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Are CDS spreads a good proxy of bank risk?

Evidence from the financial crisis

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Abstract

Based on a sample of mid-tier and top-tier internationally active banks with five-year senior CDS spreads, this paper investigates the determinants of CDS spreads and whether CDS spreads can be considered a good proxy of bank risk. The analysis encompasses three time periods: a pre-crisis period (1 January 2005 - 30 June 2007); a crisis period (1 July 2007 - 31 March 2009) and a crisis and its less acute phase period (1 July 2007 - 31 March 2010) and focuses exclusively on bank specific balance sheet ratios. The results of the empirical analysis indicate that bank CDS spreads, both in the pre-crisis period, but expecially in the crisis period (acute and less acute), reflect the risk captured by bank balance sheet ratios. We find that the determinants of bank CDS spreads vary strongly across time, as economic and financial conditions vary. TIER 1 ratio and leverage appear insignificant in all of the three periods considered, while liquidity indicators become significant only during and post crisis.

Keywords: credit default swaps (CDS) spreads; financial crisis; bank risk; balance sheet ratios

JEL Classification: G01; G21

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1. Introduction

Banks have played a crucial role in the making and spread of the recent financial crisis. Indeed, at the most critical moment of the crisis, the key player was none other than a bank, Lehman Brothers, whose default sparked the most acute phase, and a number of immediate repercussions on the whole system.[1] The demise of the American investment bank is considered an important event not only because it was responsible for a sudden collapse in global business confidence – it was the first time that a major bank was allowed to fail - but also because it marked a watershed in the history of credit default swaps (CDS). The bankruptcy of Lehman Brothers in September 2008 and, shortly afterwards, the near downfall of the insurance conglomerate American International Group (AIG), both of which were involved in the CDS sector, polarised attention towards the CDS activities of the major international banks.

CDSs, the most widespread form of credit derivative, have been, according to some, responsible for exacerbating the effects of the recent financial crisis (Dickinson 2008; Stulz 2009; Kress 2010). CDSs were originally created in the 1990s by JP Morgan, and consist of an agreement between two parties, the so-called protection buyer and protection seller. The protection seller undertakes, in exchange for a premium paid by the protection buyer, to pay out if a specific credit event[2] occurs, typically the default of a third debtor, the so-called reference entity. CDSs are thus contracts that make it possible to isolate and transfer credit risk (*Ashraf* et al. 2007). Owing to these constituent features, CDS spreads have become increasingly popular as a simple, direct indicator of a firm's credit risk, especially during the financial crisis.[3]

Research on CDS spreads is still limited, mostly because the credit derivatives market in general and the CDS market in particular has only gained a substantial size since the early 2000s.[4]

The CDS literature is composed of two groups of studies, one focussing on the pricing characteristics of CDS spreads, and the other investigating the determinants of CDS spreads and their variation.

To the first group belong the empirical analyses that demonstrate the price leadership of CDS spreads over corporate bond spreads in measuring firm-specific credit risk. Various reasons underlie this claim. *Hull* et al (2004), Zhu (2004), Das and Hanouna (2006), and *Ericsson* et al. (2009) point out that CDS contracts are quoted directly in term of spreads[5], while bond spreads require a number of complicating assumptions and calculations, for example, the specification of a benchmark risk free yield curve before credit spreads can be calculated. *Blanco* et al. (2005) show that the CDS market leads the corporate bond market in terms of price discovery. They demonstrate that price discovery takes place primarily in the CDS market for various reasons. There is evidence that corporate bond credit spreads also include non-credit risk components that explain a significant part of the observed credit spread. The illiquidity component for *Longstaff* et al. (2005) and *Chen* et al. (2007), and the different tax treatments of corporate and government bonds for *Elton* et al. (2001) have a greater effect on bond spreads than default risk.

The second group comprises the empirical analyses that investigate the determinants of CDS spreads. The credit risk literature identifies two different approaches: the structural approach and the reduced form approach.

The structural models, derived from the option pricing model originally developed by Black and Scholes (1973), are based on firms' structural variables and consider default a function of endogenous elements. The first author to apply the option pricing model to insolvency was Merton (1974), who based his formulation on the assumption that insolvency arises solely and exclusively if at bond maturity date a firm's assets are worth less its liabilities. Subsequently, a number of generalizations on Merton's model were proposed, the first by Black and Cox (1976) (cf. also

Longstaff and Schwartz 1995; Anderson and Sundaresan 1996; *Anderson* et al. 1996; Mella-Barral 1997; and Zhou 2001). These considered the possibility of default prior to bond maturity if the value of the firm's assets fell below a certain level, the threshold or default boundary.

The reduced form models emerged in the second half of the 1990s thanks to contributions from a number of scholars (the most significant were Lando 1994, 1998, Jarrow and Turnbull 1995; Madan and Unal 1995; *Jarrow* et al. 1997; Duffie and Singleton 1999; and more recently Hull and White 2000, 2001). Reduced form models are a recent approach to credit risk, and treat default as a sudden surprise, a totally exogenous event that is unrelated to the firm's balance sheet. The reason for default is not specified.

The structural models have been widely preferred to the reduced form models by practitioners in the field of credit risk, because the reduced form approach has been criticised on the grounds of the weak economic rationale for the occurrence of a default event (*Alexopoulou* et al. 2009).

There is a substantial literature that builds on the structural models to analyse movements in CDS spreads.[6] Among the studies focusing on the structural models' theoretical determinants of CDS spreads are *Aunon-Nerin* et al. (2002), Benkert (2004), *Zhang* et al. (2005), Abid and Naifar (2006), and *Ericsson* et al. (2009). In particular, *Aunon-Nerin* et al. (2002) use both firm-specific information (rating, asset volatility, stock price changes, leverage and market capitalization) and market information to explain CDS spreads. They find that these variables together drive up to 82 per cent of the variation in CDS pricing. Benkert (2004) shows that option-implied volatility is a more important factor in explaining variation in credit default swap premia than historical volatility. *Zhang* et al. (2005) show that volatility and jump risk are the most significant factors in explaining variation in CDS spreads. Abid and Naifar (2006) distinguish five different variables influencing CDS spreads: credit ratings, time to maturity (of the CDS contract), risk free interest rates, slope of the yield curve and volatility of equities. They document that the majority of variables detected

from the credit risk pricing theories explain more than 60 per cent of the total level of credit default swap. Finally, *Ericsson* et al. (2009) confirm that the theoretical variables explain a significant amount of the variation in CDS spreads. Volatility and leverage have substantial explanatory power. More recently, alongside the two groups of studies on CDS spreads mentioned above, a new current of research has emerged that examines the relationship between CDS spreads and rating announcements (*Blanco* et al. 2003; *Hull* et al. 2004; Norden and Weber 2004; Lehnert and Neske 2004; and Daniels and Shin Jensen 2004). Previously, research had analyzed the impact of credit rating announcements on stock prices, bond prices or both.

Loosely following the strand of literature on structural models, this paper investigates the determinants of CDS spreads, albeit with different explanatory variables and type of sample used.

The main aim is to understand whether CDS spreads can be considered a good proxy for bank risk. In particular, we estimate the relationship between bank balance sheet ratios and bank CDS spreads both in the pre-crisis period and in the crisis period (acute and less acute).

This paper makes three contributions to the related literature. First and foremost, this study is one of very few concerned exclusively with bank CDS spreads at an international level: most other studies examine a mix of industrial and financial firms. Only a limited number of recent studies focus exclusively on CDS spreads in the banking sector, though with different research aims: Kool (2006), *Annaert* et al. (2009) and Norden and Weber (2010), with a sample of the major European banks, *Huang* et al. (2008) and Hart and Zingales (2009), with a sample of the major US banks, *Eichengreen* et al. (2009) and Calice and Ioannidis (2009), with a sample of the largest US and European financial institutes (LFIs), *Almer* et al. (2008) and Volz and Wedow (2009), with a sample of banks from all over the world.

A number of reasons led to the decision to consider only CDSs spreads in the banking sector, including the pivotal role of banks in the economy, both as providers of liquidity transformation and

of monitoring services. In addition, banks played a fundamental role in the making and spread of the recent financial crisis, as well as being among the worst-hit players.

Our second contribution relates to the choice of explanatory variables of CDS spreads; we chose to concentrate only on bank balance sheet ratios, rather than considering the theoretical determinants of structural models, in other words firm-specific and market-specific factors. To the best of our knowledge, no study in the related literature has used specifically balance sheet variables to explain variation in CDS spreads. It is however generally accepted that balance sheet variables are the main indicators capable of providing concise information on a firm's health.

Finally, this paper is one of the first contributions on bank CDS spreads that also takes into account the recent crisis. Though with a different research aim, this paper adds to recent contributions by *Huang* et al. (2008), *Annaert* et al. (2009), Hart and Zingales (2009), *Eichengreen* et al. (2009) Raunig and Scheicher (2009) and Norden and Weber (2010).

The results of the empirical analysis are as follows. Firstly, bank CDS spreads, both in the pre-crisis period, but expecially in the crisis period (acute and less acute), reflect the risk captured by bank balance sheet ratios. Hence bank CDS spreads are a good proxy of bank risk. Secondly, the relationship between bank CDS spreads and balance sheet ratios is even stronger during the crisis period. Thirdly, bank CDS spreads seems to be influenced by different variables in the pre-crisis and crisis period. Fourthly, variables that a priory would be considered as determinants of CDSs spread, the TIER 1 Ratio and the Leverage, appear insignificant in all of the three periods considered. Finally, as expected, the bank CDS market in the pre-crisis period showed little interest in any of the liquidity indices considered. The liquidity crisis was in fact the last manifestation of the recent financial crisis.

The remainder of the paper is organized as follows. Sections 2 and 3 discuss data and empirical methodology respectively. Sections 4 and 5 present empirical results and robustness tests. Finally, Section 6 summarizes the major findings and concludes the paper.

2. Data Sample and Descriptive Statistics

2.1 Data description

The study considers only mid-tier and top-tier international banking groups (by total assets) with five-year senior CDS spreads. The decision to focus on CDS spreads only in the banking sector had a decisive impact on sample size, given that only a limited number of banks are involved in CDS activities, and in credit derivatives in general. Indeed this type of business is highly concentrated among a restricted number of big banks.[7] The final sample is thus composed of 57 international banks, 43 of which European (Austria: 2, Belgium: 3, Denmark: 1, Norway: 1, France: 5, Germany: 2, Ireland: 3, Italy: 5, The Netherlands: 1, Portugal: 1, Spain: 6, Sweden: 4, Switzerland: 1, and United Kingdom: 8), 7 are US, 4 are Australian and 3 Japanese banks. See Table A in the appendix for the final sample.

