships between changes in bond spreads, CDS spreads and changes in stock market implied credit spreads. Batta (2011) examine the direct relevance of accounting information to CDS spreads and their explanatory power as applied to regression models.

An important group of studies focuses on determining which type of model (accounting or market-based model) better explains corporate credit risk using the CDS spread as a proxy for credit risk. Thus, Das *et al.* (2009) analyze both models (notably, Altman, 1968; Ohlson, 2004; Merton, 1974) for the US market. They conclude that rather than viewing them as substitutes, these models should be viewed as complementary in predicting defaults. Similarly, Trujillo-Ponce *et al.* (forthcoming) find that a comprehensive model that combines

[1]A CDS is a contract between two parties. One party is the seller of credit protection *("short side")* who provides this protection against default of a particular credit name and in return receives periodic premiums until the maturity date of the CDS or a credit event occurs, whichever is first. This event can be originated by the other party or by the buyer of credit protection *("long side").* The buyer of credit protection obtains the right to sell a particular bond issued by the credit name for its par value if any credit event occurs before maturity and is therefore referred to as a credit protection buyer (Fabozzi *et al.*, 2007). The periodic premium, which is expressed as a percentage (in basis points) of its notional value, is called the CDS spread.

accounting- and market-based variables is the best option to explain the credit risk of European firms.

Another important area of research is that which focuses on the study of the determinants of CDS spreads of corporations and banks. There are two basic reasons why corporations and banks are analyzed by different methods. First, they have different financial structures, which require calculating different ratios for analysis (e.g., Kato and Hagendorff, 2010; Rauning and Scheide, 2009). Second, it has been demonstrated that certain variables that are found to affect credit spreads of corporations occasionally lose their explanatory power when applied to banks (e.g., Raunig and Scheicher, 2009; Grammatikos and Vermeulen, 2012). Fabozzi *et al.* (2007) have also conducted research in this area and tested the influence of fundamental variables on the pricing of CDSs of corporations and banks. The theoretical determinants that were included in the analysis were the interest rate, rating, sector, liquidity factors, industry sector, year to maturity and region. Their findings suggest that the first four variables are significant at the present time as predictors of the price of CDSs.

One of the primary objectives of Raunig and Scheicher (2009) is to analyze how investors in the corporate debt market view banks. The authors compare the market pricing of banks with industrial firms and use monthly data from the CDS market on the CDSs of 41 major banks and 162 non-banks (including the largest banks in the US and Europe) to analyze whether investors discriminate between the riskiness of banks and other types of firm. Using panel analysis, they decompose the CDS premia into the expected loss and the risk premium. The results indicate that market participants first believed that banks would be less risky than other firms. After the beginning of the crisis (August, 2007), they drastically changed their opinion and viewed banks as at least as risky as other firms.

Breitenfellner and Wagner (2012) examine risk factors that explain daily changes in aggregate CDS spreads before, during and after the 2007–2009 financial crises. Using the *European iTraxx CDS index*, they document time variation in the significance of spread determinants. Before and after the crisis, spread changes are primarily determined by stock returns and implied stock market volatility. Global financial variables possess explanatory power for the pre-crisis and crisis periods. Additionally, these researchers find that liquidity variables are significantly related to spread changes for financials, whereas they are unrelated for non-financials.

Focusing on the banking sector, we observe that a range of empirical studies have been published on the analysis of CDS spreads, not only to explain the banks' credit risk but also to design monetary policy and to analyze the market discipline. The most relevant studies include Chiaramonte and Casu (2013) and Annaert *et al*. (2013). Chiaramonte and Casu (2013) estimate the determinants of the CDS spread of 57 international banks (of which 43 are from Europe), considering only accounting information from the banks' balance sheet ratios. They find that the determinants of the banks' CDS spreads vary strongly over time as economic and financial conditions vary. Annaert *et al.* (2013) decompose the explained part of the CDS spread changes of 32 listed euro-area banks for which CDS contracts trade according to various risk drivers. Individual CDS liquidity and other market and business variables were identified to complement the structural model and were demonstrated to play an important role in explaining credit spread changes. For the current financial crisis, these researchers confirm that the steeply rising CDS spreads are the result of increased credit risk. The individual CDS liquidity and market-wide liquidity premia played a dominant role. During the pre-crisis period, their model and its decomposition suggest that credit risk was not correctly priced.

We extend the current literature in several directions. First, as far as we know, this study is the first to investigate the determinants of the CDS spreads of European banks using accounting as well as market, liquidity, ratings and macroeconomic information simultaneously. Second, although most of the extant research ceases at the onset of the recession, we consider an extended time span: 2004 to 2010. The extension of the analysis to include the crisis period enables us to assess whether the findings reported in previous papers are robust to changes in the economic cycle.

The remainder of the paper is structured as follows. After this introduction, Section 2 describes the data and method. Section 3 presents and discusses the primary results. Section 4 summarizes and presents the conclusions.