Initially, the study considered a dual time horizon. The first period, the pre-crisis period, prior to the onset of the subprime crisis, ran from 1 January 2005 through 30 June 2007, and was typified by very moderate CDS spreads. It is widely accepted that the outbreak of the sub-prime crisis occurred in July 2007. The analysis was conducted from 2005 onwards, the year in which international accounting standards (IAS/IFRS) became mandatory for the preparation of the consolidated financial statements of European banks.

A second period, the crisis period (the so-called 'during the crisis period'), took into account the recent crisis, spanning from 1 July 2007 to 31 March 2009; during this time, CDS spread values

grew considerably and displayed record peaks. It was decided to end the crisis period at March 2009: in subsequent months bank CDS spreads, and notably peak values, levelled off at values below those seen previously (see Figure 1) but higher than pre-crisis period values (European Central Bank 2009b; Bank for International Settlements 2010).

[Insert Figure 1]

For many banks, the crisis period has not yet come to an end. Since very high average CDS spreads were observed between April 2009 and March 2010, a third period (the so-called 'during and "post" crisis period') was included in the study. This covered the crisis and its aftermath, ot its less acute phase, from 1 July 2007, the onset, through 31 March 2010, the most recent data available at the time of the study. The "post" crisis period thus examines the least critical phase of the crisis, when bank CDS spreads began gradually to decrease (1 April 2009 - 31 March 2010). Due to the insufficient number of observations available between April 2009 and the time of the study, it was not possible to test the model on the "post" crisis period alone.

2.2 Dependent variable

This paper uses as dependent variable five-year senior CDS spreads in the banking sector. CDS spreads were chosen since they are widely considered an excellent indicator of markets' perception of a firm's default risk. Datastream was the source of data on CDS spreads. The chosen data category, 'CDS Premium Mid' corresponds to the average of 'CDS premium bid' and 'CDS premium offered', and shows the mid rate spread between the entity and the relevant benchmark curve. The rate is expressed in basis points (bp). This study uses five-year quotes in so far as this is the benchmark maturity in the CDS market. Senior CDS spreads were used since senior offers

better data coverage than subordinated. Quarterly CDS spreads were used, a choice strictly related to the type of explanatory variables considered (balance sheet variables). The daily frequency of CDS spreads was adjusted to that of the explanatory variables.

Previous studies had considered daily changes in CDS spreads (*Ericsson* et al. 2009), or weekly changes (*Aunon-Nerin* et al. 2002). Such time periods are not feasible for the analysis of balance sheet variables.

Table A in the appendix presents descriptive statistics of senior 5 year CDS spreads for 57 banks in the pre-crisis period (1 January 2005 - 30 June 2007), for the crisis period (1 July 2007 - 31 March 2009) and for the "post" crisis period alone (1 April 2009 – 31 March 2010).

The first and most significant comparison is between the pre-crisis period and the crisis period. This is followed by comparison of the crisis period and the "post" crisis period.

Prior to the recent financial crisis, the CDS spreads of sample banks, regardless of geographical area, were moderate and fairly homogeneous. In particular, average CDS spread values ranged from 6.21 bp (Rabobank) to 68.13 bp (Banque Federale des Banques). The standard deviation of CDS spreads of the banks in the study were all below average values. Furthermore, the majority of sample banks recorded very similar minimum values, ranging from 1 to 12 bp. The same is true of peak values that ranged between 20 and 40 bp on average.

Conversely, clear differences between geographical areas emerge from analysis of CDS spreads in the second period. During the crisis, though all sample bank CDS spreads showed a tendency to grow, in geographical terms such growth was heterogeneous. The Anglo-Saxon countries were worst hit by the financial crisis: first and foremost the US, followed by Ireland and the UK, due principally to the prevalence of the Originate to Distribute (OTD) banking model, but also to excessive financial leverage. Average CDS spread values, but in particular exceptionally high peak values, well in excess of average sample bank values, were recorded by US banks: Washington

Mutual Inc. (maximum: 6,235 bp), National City Corporation (maximum: 2,969), Wachovia Corporation (maximum: 1,560 bp); by Irish banks: Anglo Irish Bank Corporation (maximum: 950 bp), Bank of Ireland (maximum: 670 bp), Allied Irish Banks (maximum: 646 bp); and by UK banks: Bradford & Bingley (maximum: 1,591 bp), HBOS PLC (maximum: 500 bp), and Alliance & Leicester (maximum: 471 bp). All were thrown into crisis due to massive losses on structured financial products and, with the exception of Washington Mutual Inc., were bailed out though take-overs by other more solid banks, governments bailouts (nationalization or recapitalisation), or cash injections from their respective central banks.

The remaining sample banks recorded more moderate average and peak CDS spread values that were nevertheless above average values in the preceding period, evidence of a reasonable ability to withstand the difficulties that overwhelmed the Anglo-Saxon banks. The sole exceptions were the Spanish banks Caja De Ahorros De Valencia Castellon Y Alicante Bancaja (maximum: 1,148 bp) and Caja de Madrid (maximum: 750 bp), the Belgian banks Fortis (maximum: 666 bp) and Dexia SA (maximum: 550 bp), and the Austrian bank Erste Group Bank AG (maximum: 487 bp).

During the crisis the standard deviations of CDS spreads were below average values; in certain cases standard deviations equalled zero when banks formally had a CDS contract but traded very little. This was the case of the French Banque Federale Des Banques, and, in the pre-crisis period, the Spanish Banco de Sabadell SA.

Finally, in the "post" crisis period (1 April 2009 – 31 March 2010), Table A shows that just under half of sample banks recorded lower average CDS spread values than during the crisis period. Nevertheless, almost all peak values were lower, with the exception of three banks: the Portuguese Banco Espirito Santo, the French Banque Federale des Banques and the US Wells Fargo & Co. Minimum values were higher than the previous period. The standard deviations of sample bank CDS spreads were almost all below average values. Furthermore, there was an increase in the

number of banks with a formal CDS contract that traded very little. In particular, this was the case of the Japanese Mizuho Financial Group Inc., the US National City Corporation, US Bancorp and Washington Mutual INC, and the British Standard Chartered PLC.

2.3 Explanatory variables

This study uses as explanatory variables eight balance sheet ratios, in order of analysis profile pre-calculated by Bloomberg on the Global format. Quarterly data was selected rather than annual data to make available a higher number of observations for analysis. This choice limited the number of observations available, since not all banks with CDS contracts report financial data on a quarterly basis.

The eight balance sheet ratios by management area and their hypotezed relationship (irrespective of the time horizon considered) with the dependent variable are outlined below and summarised in Table 1.

Asset quality

Loan Loss Reserve/Gross Loans (%), qa1.

This ratio expresses the percentage value of total credits appropriated to the depreciation fund. It is a reserve for losses expressed as percentage of total loans. The higher the ratio, the lower the quality of the loan portfolio. Hence, an increase in qa1 should lead to an increase CDS spreads.

Unreserved Impaired Loans/Equity (%), qa2.

This ratio is also known as the 'capital impairment ratio'. An increase in the ratio should signal a greater probability of default. As such, a positive relationship between change in qa2 and change in CDS spreads is hypothesized.

Capital

TIER 1 Ratio (%), pat1.

This ratio measures the capital adequacy of a bank. In particular, TIER 1 capital ratio measures the ability of the bank to absorb losses. The higher the ratio, the higher the risk buffer and the lower should be the CDS spreads. Hence, a negative sign is expected.

Leverage: Equity/Total Assets (%), pat2.

There are different definitions of leverage - balance sheet, economic, and embedded - and no single measure can capture all dimensions simultaneously. The first definition is based on balance sheet concepts, the second on market-dependent future cash flows, and the third on market risk. Balance sheet leverage is the most visible and widely recognized form and it is one adopeted in this study. The leverage ratio, defined as Equity/Total Assets, reflects the level of indebtedness of a firm. One would expect that as equity diminishes, with constant total assets the proportion of debts to total assets should increase, as should the level of indebtedness and hence the risk of default. A negative sign is therefore expected between Leverage and CDS spreads.

With the choice of these two variables, we are close to *Almer* et al. who investigated the determinants of short-and long-term CDS spreads of banks using cross-sectional regressions; the authors also used as explanatory variables the following: 'Insolvency Factors': Loan Loss Reserve (%), Loan Loss Provision (%), % of Problem Loans, Pre-Tax-Profit (%) and Long-term Rating. Furthermore, leverage is the only explanatory variable used in this paper that is also present in Merton's model.

Operations

ROA (Return On average Assets) (%), op1.

This ratio is an indicator of the return on a firm's investments. The sign linking ROA to CDS spreads is uncertain. In fact the market may interpret the relationship between these variables either negatively or positively. In particular, a bank that undertakes numerous investments (low ROA) may be perceived by the market as being very risky. In this case, low ROA values would correspond to high CDS spreads (a negative relationship). On the other hand, the market may react positively if it assumed that high levels of investment are capable of creating positive income and future cash flows. In this case moderate ROA values would correspond to low CDS spreads (a positive relationship).

Further, a negative relationship between ROA and CDS may be due to a decrease (or an increase) in operating income at the same level of investment. In such case, a decrease (increase) in ROA would correspond to an increase (decrease) in CDS spreads.

ROE (Return On average Equity) (%), op2.

This ratio is an index of the return on own equity. The higher ratio, the lower the perceived default risk. Hence, a negative sign is expected.

Liquidity

Net Loans/Deposits & Short Term Funding[8] *(%)*, liq1.

This loan-to-deposit ratio is a measure of liquidity. The relationship linking this index to CDS spreads is uncertain. The relationship can be interpreted positively when banks with fewer deposits, and hence lower liquidity, are not perceived positively by the market. An increase in liq1 should therefore correspond to growth in CDS spreads. On the other hand, the relationship can be interpreted negatively when a high level of loans, for the same level of deposits, is perceived by the

market as a positive signal, since sample banks are commercial banks and loans represent their core business. Growth in liq1 should therefore correspond to a decrease in CDS spreads.

Liquid Assets[9]*/Deposits & Short Term Funding*[10]*(%)*, liq2.

A further measure of liquidity is the ratio of Liquid Assets to Deposits & Short Term Funding. The higher this percentage, the more liquid the bank and the less vulnerable to a classic run. Hence, a negative sign is expected. An increase in liq2 should decrease CDS spreads Similarly, *Almer* et al., considered as 'Illiquidity Factors' also the ratio of Total Money Market Funding to Total Liabilities (the so-called % of Wholesale Funding).

[Insert Table 1]

Table 2 reports descriptive statistics relating to the eight balance sheet variables of the sample banks for the pre-crisis period (1 January 2005 – 30 June 2007), the crisis period (1 July 2007 – 31 March 2009) and the "post" crisis period only (1 April 2009 – 31 March 2010).

Unlike CDS spreads, the values of balance sheet variables did not change significantly from the pre-crisis period to the crisis period. The only exception is the average value of qa2. Furthermore, most sample banks recorded homogeneous values for almost all variables in both periods, with the exception of the banks that ran up vast losses during the crisis and/or were bailed out by government intervention (principally the UK, Irish and US banks).

In particular, the average value of qa1 remained substantially unchanged, with a slight tendency to grow (from 1.4 per cent to 1.5 per cent), from the pre-crisis period to the crisis period for almost all banks in the study. Conversely, the other indicator of asset quality, qa2, fell considerably, probably due to the numerous capital increases carried out by the banks in difficulty during the crisis. The

average qa2 value of the sample banks decreased from 137 per cent in the pre-crisis period to 29.5 per cent during the crisis. This fall was principally attributable to two banks, Banco Espirito Santo and Credit Suisse, both of which recorded a significant fall in this index. Conversely, other sample banks – principally the UK, Irish and US banks – recorded strong growth in qa2 during the crisis rather than a fall. Such growth was substantially the result of deterioration in the quality of capital, and affected also the Belgian banks Dexia and KBC Groep NV, the Austrian Raiffeisen International Bank Holding, the Swedish Swedbank AB and the Japanese Mizuho Financial Group.

The variables relating to the banks' financial structure, pat1 and pat2, remained substantially unchanged from the pre-crisis period to the crisis period. The average value of pat1 rose from 7.8 per cent to 8 per cent. Overall, the majority of sample banks, despite being adversely affected by the crisis, exhibited a capital coefficient both before and during the crisis well above the minimum regulatory threshold. On the other hand, the average value of pat2 declined from 5.3 per cent in the pre-crisis period to 5.1 per cent during the crisis. In particular, financial leverage, calculated as the ratio of Equity to Total Assets, remained substantially unchanged during the crisis period with respect to the previous period for the majority of UK banks. Conversely, it showed a tendency to increase for the other big European banks in the sample, but above all for the US commercial banks. Overall, at a global level, the financial leverage of the sample banks remained high.

The profitability indices, op1 and op2, both declined, but at different rates. In particular, the average op1 value of sample banks fell by three percentage points, from 0.8 per cent in the pre-crisis period to 0.5 per cent in the crisis period, while average op2 values halved from 18 per cent to 9 per cent. During the crisis, negative average ROA and ROE values were recorded principally by UK, Irish and US banks.

The two liquidity indices considered, liq1 and liq2, showed fairly similar average values between the pre-crisis period and the crisis period. In particular, the former ratio rose from 82 per cent to 87 per cent, while the latter decreased slightly from 48 per cent to 47 per cent.

Finally, the last panel of Table 2 highlights how in the "post" crisis period the average value of all eight balance sheet variables remained substantially unchanged with respect to the previous period, the crisis period. The sole exception was ROE, the variable with the greatest variation. There was a moderate deterioration in the quality of bank assets: from the crisis period to the "post" crisis period, qa1 rose from 1.5 per cent to 2.3 per cent, while qa2 increased from 29.5 per cent to 32.5 per cent. The average value of the two variables relating to the financial structure of the sample banks showed a tendency to grow slightly in terms of pat1, and a to fall slightly in terms of pat2. From the crisis period to the "post" crisis period, pat1 rose from 8 per cent to 10 per cent, while pat2, increased from 5.1 per cent to 5.8 per cent. Although the banks deleveraged, leverage remained rather high even in the "post" crisis period.

The average value of the two income ratios continued to fall in the "post" crisis period also. From the crisis period to the "post" crisis period op1 declined from 0.5 per cent to 0.2 per cent, while op2 fell from 9.8 per cent to 3.2 per cent.

Finally, the average value of the two liquidity indices showed a slight tendency to grow. From the crisis period to the "post" crisis period, liq1 increased from 87 per cent to 88 per cent, while liq2 grew from 47 per cent to 50 per cent.

[Insert Table 2]

Finally, time-series graphs were plotted to show the relationship between average bank CDS spreads and each explanatory variable. Furthermore, correlation coefficients were calculated

between balance sheet variables and CDS spreads. In particular, analysis of time series graphs on the one hand, and the results of correlations on the other, made it possible to verify whether the hypothesised relationships between dependent variable and each explanatory variable were correct (see Table 1).

Figure A in the appendix shows the time series graphs of average CDS spreads versus the eight balance sheet variables for the pre-crisis period (January 2005 - June 2007) and the crisis period (July 2007 - March 2009). Since the results from the crisis period to the "post" crisis period do not differ significantly, the graphs for the "post" crisis period are not reported.

The panels in Figure A show a clear reversal in the CDS trend and in that of the majority of explanatory variables at the start of the third quarter of 2007, the time of the outbreak of the financial crisis. Furthermore, for most graphs, the relationships observed in Figure A are readily interpreted principally during the crisis period. During this period, the signs predicted in Table 1 were largely confirmed with the exception of pat1. Panel A shows the relationship between average CDS spreads and average qa1 values while Panel B presents the relationship between average CDS spreads and average qa2 values. As predicted, the time series of average CDS spreads versus average qa1 values, in the period between July 2007 and March 2009, showed the positive trend expected. Conversely, the relationship between average CDS spreads and average qa2 values showed a negative sign rather than the positive one expected.

Panel C presents the time-series of average CDS spreads versus average pat1 values. The relationship is positive in the crisis period, contrary to what was expected. CDS spreads thus tended to increase, rather than to decrease, with growth in pat1.

Panel D presents the time-series of average CDS spreads versus average of pat2 values. Also in this case, during the crisis period, the expected sign (negative) was respected. As equity decreased, with

total assets held constant, the incidence of debts on total assets increased, as did the level of indebtedness and consequently the risk of default.

Panel E shows the relationship between average CDS spreads and average op1 values while Panel F shows the relationship between average CDS spreads and average of op2 values. Panel E highlights a clearly negative relationship during the crisis. Hence the market gives a positive interpretation to low ROA in times of crisis. Panel F also shows a negative relationship: moderate ROE values increase the perceived probability of default.

Panel G presents the time-series of average CDS spreads versus average of liq1 values. Panel E highlights a negative relationship during the crisis, above all from 2008 onwards. The market thus interprets in a positive sense a high level of loan activity in times of crisis. Panel H presents the time-series of average CDS spreads versus average liq2 values. In this case also the expected sign (negative) is respected.

Table 3 shows the correlations between each explanatory balance sheet variable and CDS spreads, both for the pre-crisis period (January 2005 - June 2007) and for the crisis period (July 2007 - March 2009). Since results for the crisis period and the "post" crisis period are not very different, the "post" crisis period are not reported.

The results in Table 3 also show a reversal in the trend of CDS spreads and the majority of explanatory variables (6 variables out of 8) at the start of the third quarter 2007, with the outbreak of the financial crisis. Furthermore, Table 3 also highlights how the signs expected in Table 1 are principally respected during the crisis. The sole exception is the sign of the TIER 1 Ratio (qa1), which differs from that expected during the crisis period also. A possible explanation for this will be offered below in the section dedicated to the analysis of regression results.

In particular, Table 3 shows how the relationship between average CDS spreads and average qa1 and qa2 values was substantially independent during the first sub-period (ρ_{qa1}= 0.0107 e ρ_{qa2}= -

0.0298). In the second sub-period, qa1 was positive with the expected sign (ρ_{qa1}= 0.1174), while qa2 was still independent (ρ_{qa2}= 0.0133).

In the pre-crisis period, the relationship between average CDS spreads and the average of pat1 was substantially independent (ρ_{pat1}= 0.0031). In the crisis period, the relationship became positive (ρ_{pat1}= 0.1592), contrary to expectations.

The relationship between average CDS spreads and average pat2 values tended to be positive (ρ_{pat2}= 0.1372) in the first sub-period, contrary to expectations. Conversely, in the second sub-period, the relationship between the two variables became independent (ρ_{pat2}= -0.0441).

The relationship between average CDS spreads and both op1 and op2 was positive during the pre-crisis period (ρ_{op1}= 0.2041 e ρ_{op2}= 0.1319). In the period before the crisis, op1 was prevalently positive; op2 on the other hand did not show the expected sign. Nevertheless, during the crisis period the relationship turned suddenly negative for both indicators (ρ_{op1}= -0.3021 e ρ_{op2}= -0.3214).

In the first sub-period, the relationship between average CDS spreads and the average of liq1 was independent (ρ_{liq1}= -0.0146); in the second sub-period, it became positive (ρ_{liq1}= 0.1196), as expected.

The relationship between average CDS spreads and average liq2, in the pre-crisis period, tended to be positive (ρ_{liq2}= 0.1339), rather than negative. However, in the crisis period it became negative (ρ_{liq2}= -0.1779), confirming the expected sign.

[Insert Table 3]

3. Empirical Methodology

To determine whether balance sheet data explains bank CDS spreads, we follow a fixed effect (FE) panel data regression. Random effects (RE) were tested, but the Hausman test (1978) rejected these

in all cases. Indeed, as our sample includes banks having both sufficient valid CDS spreads and quarterly accounting data (recall that the sample includes only mid-tier and top-tier international banking groups with five-year senior CDS spreads) it is not a random sample and it is possible to assume that our results could not be generalised to all banks.

In particular, we specify the following generic model:

$$CDS_{it} = \alpha + \beta(BankBSratios)_{it} + d_{crisis} + \varepsilon_{it} \quad (1)$$

Where *i* is the subscript identifying the bank and *t* indicates the time period. In this model we introduce only time-varying bank-specific explanatory variables (balance sheet ratios) but not time-varying market-wide explanatory variables. Most empirical papers investigating the explanatory power of credit risk variables for bond and CDS include in the model several variables to proxy for business conditions, market conditions and/or uncertainty (term structure of interest rates, market return, market volatility, etc.). Given the turbulence in financial markets over the sample period, which affected to a greater or lesser degree all banks in the sample, we chose to concentrate on bank specific variables only.