2. Data and empirical methodology

2.1. Sample

The sample consists of European bank CDS spreads with 5-year maturities available in the Datastream database during the period 2004-2010.[2] The banks were selected based on the availability of CDS spread data (from the CMA source).[3] The market and macroeconomic information were collected from the Datastream database, whereas the accounting information was collected from the Bankscope database.[4] After the CDS data were matched with the information obtained from these two databases, the final sample consists of 270 observations for 45 commercial banks from 14European countries. Tables 1 and 2 show the number of observations that constitute the sample, organized by year and country.

As in similar studies, we use unconsolidated statements, thus preventing relevant differences in profit and loss statements and hindering the balance sheets of headquarters and subsidiaries from negating one other.

Table 1. Commercial banks in the sample by country

Country	Banks	Observations	Percentage
Austria	2	13	4.81
Belgium	2	13	4.81
Denmark	1	7	2.59
France	4	27	10.00
Germany	4	24	8.89
Ireland	2	14	5.19
Italy	8	42	15.56
Netherlands	3	14	5.19
Norway	1	3	1.10
Portugal	2	14	5.19
Spain	4	24	8.89
Sweden	3	20	7.41
Switzerland	2	13	4.81
United Kingdom	7	42	15.56
Total Banks	*45*	*270*	*100%*

2 For detailed information on the Datastream database, please see http://online.thomsonreuters.com/datastream.
[3]These data are available in the database until September 2010.
[4] For detailed information on the Bankscope database, please see https://bankscope2.bvdep.com/version-2012116/home.serv?product=scope2006".

Table 2. Commercial banks in the sample by year

Year	Observations	Percentage
2004	31	11.48
2005	39	14.44
2006	41	15.19
2007	39	14.44
2008	41	15.19
2009	40	14.82
2010	39	14.44
Total	*270*	*100*

2.2. Dependent variable

As previously stated, we consider as the dependent variable the CDS spreads (Premium Mid) with a 5-year maturity. Although there is broad-spectrum maturity, we focus exclusively on the 5-year contracts because they are generally considered to be the most liquid segments on the market (Annaert *et al.,* 2013; Völz and Wedow, 2011). We collect the CDS spreads at the end of each year (average for the last month) over the period 2004-2010.

2.3. Accounting-based CDS spread determinants

Our paper uses six accounting variables as proxies for asset quality, capitalization, profitability, efficiency and liquidity.[5] All of these variables have been widely used in previous studies (Chiaramonte and Casu, 2013; Das *et al.,* 2009).

To measure asset quality, we select the ratio of impaired loans to gross loans (IL/GL). This ratio indicates the amount of total loans that are doubtful. Thus, the smaller this ratio is, the better the assets quality of the financial entity, and therefore, a positive relationship is anticipated with CDS spreads.

We use the ratio of equity to total assets (Eq/TA) as a proxy for capitalization. This ratio reflects the inverse of the leverage of the banking entity. That is, the lower the value of this ratio is, the greater the leverage. Therefore, one would expect that as the proportion of debts with respect to the total assets increases, the level of indebtedness should increase

[5] The initial study included ten accounting variables. Once the most highly collinear ratios were eliminated, the final sample included six ratios.

proportionately, resulting in a greater risk of default. Thus, we expect a negative relation between this ratio and the CDS spread.

We select the return on assets (ROA) for profitability analysis. This ratio is an indicator of the bank's return on investments. The relationship between this ratio and the CDS spread is unclear. However, the market may interpret this relationship differently. According to Chiaramonte and Casu (2013), a bank that makes multiple investments with a low ROA may be perceived by the market as an entity with a high level of risk. In this case, a low ROA can correspond to high CDS spreads. However, if one assumes that higher levels of investment can result in greater future incomes, the market may react positively to such investments. In this case, moderate values of the ROA ratio could correspond to low CDS spreads.

As measure of efficiency, we use the cost-to-income ratio (CIR).This ratio measures the bank's overhead or running cost as a percentage of income generated before provision. The greater this ratio is, the lower the efficiency of the banking enterprise. Thus, we expect a positive correlation between this ratio and the CDS spread.

We chose the following common ratios to measure the bank liquidity: the interbank ratio (Interbank) and the net loans to total assets (NL/TA) ratio. Interbank is defined as the money lent to other banks divided by the money borrowed from other banks. The greater this ratio is, the greater the liquidity of a bank. Thus, this definition implies an inverse correlation with CDS spreads. In contrast, the NL/TA ratio indicates the percentage of the bank's assets that are tied up in loans. The higher this ratio is, the less liquid the bank is. Thus, a positive correlation with CDS spreads is anticipated.