In the first instance, the regressions were conducted covering the entire time horizon (1 January 2005 - 31 March 2010); one including only the eight balance sheet variables; a second one including the eight variables plus a dummy crisis that identifies the onset of the crisis (from 1 July 2007).

Subsequently, to determine whether the relationship between bank CDS spreads and balance sheet data changed from the pre-crisis to the crisis period, two further panel regressions were performed: one on the period preceding the crisis (1 January 2005 - 30 June 2007), the other on the crisis period (1 July 2007 - 31 March 2009). Finally, to understand whether the relationship between bank CDS spreads and balance sheet variables changed in a period that takes into account the crisis period as

well as the less acute phase, a final panel regression was performed on the 'during and "post" crisis period' (1 July 2007 - 31 March 2010).

The dependent variable is the same for all the regressions: bank CDS spreads. In all the regressions, levels rather than differences were used, for both dependent and explanatory variables. Note that the goal of this paper is not to predict but to explain credit spreads, hence, we use contemporaneous dependent and explanatory variables.

4. Results

Table 4 reports the results of the first two panel regressions (without and with the dummy crisis), both conducted on the entire time horizon (1 January 2005 - 31 March 2010). For both regressions, the final sample consisted of 1042 observations for 57 banks. Table 4 indicates that the eight balance sheet variables explain nearly 58 per cent of bank CDS spreads (Adjusted R-squared value); and that the eight balance sheet indices and the dummy crisis together explain almost 67 per cent of bank CDS spreads (Adjusted R-squared). The remaining 42 per cent in the first regression and 33 per cent in the second are explained by factors not considered in the model, i.e. market variables.

From the first panel regression it emerges that all the explanatory variables (the eight balance sheet ratios) are significant to a greater or lesser extent. The most significant variables are qa1, pat1, pat2, op1, op2 and liq2. Qa2 and liq1 are also significant, albeit to a lesser degree. All the significant balance sheet variables have the sign expected, with two exceptions: qa2 is negative rather than positive, and pat1 is positive rather than negative.

In the case of qa2, Panel B in Figure A shows how the relationship between this variable and bank CDS spreads was inversely proportionate during both the pre-crisis and the crisis periods. In particular, Panel B highlights how, in the pre-crisis period, high qa2 values corresponded to very low CDS spreads. This implies that in the pre-crisis period, the market was not concerned with the

poor quality of bank loan portfolios. Moreover, Panel B shows that in the crisis period, a fall in qa2 resulted in a rise rather than a fall in bank CDS spreads. The abrupt decrease in this relationship is most probably attributable to the numerous capital increases carried out by many banks in difficulty during the crisis. Evidently, recapitalization, particularly through injection of government funds, was perceived only negatively by the market, as a sign of crisis in the banking sector. This may have contributed to the increase in bank CDS spreads.

For an explanation of the reasons for the unexpected sign of pat1, see the discussion of the crisis period regression panel below.

From the second regression panel it emerges, conversely, that with the exception of qa2 and liq1, all the explanatory variables considered in this first regression were significant, though to varying degrees. The variables with the highest degree of significance are the dummy crisis, qa1 and op2. Pat1, pat2, op1 and liq2 are also significant, but to a lesser degree. As in the previous case, all the balance sheet variables have the sign expected, with the exception of pat1.

The fact that the dummy crisis is significant indicates that the crisis was a relevant event in the relationship between bank CDS spreads and balance sheet data, as expected.

To understand whether the relationship between bank CDS spreads and balance sheet data changed from the pre-crisis to the crisis period, two further panel regressions were conducted, one on the pre-crisis period (1 January 2005 – 30 June 2007), the other on the crisis period (1 July 2007 – 31 March 2009). The final sample consisted of 506 observations for 53 banks in the pre-crisis period and 354 observations for 57 banks in the crisis period (see Table 4).

Table 4 shows that the eight balance sheet ratios collectively explain 62 per cent of bank CDS spreads (Adjusted R-squared) in the period before the financial crisis and 66 per cent of bank CDS spreads (Adjusted R-squared) during the crisis. The explanatory power of the eight balance sheet

variables thus grew 4 per cent with the transition from the pre-crisis period to the crisis period in terms of Adjusted R-squared. The lower explanatory power of the eight balance sheet ratios during the pre-crisis period is simply because bank CDS spreads were flat at that time. As bank CDS spreads grew, so did the explanatory power of the balance sheet variables. Overall, the Adjusted R-squared value well in excess of 50 per cent in both periods demonstrates how bank CDS spreads in the pre-crisis period, but above all in the crisis period, reflect a great deal of the risk expressed by the balance sheet variables, and, to a lesser extent, by market variables (demand, supply, liquidity, etc.) unrelated to bank-specific characteristics. These results confirms those reported by *Annaert* et al. (2009), which suggest that the variables used by structural credit risk models are not significant in explaining bank CDS spread changes in the period prior to the crisis.

In the period preceding the crisis qa1, pat2 and op1 are the only significant variables. The first two significant explanatory variables (qa1 and pat2) respected the sign expected in Table 1. Indeed, Table 4 shows a positive relationship between qa1 and bank CDS spreads, and a negative relationship between pat2 and bank CDS spreads. Nevertheless, the negative relationship in the pre-crisis period between pat2 and the CDS spreads in Table 4 conflicts with the results of Panel D of Figure A and Table 3. Both Panel D and the correlation results show how, in the pre-crisis period, the relationship between CDS spreads and pat2 was positive, hence high leverage values (calculated as Equity to Total Assets) corresponded to very low CDS spreads values. This implies that until the onset of the crisis, the market was not concerned by the very high leverage of numerous of banks.

The fact that leverage is a significant variable in the pre-crisis period confirms the findings of the study by *Almer* et al., according to which bank CDS spreads in the pre-crisis period were particularly sensitive to 'Insolvency Factors', one of which was leverage. What is more, this result also confirms the structural models' approach to leverage as a key variable in explaining CDS spreads.

In terms of the relationship between op1 and CDS spreads, in Table 1 two alternative signs were formulated. The results in Table 4 reveal that, in the pre-crisis period, the relationship between op1 and CDS spreads was positive. Hence in the pre-crisis period, a decrease in op1 brought about a decrease rather than an increase in bank CDS spreads: evidently, the market associated the fall in ROA with a high level of investment capable of generating positive cash and income flows in future.

It also emerges that, as expected, in the pre-crisis period the bank CDS market did not pay attention to any liquidity index. The liquidity crisis (in terms of both market liquidity risk and funding risk) was the last manifestation of the recent financial crisis. This outcome confirms the findings of the study by *Almer* et al. (2008), according to which 'Liquid Factors' did not have a significant impact on bank CDS spreads in the pre-crisis period.

In the crisis period, on the other hand, it emerges from Table 4 that the number of significant explanatory variables showed a tendency to grow with respect to the previous period (four rather than three). This indicates that the market probably pays greater attention to balance sheet indices particularly in periods of financial stress. On the other hand, Table 4 shows how only one of the explanatory variables that were significant during the crisis was significant also during the pre-crisis period: qa1. This implies that the type of variable to which the market pays attention tends to vary as economic and financial conditions vary. This is in line with the finding of *Annaert* at al. (2010) who finds that the determinants of bank CDS spreads vary strongly across time. This finding also confirms similar results in studies for bond spreads and indicates that models which attempt to explain changes in bank CDS spreads must be re-estimated as macro-economic conditions change in order to give the "right" information to regulators and policy makers. The variables which were significant during the crisis are qa1, pat1, op2 and liq1. Conversely both op1 and pat2 lost significance during the crisis period. Contrary to what was expected, in the period that takes into

account only the crisis, Leverage was not a significant variable in explaining bank CDS spreads. Hence it is not correct to assert that excessive use of leverage was associated with high bank CDS spreads. This emerges clearly from Panel D of Figure A, which shows the high leverage of the sample banks during both the pre-crisis period and the crisis period. In the first sub-period, CDS spreads remained low; while during the second period record peaks were seen. Only at the outbreak of the crisis (July 2007) did CDS spread values begin to rise significantly. Hence the outbreak of crisis was one of factors responsible for growth in bank CDS spreads, and not excessive leverage itself, although excessive bank leverage is considered one of the determinants of the crisis.

Despite the fact that these results seem to contradict the conclusions of Di Cesare e Guazzarotti (2010), who find that leverage remains one of the most significant variables in explaining CDSs spreads for U.S. non-financial firms even during the crisis period, it is important to recall that leverage of a bank is fundamentally a different variable from a firm's leverage. Indeed, prior to the crisis, quantitative limits on bank leverage were rare and only post-crisis there are talks of introducing bank leverage limits as an additional prudential tool to complement minimum capital adequacy requirements. Our study underlines the difference between the financial and non-financial sector CDSs and casts doubts on the predicitive value of models and combine both financial and non-financial firms.

All four of the explanatory variables that were significant during the crisis present the highest level of significance. Furthermore, the sign expected in Table 1 is respected for all variables except pat1.

In particular, as predicted, Table 4 highlights a positive relationship between qa1 and bank CDS spreads and a negative relationship between op2 and bank CDS spreads. As qa1 increases, the probability of default increases, while as op2 decreases the risk of default tends to increase.

Analysis of the signs of two of the four significant variables reveals that the probability of default tends to increase principally for banks that in recent years had a poor quality loan portfolio, and/or lower returns on equity.

In terms of the relationship between the liquidity index liq1 and CDS spreads, in Table 1 two alternative signs were hypothesized. The results of Table 4 show that during the crisis period, the relationship between liq1 and CDS spreads was negative. What is more, compared to the previous period, the sign of this relationship (though not significant) varied according to the period considered: positive in the pre-crisis period, and negative during the crisis. Analysis of Panel H of Figure A reveals how during the crisis period (July 2007 – March 2009) the relationship between liq1 and CDS spreads progressively switched sign from positive to negative. This becomes particularly clear from the second half of 2008 onwards. It was the crisis that caused the change in sign in the relationship between liq1 and CDS spreads.