2.4. Market-based CDS spread determinants

We use equity return (EqRet) and equity volatility (EqVol) as market-based CDS spread determinants. Both variables are commonly used in credit risk models based on market information (e.g., Das *et al.*, 2009; Trujillo *et al.*, forthcoming*;* Ericsson *et al.*, 2009). Following Annaert *et al.* (2013) and Christie (1982), we have chosen the variable EqRet as a measure of financial leverage relative to market value.[6] We anticipate a negative correlation between this variable and CDS spread because the lower the stock returns are, the greater the leverage measured as a multiple of market value and consequently the greater the anticipated CDS spreads. We have calculated this variable based on the annual equity return because we work with annual data.

With respect to EqVol, a higher equity volatility theoretically results in higher credit spreads because it increases the likelihood that the default threshold is reached (Annaert *et al.,* 2013). Therefore, we anticipate a positive correlation between this variable and the credit spreads. As with the previous variable, we calculated this volatility using the annual historical standard deviation as a proxy.

2.5. Liquidity

Most studies that have analyzed CDS spreads have chosen as explanatory variables those factors that capture the liquidity of the contract (as described by Longstaff *et al.*, 2005, among others). However, the results obtained to date have not characterized the relationship between these variables. Thus, Chen *et al.* (2007) find a negative relationship with the CDS spread, whereas Völz and Wedow (2011) find a significant positive correlation.

Although different proxies exist for measuring the bank-specific liquidity, we consider the CDS bid-offer spread (Bid-Off) because this variable is the most commonly employed by previous authors (Völz, 2011; Houweling and Vort, 2005; among others). Specifically, according to Fabozzy *et al.* (2007), we use yearly average relative bid-offer spreads, which are calculated as follows: (2 x (offered-bid))/(bid+offered). Then, we calculate the median yearly bid and the median yearly offered price to retrospectively calculate the difference between the two.

2.6. Macroeconomic CDS spread determinants

We use the following macroeconomic variables to capture the general market and economic conditions: the 10-year Treasury bond rate (TBond),

[6] These variables are included in the Merton (1974) model, which derives a closed form formula for the credit spread on a risky zero bond using asset growth, asset volatility and leverage as the key economic drivers for bankruptcy (Annaert *et al.,* 2013).

Market Return (MarkRet) and Market Volatility (MarkVol).[7] These variables have been frequently used in studies that model credit risk (e.g., Das *et al.*, 2009).

The variable TBond captures the sovereign default risk. We anticipate a positive correlation between this variable and the bank CDS spread. That is, the greater the sovereign default risk is, the larger the CDS spreads of the country's banking system.

The MarkRet variable is intended to capture the general business climate. When this variable improves, the probability of default decreases. Thus, a negative correlation with credit spreads is anticipated. As a proxy for this variable, we use the variation of the *Stoxx Europe 50* index. This index, which is also known as *Europe's Leading Blue-chip Index,* provides a representation of super sector leaders in Europe. The index covers 50 stocks from 18 European countries.

Finally, MarkVol captures the uncertainty that surrounds economic prospects, which is greater when there is greater market volatility. Therefore, we expect a positive correlation with credit spreads. We use as a proxy the *Vstoxx Volatility Index*, which captures the expected volatility for the *Dow Jones EuroStoxx 50 Index.*

2.7. Control variables

Finally, we control for the issuer rating (Rating) and the bank size (Size).The correlation between the issuer rating variable and CDS spreads has been extensively studied. Most of the empirical studies having concluded that the lower the issuer's credit rating is, the greater the average CDS spreads, with a dramatic increase in these spreads when the rating decreases from investment-grade to speculative grade (Das *et al*., 2009, Annaert *et al*., 2013 and Fabozzy *et al.,*2007; among others).

In our study, we consider the rating of the reference entity at the end of the year, as provided by the Fitch Group rating agency. Then, we code the different rating classifications as follows: AAA=1; A=2; BBB=3.Thus, we anticipate a positive correlation between the constructed variable and the CDS spread.

[7] We also included a measure of the overall industry return, *bank market return*, measured using the *í Stoxx Europe 600Bank index*. Nevertheless, this indicator was eliminated because of its high collinearity with MarkRet.

The Size variable captures the bank's absolute size measured as the logarithm of total assets. We anticipate a negative correlation with CDS spread, given that larger banks are typically associated with lower levels of risk. That is, there would have been reasons for aggressive regulatory intervention in failing banks when the banking system is weak precisely because of concerns regarding systemic risk (Brown, 2011; Allen and Gale, 2000).