All in all, in the pre-crisis period banks with fewer deposits, hence lower liquidity, were perceived as more risky by the market, and this factor tended to cause growth in CDS spreads; conversely, during the crisis, a high level of loans with deposits held constant was perceived by the market as positive sign, the sample banks being commercial banks and loans their core business. Growth in liq1 thus corresponded to a fall in CDS spreads.

Pat1, a significant explanatory variable during the crisis, has a different sign from the one expected: positive rather than negative. Pat1 was positive during the pre-crisis period also, although it was not significant. This positive relationship implies that the growth in pat1 was accompanied, in both the pre-crisis and the crisis period, by an increase rather than a decrease in the perceived probability of bank default. As Panel C of Figure A indicates, the positive relationship between pat1 and CDS spreads is particularly evident in the crisis period. The positive (rather than negative) sign of pat1 in Table 4 suggests that the market, above all in the crisis period, lacked faith in this capital index. The

banks in difficulty in the final period, with rapidly growing CDS spreads, had a TIER 1 Ratio well in excess of the minimum requirement and also above the average for their geographical area. What emerges is thus the limited efficacy of the capital index TIER 1 Ratio in safeguarding banks from the potential risk of default. This is confirmed, at least in part, by a number of recent proposals for reform of prudential banking regulations (Basel 3), that focus, among other things, on improving the quality of regulatory capital.

From Table 4 it is also evident that qa2 and liq2 are not significant variables either in the pre-crisis or in the crisis period.

Finally, to investigate whether the relationship between bank CDS spreads and balance sheet data changes in a period that takes into account not only the crisis (1 July 2007 – 31 March 2009), but also the less acute phase (1 April 2009 – 31 March 2010), a fifth panel regression with fixed effects was performed (see Table 4).

The final sample consisted of 536 observations for 55 banks. Table 4 shows that the eight balance sheet variables explain 65 per cent (Adjusted R-squared) of bank CDS spreads. Hence, even in the period that takes into account the full-blown crisis and the less acute phase, the relationship between balance sheet variables and bank CDS spreads does not change. Four variables are found significant: qa1, pat1, pat2 and op2. With the exception of pat2, the other three balance sheet variables cited above remained significant also in the period that takes into account the less acute phase of the crisis, though with a lower degree of significance, with the exception of op2. Moreover qa1, with varying degrees of significance, is the only significant variable in all three period considered: pre-crisis, crisis, and crisis period and less acute phase.

The results of the fifth panel regression reveal that, with the inclusion of the less acute phase of the crisis, pat2 becomes significant once more, exactly like the pre-crisis period, though with a lesser

degree of significance. Nevertheless, even in the latter period, leverage was not among the key determinants of bank CDS spreads. All four explanatory variables show the sign expected.

[Insert Table 4]

5. Robustness Tests

As the main goal of this paper is not to predict but to explain credit spreads, in the empirical analysis we used contemporaneous dependent and explanatory variables. However, bank CDS spreads may precede balance sheet data or react to the publication of results. To test this hypothesis, a number of further regressions were carried out. The first group of regressions considered bank CDS spreads at time t-1, the quarter preceding the quarter considered, and balance sheet data at time t, the quarter considered. The second group of panel regressions considered bank CDS spreads at time t+1, the quarter following the quarter considered, and balance sheet variables a time t. Both regressions with bank CDS spreads at time t-1 and those with bank CDS spreads at time t+1 were conducted on all five time periods considered in Table 4. Table 5, however, presents the results of the three principal periods only: the pre-crisis period (1 January 2005 - 30 June 2007), the 'during the crisis period' (1 July 2007 - 31 March 2009) and the 'during and "post" crisis period' (1 July 2007 - 31 March 2010).

Comparison of the results of the panel regressions in Table 5 with those of the panel regressions of Table 4, which consider both bank CDS spreads, and balance sheet variables at time t, reveals that bank CDS spreads did not react in advance to the crisis and required less than a three month lag to incorporate the balance sheet information. The CDS market is thus an efficient market capable of reacting to information as it is made public. For this reason, it is correct to consider both bank CDS spreads and balance sheet variables at time t.

The Adjusted R-squared values in Table 4 in all three time periods are higher than those obtained considering bank CDS spreads at time t+1. Moreover, in two of the three periods, the crisis period and the 'during and "post" crisis period', values are marginally higher even than those obtained considering bank CDS spreads at time t-1.

[Insert Table 5]

6. Conclusions

This paper investigates whether CDS spreads can be considered a good proxy for bank riskiness. The analysis was conducted on the pre-crisis period, the crisis period, and also on a period that takes into account the more and less acute phase, on a sample of 57 mid-tier to top-tier international banks (in terms of assets) with senior CDS spreads at 5 years. The explanatory variables considered consisted exclusively of balance sheet variables relating to the quality of bank assets, capital, earning potential and liquidity, since it is generally accepted that these are the key indicators capable of providing concise information of the health of an enterprise.

Fixed-effects panel regression yielded the following results. Bank CDS spreads, both in the pre-crisis period, but especially in the crisis period (acute and less acute), reflect the risk captured by balance sheet ratios. The lower explanatory power of the balance sheet indices in the pre-crisis period is mainly because bank CDS spreads were relatively flat at that time. As bank CDS spread grew, so did the explanatory power of the balance sheet variables. The crisis was thus a relevant event in the relationship between bank CDS spreads and balance sheet data. Consistently with what was emphasised during the crisis, it is thus correct to consider CDS spreads a proxy for bank riskiness, given that balance sheet variables explain a large part of bank CDS spreads.

The relationship between bank CDS spreads and balance sheet ratios was even stronger during the crisis period, when the number of significant explanatory variables showed a tendency to grow with respect to the previous pre-crisis period. Furthermore, bank CDS spreads seem to be influenced by different variables in the pre-crisis and crisis period. This finding confirms similar results in studies for both bond and CDSs spreads and indicates that models which attempt to explain changes in bank CDS spreads must be re-estimated as macro-economic conditions change in order to give the "right" information to regulators and policy makers.

The ratio Loan Loss Reserve to Gross Loans is the only significant variable in all the three periods considered. The probability of default is likely to increase principally for those banks with poor quality loan portfolios.

Contrary to what was expected, both Leverage and the TIER 1 Ratio were not among the determinants of bank CDS spreads in all three periods considered. Indeed, the sample banks showed high levels of leverage both in the pre-crisis period, when bank CDS spreads were moderate, and in the crisis period, when bank CDS spreads reached peak levels. What is more, the sample banks that ran into difficulty almost always had a TIER 1 Ratio well above the statutory minimum. Overall, doubts emerge in relation to the efficacy of the capital index TIER 1 Ratio as a safeguard against the risk of future default.

Finally, as expected, the bank CDS market in the pre-crisis period showed no interest in any of the liquidity indices considered. The liquidity crisis was in fact the last manifestation of the recent financial crisis.

On the whole, the existence of a strong relationship between the dynamics of banks CDS spreads and the economic and financial trend of the banks underlines the need for regulators and supervisory authorities to pay greater attention to bank CDS spreads, to enable them to identify in

advance signs of crisis in the banking sector and to avoid the consequences of further financial turmoil undermining the overall stability of the system.

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Notes

1. Allen and Gale (2007a, 2007b), Goodhart (2008), International Monetary Fund (IMF, 2008), International Organization of Securities Commissions (IOSCO, 2008), Bank for International Settlements (BIS, 2008, 2009), and Brunnermeier (2009) offer a detailed analysis of the subprime crisis.
2. The International Swap and Derivatives Association (ISDA) released sets of Credit Derivatives Definitions in 1999 (which were amended in 2001) and 2003. They are: Bankruptcy, Obbligation Acceleration, Obbligation Default, Failure to Pay, Repudiation/Moratorium, and Restructuring.
3. See European Central Bank (2009a, pp.64-70).
4. In particular, the national outstanding of credit default swaps, which ISDA began to survey at midyear 2001, grew from $631.5 billion at midyear 2001 to $62 trillion in 2007, reaching a peak. In the two subsequent years the number of CDS diminished, to $38.5 trillion in 2008 and $30.4 trillion in 2009. Recent reduction of the number of CDS is principally due to trade cancellations (International Swaps and Derivatives Association, 2010).
5. The quoting convention for CDSs is the annual premium payment as a percentage of the notional value of the reference obligation. Under certain conditions, this CDS premium should be approximately equal to the credit spread (yield minus risk-free rates) of the reference bond of the same maturity. See Bank for International Settlements (2003, p. 84).

6. Initially the literature concentrated on the structural models' theoretical determinants of corporate bond credit spreads, rather than CDS spreads. See, for example, *Collin-Dufresne* et al., 2001; Campbell and Taksler, 2003; Cremers et al., 2004 and, recently, Avramov at al., 2007.
7. See *Ashraf* et al. (2007). There are overall only 89 international banks with senior CDS spreads at 5 years. However, data problems and missing values allowed us to consider only a sample of 57 international banks.
8. 'Short Term Funding' denotes the sum of Customer Deposits, Banks Deposits and Total Money Market Funding.
9. 'Liquid Assets' denotes the sum of Government Securities, Trading Securities, Cash and Due from Banks, and Due from Other Banks.
10. See note 8.

References

Abid, F., and N. Naifar. 2006. The determinants of credit default swap rates: an explanatory study. *International Journal of Theoretical Applied Finance* 9: 23-42.

Alexopoulou, I., M. Andersson, and O.M. Georgescu. 2009. An Empirical Study on the Decoupling Movements between Corporate Bond and CDS Spreads. ECB Working Paper Series, August.

Allen, F., and D. Gale. 2007a. An introduction to financial crises. University of Pennsylvania and New York University, August.

Allen, F., and D. Gale. 2007b. Understanding Financial Crises. Claredon Lecture Series in Finance, Oxford: Oxford University Press.

Almer, T., T. Heidorn, and C. Schmaltz. 2008. The Dynamics of Short- and Long- Term CDS-spreads of Banks. Frankfurt School – Working Paper Series No. 95, April.

Anderson, R., and S. Sundaresan. 1996. Design and valuation of debt contrast. *Review of Financial Studies* 9: 37-68.

Anderson, R., S. Sundaresan, and P. Tychon. 1996. Strategic Analysis of Contingent Claims. *European Economic Review* 40: 871-81.

Annaert, J., M. De Ceuster, M. Van Roy, and C. Vespro. 2009. What determines euro area bank CDS spreads? National Bank of Belgium Working Paper No. 190, May.

Ashraf, D., Y. Altunbas, and J. Goddard. 2007. Who Transfers Credit Risk? Determinants of the Use of Credit Derivatives by Large US Banks. *The European Journal of Finance* 13: 483-500.

Aunon-Nerin, D., D. Cossin, T. Hricko, and Z. Huang. 2002. Exploring for the Determinants of Credit Risk in Credit Default Swap Transaction Data: Is Fixed-Income Markets' Information Sufficient to Evaluate Credit Risk? Working Paper, HEC-University of Lausanne and Fame, December.

Avramov, D., J. Gergana, and A. Philipov. 2007. Understanding Changes in Corporate Credit Spreads. *Financial Analysts Journal* 63: 90-105.

Bank for International Settlements. 2003. *Quarterly Review*, Basel, December.

Bank for International Settlements. 2008. *Annual Report*, Basel, June.

Bank for International Settlements. 2009. *Annual Report*, Basel, June.

Bank for International Settlements. 2010. *Annual Report*, Basel, June.

Benkert, C. 2004. Explaining Credit Default Swap Premia. *Journal of Futures Markets* 24: 71-92.

Black, F., and J.C. Cox. 1976. Valuing corporate securities: some effects of bond indenture provisions. *Journal of Finance* 31: 351-67.

Black, F., and M. Scholes. 1973. The pricing of options and corporate liabilities. *Journal of Political Economy* 81: 637-54.

Blanco, R., S. Brennan, and I.W. Marsh. 2003. An empirical analysis of the dynamic relationship between investment grade bonds and credit default swaps. Working Paper No. 211, Bank of England, May.

Blanco, R., S. Brennan, and I.W. Marsh. 2005. An empirical analysis of the dynamic relation between investment-grade bonds and credit default swaps. *Journal of Finance* 60: 2255-81.

Brunnermeier, M. 2009. Deciphering the Liquidity and Credit Crunch 2007-2008. *The Journal of Economic Perspectives* 23: 77-100.

Calice, G., and C. Ioannidis. 2009. An Empirical Analysis of the Impact of the Credit Default Swap Index Market on Large Complex Financial Institutions. School of Management, University of Bath, July.

Campbell, J.Y., and G.B. Taksler. 2003. Equity volatility and corporate bond yields. *Journal of Finance* 58: 2321-50.

Chen, L., D.A. Lesmond, and J.Z. Wei. 2007. Corporate Yield Spreads and Bond Liquidity. *Journal of Finance* 62: 119-49.

Collin-Dufresne, P., R.S. Goldstein, and J.S. Martin. 2001. The Determinants of Credit Spread Changes. *Journal of Finance* 51: 2177-208.

Cremers, M., J. Driessen, P.J. Maenhout, and D. Weinbaum. 2004. Individual Stock-Option Prices and Credit Spreads. Yale ICF Working Paper No. 04-14, December.

Daniels, K.N., and M. Shin Jensen. 2004. The effect of credit ratings on credit default swap spreads and credit spreads. Centre for Analytical Finance (CAF) Working Paper No. 191, December.

Das, S.R., and P. Hanouna. 2006. Credit Default Swap Spreads. *Journal of Investment Management* 4: 93-105.

Di Cesare, A., and G. Guazzarotti. 2010. An Analysis of the Determinats of Credit Default Swap Spread Changes Before and During the Subprime Financial Turmoil. Working Papers Banca d'Italia No. 749, marzo.

Dickinson, E. 2008. Credit Default Swaps: So Dear To Us, So Dangerous. Fordham University - School of Law, November.

Duffie, D., and K.J. Singleton. 1999. Modeling Term Structures of Defaultable Bonds. *Review of Financial Studies* 12: 687-720.

Eichengreen, B., A. Mody, M. Nedeljkovic, and L. Sarno. 2009. How the Subprime Crisis Went Global: Evidence from Bank Credit Default Swap Spreads. NBER Working Paper Series 14904, April.

Elton, E.J., M.J. Gruber, D. Agrawal, and C. Mann. 2001. Explaining the rate spread on corporate bonds. *Journal of Finance* 56: 247-77.

Ericsson, J., K. Jacobs, and R. Oviedo. 2009. The determinants of credit default swap premia. *Journal of Financial and Quantitative Analysis* 44: 109-32.

European Central Bank, 2009a. Credit Default Swaps and Counterparty Risk. Working Paper, August.

European Central Bank, 2009b. Financial Stability Review, June.

Goodhart, C.A.E. 2008. The background to the 2007 financial crisis. *International Economics and Economic Policy* 4: 331-46.

Greatrex, C.A. 2008. The Credit Default Swap Market's Determinants. Fordham University Department of Economics Discussion Paper No. 05, March.

Hart, O., and L. Zingales. 2009. A New Capital Regulation For Large Financial Institutions. University of Chicago, NBER & CEPR, April.

Hausman, J.A., 1978. Specification tests in econometrics. *Econometrica* 46: 1251-1371.

Huang, X., H. Zhou, and H. Zhu. 2008. A Framework for Assessing the Systemic Risk of Major Financial Institutions. CAREFIN Working Paper No. 11, October.

Hull, J., and A. White. 2000. Valuing credit default swap II: modelling default correlations. Unpublished manuscript, University of Toronto.

Hull, J., and A. White. 2001. The General Hull-White Model and Super Calibration. *Financial Analysts Journal* 57: 34-43.

Hull, J.C., M. Predescu, and A. White. 2004. The relationship between credit default swap spreads, bond yields, and credit rating announcements. *Journal of Banking and Finance* 28: 2789-811.

International Monetary Fund. 2008. *Global Financial Stability Report.* Washington DC, April.

International Organization of Securities Commissions. 2008. *Report on the subprime crisis*. Working Paper, May.

International Swaps and Derivatives Association. 2010. *ISDA Market Survey*. http://www.isda.org/statistics/pdf/ISDA-market-survey-historical-data.pdf.

Jarrow, R., and S.M. Turnbull. 1995. Pricing Derivatives on Financial Securities Subject to Credit Risk. *Journal of Finance* 50: 53-86.

Jarrow, R., D. Lando, and S.M. Turnbull. 1997. A Markov Model for the Term Structure of Credit Spreads. *Review of Financial Studies* 10: 481-523.

Kool, C.J.M.. 2006. Financial Stability in European Banking: The Role of Common Factors. Utrecht School of Economics - Utrecht University, the Netherlands, March.

Kress, J.C. 2010. Credit Default Swap Clearinghouses and Systemic Risk: Why Centralized Counterparties Must Have Access to Central Bank Liquidity? Social Science Research Network (SSRN) Paper, April.

Lando, D. 1994. Three essays on contingent claims pricing. Unpublisher manuscript, Ph.D. dissertation, Cornell University.

Lando, D. 1998. On Cox Processes and Credit Risky Securities. *Review of Derivatives Research* 2: 99-120.

Lehnert, T., and F. Neske. 2004. On the Relationship between Credit Rating Announcements and Credit Default Swap Spread for European Reference Entities. Limburg Institute of Financial Economics (LIFE) Working Paper 04-016, October.

Longstaff, F.A., and E.S. Schwartz. 1995. A Simple Approach to Valuing Riskly and Floating Rate Debt. *Journal of Finance* 50: 789-819.

Longstaff, F.A., S. Mithal, and E. Neis. 2005. Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Defualt Swap Market, *Journal of Finance* 60: 2213-53.

Madan, D., and U. Haluk. 1995. Pricing the Risks of Default. *Review of Derivatives Research* 2: 121-60.

Mella-Barral, P. 1997. Strategic Debt Service. *Journal of Finance* 52: 531-56.

Merton, R.C. 1974. On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *Journal of Finance* 29: 449-70.

Norden, L. and M. Weber. 2010. When Senior meets Junior: Information in Credit Default Swap Spreads of Large Banks. Social Science Research Network (SSRN) Paper, March.

Norden, L., and M. Weber. 2004. Informational efficiency of credit default swap and stock markets: The impact of credit rating announcements. *Journal of Banking and Finance* 28: 2813-43.

Raunig, B., and M. Sheicher. 2009. Are banks different? Evidence from the CDS market. Oesterreichische Nationalbank Working Paper No. 152, May.

Stulz R.N. 2009. Credit Default Swaps and the Credit Crisis. Social Science Research Network (SSRN) Paper, September.

Volz, M., and M. Wedow. 2009. Does banks' size distort market prices? Evidence for too-big-to-fail in the CDS market. Deutsche Bundesbank Discussion Paper, Series 2: Banking and Financial Studies No. 6, March.

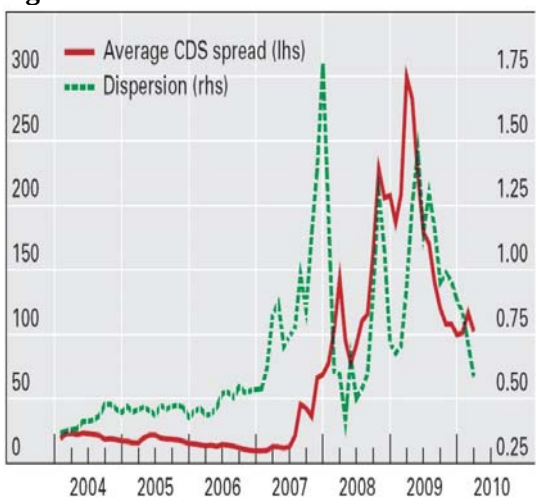
Zhang, B.Y., H. Zhou, and H. Zhu. 2005. Explaining credit default swap spreads with equity volatility and jump risks of individual firms. BIS Working Paper No. 181, September.

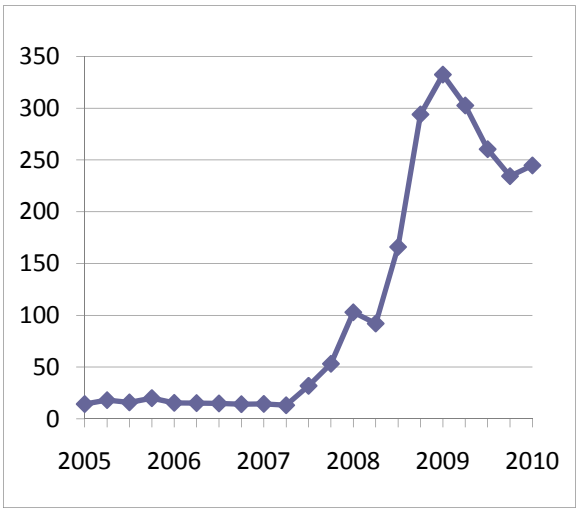
Zhou, C. 2001. The term structure of credit spreads with jump risk. *Journal of Banking and Finance* 25: 2015-40.