2.8. The empirical model

To investigate the relationship between the groups of studied variables (accounting, market, liquidity and macroeconomic variables) and the CDS spread, we estimate the following linear regression:

$$Y_{i,t} = \alpha + \beta_1 \cdot \mathrm{IL/GL}_{i,t} + \beta_2 \cdot \mathrm{Eq/TA}_{i,t} + \beta_3 \cdot \mathrm{ROA}_{i,t} + \beta_4 \cdot \mathrm{CIR}_{i,t} + \beta_5 \cdot \mathrm{Interbank}_{i,t} + \beta_6 \cdot \mathrm{NL/TA}_{i,t} + \beta_7 \cdot \mathrm{EqRet}_{i,t} + \beta_8 \cdot \mathrm{EqVol}_{i,t} + \beta_9 \cdot \mathrm{Bid\text{-}Off}_{i,t} + \beta_{10} \cdot \mathrm{Rfree}_{i,t} + \beta_{11} \cdot \mathrm{MarkRet}_t + \beta_{12} \cdot \mathrm{MarkVol}_t + \beta_{13} \cdot \mathrm{Rating}_{i,t} + \beta_{14} \cdot \mathrm{Size}_{i,t} + \varepsilon_{i,t}. \quad (1)$$

For this regression, the subscripts *i* and *t* denote index banks and years, respectively, whereas *Y* denotes the dependent variable, which is the natural logarithm of the CDS spread at the end of the year. As previously stated, we consider six firm-specific accounting variables, two market-based variables, one variable used as a proxy for the liquidity of the contract and three variables to account for the macroeconomic environment. Finally, we include as control variables the rating and the size of the bank. Similar to Chiaramonte and Casu (2013), we use levels rather than differences in our equation because we are more interested in explaining the spread than in making predictions. The notations of these explanatory variables are described in Table 3. In the regression above, $\varepsilon_{i,t}$ is the disturbance term.

Table 3. Explanatory variables

Classification	Explanatory variables	Notation	Expected sign	Source
Accounting Variables				
Asset Quality	Impaired Loan / Gross Loans (in %)	IL/GL	+	*Bankscope*
Capitalization	Equity / Total Asset (in %)	Eq/TA	-	*Bankscope*
Profitability	Net Income / Average Total Assets (in %)	ROA	+/-	*Bankscope*
Efficiency	Cost /Income Ratio (in %)	CIR	+	*Bankscope*
Liquidity	Interbank Ratio (in %)	Interbank	-	*Bankscope*
Liquidity	Net Loans / Total Asset (in %)	NL/TA	+	*Bankscope*
Market Variables				
Market	Equity Return	EqRet	-	*Datastream*
Market	Equity Volatility	EqVol	+	*Datastream*
Liquidity				
Liquidity	CDS Bid-Offered (in basis points)	Bid-Off	+/-	*Datastream*
Macroeconomic Variable				
Macroeconomic	10-year Treasury bond (in %)	TBond	+	*Datastream*
Macroeconomic	Market Return (Stoxx Europe 50)	MarkRet	-	*Datastream*
Macroeconomic	Market Volatility (Vstoxx Volatility Index)	MarkVol	+	*Datastream*
Rating Variable				
Rating	Rating assigned by Fitch Rating (AAA=1; A=2; BBB=3)	Rating	+	*Bankscope*
Control Variable				
Total Asset	Log (Total Assets)	Size	-	*Bankscope*

3. Results

3.1. Results from the baseline model

Table 4 shows the median and standard deviation of the CDS spreads and of the different explanatory variables that form our equation for each of the studied years. It can be observed that the spreads increase considerably, nearly doubling during the years of the financial crisis (2007-2010). A similar effect is observed for the default rate (the IL/GL ratio), which increases from a median value of 2% in the years prior to the crisis to rates of more than 5% in 2009 and 2010. Additionally, there is a significant decline in bank profitability (from 0.660% in 2004 to 0.236% in 2010). Relative to other market variables, there is a distinct increase in the volatility of equity, particularly in 2008 and 2009.