Zhu, H. 2004. An empirical comparison of credit spreads between the bond market and the CDS market. BIS Working Papers No. 160, August.

Tables and Figures

Figure 1. CDS market.





Notes: In the figure on the left, taken from the BIS Annual Report (2010), the CDS market is based on the CDS spreads of 34 large banks and 14 large insurance companies in Europe and North America. Average CDS spread (lhs) is in basis points. Dispersion (rhs) is the standard deviation of the cross section of CDS spreads, divided by the contemporaneous average.
The figure on the right show the trend of average CDS spread values for the 57 sample banks. Average values for bank CDS spreads are in base points.
Source: Bank for International Settlements. 2010. *Annual Report*, Basel, June (for the figure on the left) and Datastream Database (for the figure on the right).

Table 1. Explanatory variables and predicted sign

Variable	Description	Predicted sign
Asset Quality		
qa1	Loan Loss Reserve/Gross Loans (%)	POSITIVE
qa2	Unreserved Impaired Loans/Equity (%)	POSITIVE
Capital		
pat1	TIER 1 Ratio (%)	NEGATIVE
pat2	Leverage: Equity/Total Assets (%)	NEGATIVE
Operations		
op1	ROA (%) = Net Income/Average Total Assets	NEGATIVE / POSITIVE
op2	ROE (%) = Net Income/Average Equity	NEGATIVE
Liquidity		
liq1	Net Loans/Deposits & Short Term Funding (%)	POSITIVE / NEGATIVE
liq2	Liquid Assets/Deposits & Short Term Funding (%)	NEGATIVE

Table 2. Summary statistics on eight balance sheet indicators for sample banks

Variable	Pre-crisis period*		During the crisis period*		"Post" crisis period*	
	Mean (Std. Dev.)	Min. – Max.	Mean (Std. Dev.)	Min. – Max.	Mean (Std. Dev.)	Min. – Max.
Asset Quality						
Qa1	0.014	0.000-0.041	0.015	0.001-0.042	0.023	0.000-0.067
	(0.009)		(0.009)		(0.013)	
Qa2	1.370	0.000-107.945	0.295	0.000-36.044	0.325	0.018-1.284
	(9.505)		(1.900)		(0.214)	
Capital						
Pat1	0.078	0.047-0.139	0.080	0.051-0.145	0.100	0.060-0.164
	(0.013)		(0.015)		(0.019)	
Pat2	0.053	0.019-0.104	0.051	0.008-0.117	0.058	0.020-0.114
	(0.021)		(0.022)		(0.021)	
Operations						
Op1	0.008	-0.001-0.025	0.005	-0.044-0.022	0.002	-0.018-0.009
	(0.004)		(0.006)		(0.005)	
Op2	0.182	-0.071-0.562	0.098	-0.649-0.328	0.032	-0.642-0.224
	(0.060)		(0.138)		(0.137)	
Liquidity						
Liq1	0.820	0.139-2.031	0.870	0.125-1.993	0.886	0.215-1.876
	(0.351)		(0.381)		(0.373)	
Liq2	0.484	0.128-1.530	0.473	0.114-1.750	0.504	0.127-1.851
	(0.276)		(0.289)		(0.308)	

Notes: This table reports summary statistics on eight explanatory balance sheet variables for the sample banks for the pre-crisis period (1 January 2005 - 30 June 2007), the crisis period (1 July 2007 - 31 March 2009) and the "post" crisis period (1 April 2009 - 31 March 2010).

* The number of banks in the period preceding the crisis was 53, in the crisis period 55, and in the "post" crisis period 47.

The independent variables (qa1, qa2, pat1, pat2, op1, op2, liq1, and liq2) are defined in paragraphs 2.3.

Source Datastream Database and authors' calculations.

Table 3. Correlations in the pre-crisis period and during the crisis

	BPM (or CDS spreads)	
Variable	**Pre crisis period**	**During the crisis period**
Qa1	0.0107	0.1174*
Qa2	-0.0298	0.0133
Pat1	0.0031	0.1592*
Pat2	0.1372*	-0.0441
Op1	0.2041*	-0.3021*
Op2	0.1319*	-0.3214*
Liq1	-0.0146	0.1196*
Liq2	0.1339*	-0.1779*

Notes: The dependent variable (BPM or CDS spreads) and the independent variables (qa1, qa2, pat1, pat2, op1, op2, liq1, and liq2) are defined respectively in paragraphs 2.2 and 2.3.
The pre-crisis period spans from 1 January 2005 to 30 June 2007, while the crisis period extends from 1 July 2007 to 31 March 2009.
The variables with no * are independent.

Table 4. Panel Regressions Fixed-Effects

Variable	Whole period	Whole period and dummy crisis	Pre-crisis period	During the crisis period	During and "post" crisis period
Qa1	1670.804***	1859.056***	292.963*	5862.583***	1593.216**
	(394.840)	(348.600)	(130.967)	(1053.18)	(545.769)
Qa2	-0.837*	-0.219	-0.040	-0.756	-0.539
	(0.336)	(0.299)	(0.071)	(1.756)	(1.638)
Pat1	1170.657***	442.051**	34.228	2284.093***	878.135**
	(177.339)	(162.460)	(63.884)	(421.711)	(261.151)
Pat2	-1045.822***	-805.113**	-282.731***	-1007.206	-1825.982**
	(294.859)	(260.590)	(78.108)	(753.378)	(532.725)
Op1	-2813.332***	-1632.576*	1877.809***	2286.165	-1236.486
	(781.307)	(693.064)	(351.552)	(1411.507)	(1144.757)
Op2	-182.746***	-112.803***	-14.069	-287.654***	-161.719***
	(30.334)	(27.093)	(11.741)	(56.755)	(44.338)
Liq1	48.922**	4.691	5.205	-173.674***	-59.796
	(16.267)	(14.597)	(4.198)	(41.803)	(25.065)
Liq2	-61.719***	-44.778**	-4.285	-24.075	-38.687
	(17.058)	(15.087)	(4.050)	(40.436)	(27.682)
Dummy crisis		62.960***			
		(3.771)			
Number of observations	1042	1042	506	354	536
Number of sample banks	57	57	53	55	55
Adjusted R-squared	0.5760	0.6699	0.6242	0.6636	0.6509

Notes: The dependent variable is BPM, or CDS spreads, which measure the probability of default. The explanatory variables are 8 balance sheet ratios referring to asset quality (qa1 and qa2), capital (pat1 and pat2), operations (op1 and op2), and liquidity (liq1 and liq2). The dummy crisis identifies the start of the crisis (1 July 2007).

The dependent variable and the independent variables are defined respectively in paragraphs 2.2 and 2.3. 'Whole period' denotes the period from 1 January 2005 to 31 Marcho 2010 (latest data available). 'Pre-crisis period' denotes the period from 1 January 2005 to 30 June 2007.'During the crisis period' denotes the period from 1 July 2007 to 31 March 2009. 'During and "post" crisis period' denotes the period from 1 July 2007 to 31 March 2010.

Standard Errors of estimated coefficients are reported in parentheses.

*** denotes coefficient statistically different from zero (1% level, two-tail test), ** 5% level, * 10% level.

Table 5. Panel Regressions Fixed-Effects (Robustness Test)

Variable	CDS t-1			CDS t+1		
	Pre-crisis period	**During the crisis period**	**During and "post" crisis period**	**Pre-crisis period**	**During the crisis period**	**During and "post" crisis period**
Qa1	164.553 (180.227)	5369.763*** (952.113)	2451.319*** (551.325)	283.309 (174.686)	7739.342*** (1664.895)	1225.067 (925.957)
Qa2	-0.007 (0.078)	-1.357 (1.587)	-1.119 (1.654)	-0.059 (0.094)	-2.033 (2.773)	-0.704 (2.571)
Pat1	-72.790 (61.929)	1286.912** (381.658)	1010.722*** (264.131)	46.467 (85.234)	1505.8* (666.108)	-294.350 (432.849)
Pat2	- 176.789* (78.294)	-641.488 (681.786)	-342.148 (538.279)	-306.580** (104.183)	5136.536*** (1189.683)	776.609 (870.604)
Op1	109.155 (354.268)	1698.639 (1277.111)	-1463.076 (1158.025)	3999.907*** (468.943)	-7218.875** (2231.055)	- 10023.87*** (1824.147)
Op2	-4.405 (13.145)	-273.142*** (51.304)	-213.397*** (44.797)	-22.688 (15.661)	-56.170 (89.697)	153.059* (71.033)
Liq1	3.367 (4.217)	-130.528** (38.545)	-31.534 (25.665)	6.492 (5.600)	-63.730 (66.100)	1.427 (42.748)
Liq2	-1.762 (4.179)	1.122 (36.609)	-19.035 (27.996)	0.372 (5.403)	-103.639 (63.880)	-104.793* (45.526)
N.of observations	455	352	534	504	353	490
N. of sample banks	53	55	55	52	55	55
Adjusted R-squared	0.6497	0.5970	0.6357	0.5361	0.6120	0.5483

Notes: The dependent variable is BPM, or CDS spreads, which measure the probability of default. The explanatory variables are 8 balance sheet ratios referring to asset quality (qa1 and qa2), capital (pat1 and pat2), operations (op1 and op2), and liquidity (liq1 and liq2). The dependent variable and the independent variables are defined respectively in paragraphs 2.2 and 2.3.

'CDS t-1' denotes CDS spread values for the quarter preceding the quarter in progress; 'CDS t+1' denotes CDS spreads for the quarter following the quarter in progress.

The balance sheet data in both panel regressions are at time t (the quarter in progress). 'Pre-crisis period' denotes the period from 1 January 2005 to 30 June 2007. 'During the crisis period' denotes the period from 1 July 2007 to 31 March 2009. 'During and "post" crisis period' denotes the period from 1 July 2007 to 31 March 2010.

Standard Errors of estimated coefficients are reported in parentheses. Adjusted R-squared derives from areg.