Table 4. Summary statistics by year

Year	CDS spread	IL/GL	Eq/TA	ROA	CIR	Interbank	NL/TA	EqRet	EqVol	Bid-Off	TBond	MarkRet	MarkVol	Size
2004	1.105	2.232	5.068	0.660	62.381	91.817	45.988	0.125	0.187	0.197	3.748	0.043	-0.335	8.642
	(0.127)	(1.727)	(2.238)	(0.473)	(14.947)	(78.686)	(16.965)	(0.142)	(0.039)	(0.045)	(0.519)	(0.000)	(0.000)	(0.459)
2005	1.143	2.146	4.958	0.637	59.722	89.873	47.111	0.239	0.173	0.217	3.416	0.201	0.001	8.364
	(0.225)	(1.820)	(2.104)	(0.495)	(14.867)	(77.669)	(17.577)	(0.146)	(0.045)	(0.071)	(0.470)	(0.000)	(0.000)	(0.487)
2006	0.990	2.048	5.118	0.864	56.614	86.730	49.069	0.223	0.220	0.238	4.045	0.100	0.033	8.416
	(0.237)	(1.827)	(2.587)	(0.844)	(11.213)	(75.516)	(19.594)	(0.177)	(0.046)	(0.080)	(0.452)	(0.000)	(0.000)	(0.495)
2007	1.578	1.851	4.963	0.743	58.957	85.945	51.289	-0.152	0.276	0.195	4.385	-0.004	0.218	8.486
	(0.323)	(1.479)	(2.530)	(0.401)	(13.857)	(66.768)	(21.020)	(0.157)	(0.086)	(0.098)	(0.345)	(0.000)	(0.000)	(0.487)
2008	2.140	3.023	4.460	0.097	75.951	65.418	54.669	-0.632	0.652	0.110	3.643	-0.434	1.429	8.456
	(0.330)	(3.102)	(2.375)	(0.932)	(50.639)	(55.283)	(21.607)	(0.184)	(0.210)	(0.069)	(0.595)	(0.000)	(0.000)	(0.507)
2009	1.990	5.049	5.614	0.016	61.192	83.441	51.795	0.422	0.716	0.086	3.769	0.241	-0.452	8.471
	(0.203)	(5.031)	(2.580)	(0.731)	(19.417)	(82.620)	(19.942)	(0.492)	(0.335)	(0.029)	(0.587)	(0.000)	(0.000)	(0.507)
2010	2.183	5.568	5.805	0.236	66.509	80.872	52.080	-0.140	0.401	0.071	4.150	0.000	-0.006	8.481
	(0.254)	(4.479)	(2.662)	(1.152)	(25.563)	(67.965)	(19.910)	(0.253)	(0.157)	(0.021)	(1.555)	(0.000)	(0.000)	(0.533)
Total	1.605	3.156	5.140	0.458	63.107	83.085	50.442	0.007	0.383	0.158	3.882	0.018	0.147	8.468
	(0.543)	(3.406)	(2.463)	(0.828)	(25.850)	(72.000)	(19.647)	(0.417)	(0.269)	(0.091)	(0.805)	(0.211)	(0.583)	(0.498)

Note: This table reports means and SD (in parentheses) for the entire sample by year. The sample consists of 45 European commercial banks (270 observations). See Table X for a description of the variables.

Table 5 shows the regression results obtained in this study. We observe the important roles that market variables (EqRet and EqVol) play as predictors of the CDS spread. Both of these variables exhibit strongly significant correlations in the anticipated direction: the CDS spread decreases as the profitability of equity increases and increases with greater stock volatility.

In contrast, the accounting variables do not appear to correlate significantly with CDS spreads in our regression. Whereas all of the studied variables do exhibit the anticipated direction in their correlations with the CDS spread, only the default rate (IL/GL) was statistically significant (at the 10% confidence level).

Similar to previous studies (e.g., Chen *et al.,* 2007; Fabozzi *et al.,* 2007), we observe a highly significant negative correlation between the variable used to approximate the liquidity of the contract (the Bid-Off spread) and the CDS spread. That is, the greater the liquidity of the contract is, the lower the spreads demanded by investors.

Both the macroeconomic variable that captures the 10-year Treasury bond rate (TBond) (insignificant) and the variable that reflects market returns (MarkRet) exhibit the anticipated direction of correlation with CDS spreads. The market return coefficient is significantly negatively related to bank credit spreads. Contrary to our expectations, the market volatility (MarkVol) exhibits a negative sign. However, these results are consistent with those reported by Annaert et al. (2013) for euro-area bank CDS spreads during the 2004-2010 period and for the financial *itraxx CDS Index* spread from June 2004 to June 2007 reported by Alexander and Kaeck (2008).

The relationship between the rating assigned by Fitch Rating and the CDS spread is positive, which suggests that better ratings are associated with lower CDS spreads if we recall the coding convention used in this study (Table 3). However, this relationship is not statistically significant.

Finally, bank size appears to be inversely correlated with the CDS spread. That is, the larger that the bank was, the smaller the CDS spread, most likely because of a “too big to fail” effect.

Table 5. Determinants of CDS spreads in European banks

Variables	CDS spread
IL/GL	0.0082*
	(0.0048)
Eq/TA	-0.0012
	(0.0073)
ROA	-0.0131
	(0.0253)
CIR	0.0003
	(0.0006)
Interbank	-0.0002
	(0.0003)
NL/TA	0.0014
	(0.0014)
EqRet	-0.2258***
	(0.0833)
EqVol	0.6925***
	(0.1092)
Bid-Off	-2.8847***
	(0.4339)
TBond	0.0164
	(0.0269)
MarkRet	-0.4241**
	(0.1828)
MarkVol	-0.0837*
	(0.0497)
Rating	0.0317
	(0.0409)
Size	-0.1044*
	(0.0525)
Intercept	2.5027***
	(0.5372)
Year dummies	No
Clustering level	Bank
N	270
R^2	78.51%
Adjusted R^2	77.33%

Note: This table reports ordinary least squares (OLS) regressions of the log of CDS spreads. See Table 3 for a description of the variables. Robust standard errors, which are clustered by banks, are reported in parentheses. Significance levels are indicated as follows: ***= significant at the 1% level, **= significant at the 5% level and *= significant at the 10% level.

3.2. A comparative analysis between the pre-crisis period (2004-2006) and the crisis period (2007-2010)

We now divide the sample into two periods: a pre-crisis period (2004 to 2006) and a crisis period (2007 to 2010). We use this approach to examine possible differences in our regression because of the impact of the financial/economic crisis in the European banking sector. Although the results obtained using this approach resemble those of our baseline model, we observe certain differences between the two periods (before the crisis and during the crisis) with respect to the explanatory power of the model and the statistical significance of certain explanatory variables (Table 6). In particular, we find that the model's explanatory power is considerably higher during than before the crisis period (with an adjusted R^2 value of 71% during the crisis period versus 63% during the pre-crisis period). This finding is consistent with that reported by other authors, such as Chiaramonte and Casu (2013) and Annaert *et al*. (2013), for the banking industry. The former study suggests that the explanatory power during the pre-crisis period is lower because CDS spreads were flat at that time.

Table 6. Comparative analysis between the pre-crisis period (2004-2006) and the crisis period (2007-2010)

	CDS spread	
Variables	**Pre-crisis period (2004-2006)**	**Crisis period (2007-2010)**
IL/GL	0.0159	0.0019
	(0.0123)	(0.0054)
Eq/TA	0.0035	-0.0137
	(0.0093)	(0.0086)
ROA	-0.0168	-0.0268
	(0.0289)	(0.0278)
CIR	0.0012	0.0002
	(0.0022)	(0.0006)
Interbank	-0.0006*	-0.0003
	(0.0003)	(0.0003)
NL/TA	0.0004	0.0008
	(0.0013)	(0.0013)
EqRet	-0.0723	-0.0788
	(0.1871)	(0.0558)
EqVol	1.5156***	0.4364***
	(0.3797)	(0.0744)
Bid-Off	-0.7665***	-2.1874***
	(0.2356)	(0.2415)
TBond	-0.0075	0.0111
	(0.0338)	(0.0210)
MarkRet	1.6765***	-3.0597***
	(0.3452)	(0.5909)
MarkVol	-0.6894***	-1.0245***
	(0.1125)	(0.2033)
Rating	0.1255**	0.0153
	(0.0491)	(0.0395)
Size	-0.1284**	-0.1687***
	(0.0551)	(0.0511)
Intercept	1.7849***	3.5656***
	(0.5923)	(0.5247)
Year dummies	No	No
Clustering level	Bank	Bank
N	111	159
R^2	67.54%	73.25%
Adjusted R^2	62.81%	70.65%

Note: This table reports OLS regressions of the log of CDS spreads for the pre-crisis period (2004-2006) and the crisis period (2007-2010). See Table 3 for a description of the variables. Robust standard errors, which are clustered by banks, are reported in parentheses. Significance levels are indicated as follows: ***= significant at the 1% level, **= significant at the 5% level, and *= significant at the 10% level.

The accounting variables in our equation continue to have relatively little explanatory power, and the IL/GL ratio ceases to be significant when the period of analysis is divided in two. The Interbank ratio becomes significant (at the 10% level) as a predictor of the CDS spread during the pre-crisis period. Regarding the market variables, although the variable used to measure market volatility continues to be strongly significant in our regressions, the equity return variable now loses its statistical significance while maintaining the anticipated sign in its relationship to CDS spreads. However, although the market volatility remains strongly significant with the anticipated sign in both periods, a strong divergence is observed in the variable that measures market profitability. During the crisis period, greater profitability of equities is associated with significantly lower CDS spreads in the banking industry. However, during the pre-crisis period, increased profitability in the stock index is associated with increased CDS spreads. Finally, both control variables (Rating and Size) retain their anticipated signs, although we observe changes in statistical significance, which seem to confirm a stronger correlation between ratings and CDS spreads during the pre-crisis periods than during periods of economic instability. In addition, a new positive effect of size on the CDS spread appears to divide the two periods of our sample, with a strongly significant explanatory effect for the crisis period.

3.3. An analysis of the explicative power of the explanatory variables

To measure the relative importance of each of the groups of explanatory variables (accounting, market, liquidity and macroeconomic), we divide our initial regression in four (Table 7). As expected, the market variables have the greatest explanatory power (with an adjusted R^2 value of 54%), as does the variable that measures the liquidity of the contract (with an adjusted R^2 value of 55%). The variables that measure the effect of macroeconomic factors on the CDS spread have the least explanatory power, with an adjusted R^2 value of 19%. The accounting variables have an adjusted R^2 value of 27%.

Table 7. Regressions by group of explanatory variables

Variables	CDS spread (1)	(2)	(3)	(4)
IL/GL	0.0266	-	-	-
	(0.0167)			
Eq/TA	-0.0259	-	-	-
	(0.0175)			
ROA	-0.2344***	-	-	-
	(0.0542)			
CIR	0.0021**	-	-	-
	(0.0010)			
Interbank	-0.0001	-	-	-
	(0.0004)			
NL/TA	0.0046***	-	-	-
	(0.0016)			
EqRet	-	-0.3637***	-	-
		(0.0680)		
EqVol	-	1.2412***	-	-
		(0.1154)		
Bid-Off	-	-	-4.4590***	-
			(0.5427)	
TBond	-	-	-	0.0876*
				(0.0505)
MarkRet	-	-	-	-1.8069***
				(0.1868)
MarkVol	-	-	-	-0.2936***
				(0.0661)
Intercept	1.1442***	1.1329	2.3105***	1.3420***
	(0.1361)	(0.0448)***	(0.0793)	(0.1993)
Year dummies	No	No	No	No
Clustering level	Bank	Bank	Bank	Bank
N	270	270	270	270
R^2	28.57%	53.87%	55.33%	20.16%%
Adjusted R^2	26.94%	53.52%	55.16%	19.26%

Note: This table reports OLS regressions of the log of CDS spreads for accounting-based variables (column 1), market-based variables (column 2), liquidity variable (column 3) and macroeconomic variables (column 4). See Table X for a description of the variables. Robust standard errors, which are clustered by banks, are reported in parentheses. Significance levels are indicated as follows: ***= significant at the 1% level, **= significant at the 5% level and *= significant at the 10% level.

3.4. A fixed-effects model

As a final robustness check, we evaluate the method of estimation used in the analysis. Because panel data are used, we can re-estimate the model with either fixed or random effects. Hausman tests suggest that the fixed effects estimator is more appropriate in our case (Table 8). We now assume that the omitted variables may potentially correlate with the existing regressors.

In this case, more accounting variables are found to be statistically significant (the Eq/TA ratio, the Interbank ratio and the NL/TA ratio). The market and liquidity variables are again highly statistically significant, with the anticipated signs. However, the variables that account for the macroeconomic environment, such as the rating and size metrics, lose their statistical significance.

Table 8. Fixed-effects model

Variables	CDS spread
IL/GL	0.0129
	(0.0187)
Eq/TA	-0.0437**
	(0.0212)
ROA	-0.0356
	(0.0329)
CIR	0.0005
	(0.0006)
Interbank	-0.0009*
	(0.0004)
NL/TA	0.0132***
	(0.0034)
EqRet	-0.2645***
	(0.0747)
EqVol	0.5399***
	(0.0922)
Bid-Off	-3.2485***
	(0.4770)
TBond	0.0431
	(0.0354)
MarkRet	0.0879
	(0.2159)
MarkVol	0.0762
	(0.0784)
Rating	0.0591
	(0.0597)
Size	-0.1385
	(0.2070)
Intercept	-0.4038
	(1.8873)
Year dummies	No
Clustering level	Bank
N	270
R^2 (within)	84.59%
Hausman	0.0000

Note: This table reports fixed-effects regressions of the log of CDS spreads. See Table 3 for a description of the variables. Robust standard errors, which are clustered by banks, are reported in parentheses. Significance levels are indicated as follows: ***= significant at the 1% level, **= significant at the 5% level and *= significant at the 10% level.

4. Summary and conclusions

This paper empirically analyzes the determinants of CDS spreads of a sample of 45 European banks over the 2004-2010 period. We use variables related to accounting- and market-based data, an indicator of liquidity in the CDS market and several proxy variables for the macroeconomic environment in which these financial institutions operate. We demonstrate the important role of market variables (EqRetand EqVol) as predictors of the CDS spread (with an adjusted R^2 value of 54%) in addition to the variable that captures the liquidity of the contract (adjusted R^2 value of 55%). Similar to previous studies (e.g., Chen *et al.,* 2007; Fabozzi *et al.,* 2007), we find a strongly significant negative correlation between the variable that approximates the liquidity of the contract (the Bid-Off spread) and the CDS premium.

Accounting variables do not appear to play an important role in our regression model. Whereas all of these variables are correlated with CDS spread in the anticipated direction, only the default rate (IL/GL) is statistically significant. Together, the accounting variables have an adjusted R^2 value of 27%.

Among the macroeconomic variables studied, the market return coefficient is significantly negatively related to bank credit spreads. However, the market volatility exhibits a negative sign, which is consistent with the results reported by Annaert et al. (2013) for the euro-area bank CDS spread during 2004-2010.

Finally, the size of the bank appears to be inversely correlated with the CDS spread. That is, the larger the bank is, the smaller the CDS spread, most likely because of a “too big to fail” effect.

When we divide the sample into two periods, a pre-crisis period (2004 to 2006) and a crisis period (2007 to 2010), we obtain similar results to those of the baseline model, although a few differences are observed with respect to the explanatory power of the model and the statistical significance of certain explanatory variables. Similar to Chiaramonte and Casu (2013) and Annaert *et al*. (2013) for the banking industry and Trujillo-Ponce *et al.* (forthcoming) for a sample of European firms, we conclude that the explanatory power of the model is considerably higher during the crisis period than before the crisis period. This finding may be explained by a lower sensitivity of CDS spreads to the studied financial indicators during periods of economic stability.

References

Alexander, C., Kaeck, A., 2008. Regime dependent determinants of credit default swap spreads. *Journal of Banking and Finance* 32, 1008-1021.

Allen, F., Gale, D., 2000. Financial Contagion. *Journal of Political Economy* 108, 1-33.

Altman, E., 1968. Financial ratios, discriminate analysis and the prediction of corporate bankruptcy. *Journal of Finance* 23, 589-609.

Annaert, J.M., De Ceuster, M., Van Roy, P., Vespro, C., 2013. What Determines Euro Area bank CDS Spread. *Journal of International Money and Finance* 32, 444-461.

Bank for the International Settlements (BIS). 2011. Annual Report Bank for International Settlements. *Basel.*

Batta, G. 2011. The Direct Relevance of Accounting Information for Credit Default Swap Pricing. *Journal of Business Finance and Accounting* 38, 1096-1122.

Blanco, R., Brennan, S., Marsh I.W. 2005. An empirical analysis of the dynamic relation between investment-grade bonds and credit default swaps, *The Journal of Finance*, 5, 2255- 2281.

Breitenfellner, B., Warner, N. 2012. Explaining aggregate credit default swap spreads. *International Review of Financial Analysis* 22, 18–29.

Brown, Craig O., Serdan Dinç, I. 2009. Too many to fail? Evidence of regulatory forbearance when the banking sector is weak. *Review of Financial Studies* 24, 1378-1405.

Chen, L., Lesmond, D.A., Wei, J., 2007. Corporate yield spreads and bond liquidity. *The Journal of Finance* 62,119-149.

Chiaramonte, L., Casu, B. 2013. The determinants of bank CDS spread: evidence from the financial crisis. *The European Journal of Finance,* 19, 861-887.

Christie, A.A. 1982. The stochastic behavior of common stock variances. Value, leverage and interest rate effects. *Journal of Financial Economics* 10, 407-432

Das, S.R., Hanouna, P., Sarin, A. 2009. Accounting-based versus market-based cross-sectional models of CDS spreads. *Journal of Banking and Financing* 33, 719-730.

Ericsson, J., Jacobs, K., Oviedo, R. 2009. The determinants of credit default swaps premia, *Journal of Financial and Quantitative Analysis* 44, 190-132.

Fabozzi, F.J., Cheng, X., Chen, R-R. 2007. Exploring the components of credit risk in credit default swaps. *Finance Research Letters* 4, 10-18.

Forte, S., Peña, J.I., 2009. Credit spreads: An empirical analysis on the informational content of stocks, bonds, and CDS. *Journal of Banking and Finance* 33, 2013-2025.

Grammatikos, T., Vermeulen, R. 2012. Transmission of the financial and sovereign debt crises to de EMU: Stock prices, CDS spreads and exchange rates. *Journal of International Money and Finance,* 31, 517-533.

Houweling, P., Vorst, T., 2005. Pricing default swaps: empirical evidence. *Journal International Money Finance,* 24, *1220-1225*

Hull, J. C., Predescu, M., White, A. 2004. The relationship between credit default swaps spreads, yields bonds and credit rating announcements. *Journal of Banking and Finance* 28, 2789-2811.

Kato, P., Hagendorff, J. 2010. Distance to default, subordinated debt, and distress indicators in the banking industry, *Accounting and Finance* 50, 853–870.

Longstaff, F.A., Mithal, S., Neis, E., 2005. Corporate yield spreads: default risk or liquidity? New evidence from the credit-default swap market. *Journal of Finance* 60, 2213-2253.

Merton, R. C. 1974. On the pricing of corporate debt: The risk structure of interest rates, *Journal of Finance* 29, 449-470.

Ohlson, J. 1980. Financial ratios and the probabilistic prediction of bankruptcy, *Journal of Accounting Research* 19, 109-131.

Raunig, B., Scheicher, M. 2009. Are banks different?. Evidence from the CDS market. *Oesterreichische Nationalbank*.

Trujillo-Ponce, A., Samaniego-Medina, R., Cardone-Riportella, C. forthcoming. Examining what best explains corporate credit risk: Accounting-based versus market-based models. *Journal of Business Economics and Management,* doi:10.3846/16111699.2012.720598.

Völz, M., Wedow, M. 2011. Market discipline and too-big-to fail in the CDS market: Does banks´ size reduce market discipline? *Journal of Empirical Finance* 18, 195-210.