*** denotes coefficient statistically different from zero (1% level, two-tail test), ** 5% level, * 10% level.

Appendix

Table A. Summary statistics on CDS spreads for sample banks

	Pre-crisis period		During the crisis period		"Post" crisis period	
Banks (Country)	**Mean (Std. Dev.)**	**Min. – Max.**	**Mean (Std. Dev.)**	**Min. – Max.**	**Mean (Std. Dev.)**	**Min. – Max.**
Erste Group Bank AG (AT)	19.93 (13.47)	1 - 75.08	120.46 (103.78)	13.69 - 487.13	186.07 (69.30)	110.88 - 401.16
Raiffeisen International Bank Holding (AT)	37.19 (36.53)	1 - 224.97	171.28 (95.90)	70.90 - 535	213.07 (75.68)	134.56 - 451.69
Dexia SA (BE)	9.42 (1.66)	6.50 - 14	166.55 (122.76)	11.40 - 550	236.81 (77.11)	159.46 - 469.40
Fortis (BE)	16.50 (5.26)	8 - 31.62	74.83 (64.75)	10.80 - 666.70	74.06 (22.08)	48.87 - 150
KBC Groep NV (BE)	9.60 (1.72)	6.90 - 15.70	126.33 (76.65)	9.80 - 343.30	185.79 (65.46)	99.62 - 325
Danske Bank A/S (DK)	7.08 (3.11)	3.50 - 21	68.67 (61.87)	4.10 - 225	101.16 (36.45)	60.56 - 217.10
Banco Bilbao Vizcaya Argentaria (ES)	9.71 (1.36)	7.10 - 16.50	76.08 (36.76)	11.50 - 184.95	95.32 (19.49)	66.91 - 156.83
Banco de Sabadell SA (ES)	24.20 (0)	24.20	167.02 (97.92)	19.60 - 371.66	203.01 (56.41)	133.39 - 337.30
Banco Popular Espanol (ES)	11.27 (3.92)	7.97 - 31.54	116.50 (112.71)	14.78 - 340	188.52 (50.72)	129.77 - 323.10
Banco Santander SA (ES)	10.22 (1.67)	7 - 17.50	78.21 (37.61)	11.50 - 183.61	93.44 (19.51)	65.75 - 153.82
Caja de Ahorros de Valencia Castellon Y Alicante Bancaja (ES)	16.58 (4.06)	9.50 - 31.36	387.21 (299.71)	28.60 - 1,148	475.75 (117.75)	325.33 - 896.92
Caja de Madrid (ES)	21.45 (3.03)	14.80 - 27.05	284.59 (236.85)	23 - 750	457.83 (79.30)	329.88 - 719.30
Banque Federale des Banques (FR)	68.13 (55.44)	1 - 265.92	14.78 (0)	14.78	24.42 (24.66)	14.78 - 98.60
BNP Paribas (FR)	7.81 (1.97)	5 - 14.50	54.99 (25.49)	7.50 - 143.13	67.63 (13.17)	46.88 - 112.64
Crédit Agricole SA (FR)	8.06 (1.84)	5.50 - 13.50	70.69 (32.96)	8 - 165	91.95 (13.36)	60.69 - 122.83
Natixis (FR)	9.28 (1.79)	6.30 - 15	145.67 (93.63)	10.30 - 390.18	181.08 (73.55)	103.07 - 341.20
Société Générale (FR)	8.64 (2.30)	5.70 - 15.50	73.33 (35.83)	8.50 - 165	90.04 (12.31)	60.72 - 122.67
Deutsche Bank AG Registered (DE)	13.61 (2.99)	8.70 - 26.30	82.92 (38.69)	14.50 - 186.20	94.94 (18.59)	67.02 - 151.475

Deutsche Postbank AG (DE)	20.50 (3.17)	6.50 - 28.90	54.73 (23.50)	18.30 - 105.30	50.54 (8.70)	38.64 - 81
Allied Irish Banks PLC (IE)	8.81 (2.35)	5.70 - 17.50	151.09 (137.56)	10.40 - 646.72	279.19 (80.91)	159.81 - 579.42
Anglo Irish Bank Corporation LTD (IE)	20.20 (5.93)	3 - 41	279.13 (210.52)	14 - 950	460.58 (121.90)	307.83 - 837.66
Bank of Ireland (IE)	8.62 (1.79)	5 - 14.50	169.04 (147.37)	10.10 - 670.28	270.51 (89.19)	154.58 - 590.98
Banca Monte dei Paschi di Siena (IT)	13.70 (4.82)	6 - 25	75.40 (35.01)	9.50 - 171.68	82.02 (18.24)	55.79 - 150
Banco Popolare SCARL (IT)	21.98 (5.36)	11 - 37.79	18.07 (6.62)	14 - 28.39	-	-
Intesa Sanpaolo (IT)	11.78 (3.78)	5.40 - 19.50	66.65 (39.51)	8.50 - 200	68.16 (20.01)	44.53 - 155.70
UBI Banca SCPA (IT)	17.63 (2.80)	10 – 25	70.48 (50.75)	13 - 190	83.69 (21.34)	59.70 - 171
Unicredit SPA (IT)	12.84 (2.76)	7 - 20.70	83.64 (50.70)	10 - 278.74	102.44 (19.80)	68.52 - 190
Rabobank (NL)	6.21 (2.01)	2.50 - 10	69.21 (50.96)	5 - 204.30	82.71 (29.56)	52.18 - 189.07
DNB NOR ASA (NO)	-	-	100.27 (45.30)	37.50 - 188.11	86.53 (32.07)	49.53 - 185.60
Banco Espirito Santo (PT)	13.33 (3.10)	8.20 - 22.70	91.32 (44.56)	12.50 - 230	134.62 (30.91)	92.18 - 263.97
Nordea Bank AB (SE)	11.05 (2.67)	5 - 19.31	61.43 (42.45)	14.78 - 165	81.96 (25.20)	49.60 - 154.30
Skandinaviska Enskilda Banken (SE)	15.59 (9.66)	6.68 - 31.54	79.72 (69.28)	8.33 - 281.50	139.17 (36.17)	92.99 - 238.40
Svenska Handelsbanken (SE)	12.06 (3.34)	5.41 - 19.31	51.11 (42.08)	14.78 - 163.40	77.97 (25.97)	47.71 - 154.30
Swedbank AB (SE)	25.39 (7.82)	10.94 - 35.24	89.95 (96.55)	14.78 - 362	180.16 (74.39)	102.48 - 328
Credit Suisse Group AG (SW)	14.90 (3.73)	9.20 - 25.50	98.42 (55.14)	17.50 - 262.88	88.37 (30.27)	52.80 - 190.33
Alliance & Leicester PLC (UK)	14.36 (12.42)	1 - 78.78	131.33 (88.15)	11.78 - 471	82.04 (23.05)	54.77 - 154.50
Barclays PLC (UK)	8.52 (1.94)	5.30 - 15.80	103.14 (59.44)	11 - 270	108.61 (37.10)	70.38 - 220
Bradford & Bingley PLC (UK)	25.04 (16.08)	1 - 84.56	320.93 (298.33)	31.67 - 1,591	439.34 (80.51)	325.40 - 610.20
HBOS PLC	8.44 (2.58)	4.90 - 16.50	118.43 (69.90)	11.40 - 500.80	148.63 (26.55)	102.23 - 220.03

(UK)						
HSBC Holdings PLC (UK)	8.46 (2.19)	4.90 - 15.50	70.89 (38.04)	10.40 - 170.59	72.77 (22.01)	51.77 - 158.57
Lloyds Banking Group PLC (UK)	6.97 (2.43)	3.50 - 15.50	75.60 (49.77)	6.50 - 221.05	143.42 (26.87)	99.35 - 207.50
Royal Bank of Scotland Group (UK)	7.84 (2.50)	3.50 - 15.50	98.92 (57.50)	9 - 299.60	145.19 (26.17)	99.99 - 210.90
Standard Chartered PLC (UK)	16.02 (1.91)	8.50 - 22.50	40.10 (23.77)	16.20 - 63.70	63.70 (0)	63.70
Bank of America Corporation (US)	13.59 (3.79)	7.80 - 23.80	108.99 (71.70)	13.50 - 400.68	157.07 (58.83)	91.06 - 397.50
JP Morgan Chase & Co. (US)	20.94 (6.97)	11 - 43.50	95.17 (44.50)	19.80 - 242.05	83.14 (35.33)	44.24 - 199.10
National City Corporation (US)	21.62 (4.80)	10.40 - 29.44	311.84 (560.67)	18.30 - 2,969	733 (0)	733
US Bancorp (US)	-	-	69.85 (51.94)	1 - 115.30	113 (0)	113
Wachovia Corporation (US)	13.69 (2.64)	8.20 - 21.30	162.16 (124.98)	14.60 - 1,560	248.81 (12.63)	86.53 - 311.21
Washington Mutual INC (US)	35.70 (10.51)	18.80 - 63.20	2,138 (2,580)	41.40 - 6,235	6,055 (0)	6,055
Wells Fargo & Co. (US)	11.93 (3.36)	6 - 19.20	98.95 (57.28)	11.40 - 307.85	119.07 (49.36)	63.04 - 312.50
Mitsubishi UFJ Financial Group (JP)	13.67 (5.44)	5.50 - 29	69.22 (38.50)	6.90 - 163.80	68.29 (16.66)	37.60 - 115
Mizuho Financial Group Inc. (JP)	28.85 (7.27)	12.21 - 34.91	37.74 (10.48)	13.50 - 48.50	43 (0)	43
Sumitomo Mitsui Financial Group (JP)	13.87 (5.46)	5.20 - 25.20	69.97 (39.89)	6.90 - 150	69.84 (16.15)	42 - 115
Aust and NZ Banking Group (AU)	8.31 (1.95)	4.40 - 13.50	85.10 (51.37)	5.50 - 228.27	86.88 (20.83)	61.03 - 163.07
Commonwealth Bank of Australia (AU)	8.54 (2.61)	4.40 - 19.10	82.15 (48.39)	5 - 218.30	84.66 (20.95)	55 - 159.14
National Australia Bank LTD (AU)	8.30 (2.01)	4.50 - 14	85.92 (51.40)	4.90 - 225	87.07 (20.96)	61.03 - 163.58
Westpac	8.37	4.70 - 14.20	81.51	5.50 - 221.73	84.74	57 - 159.16

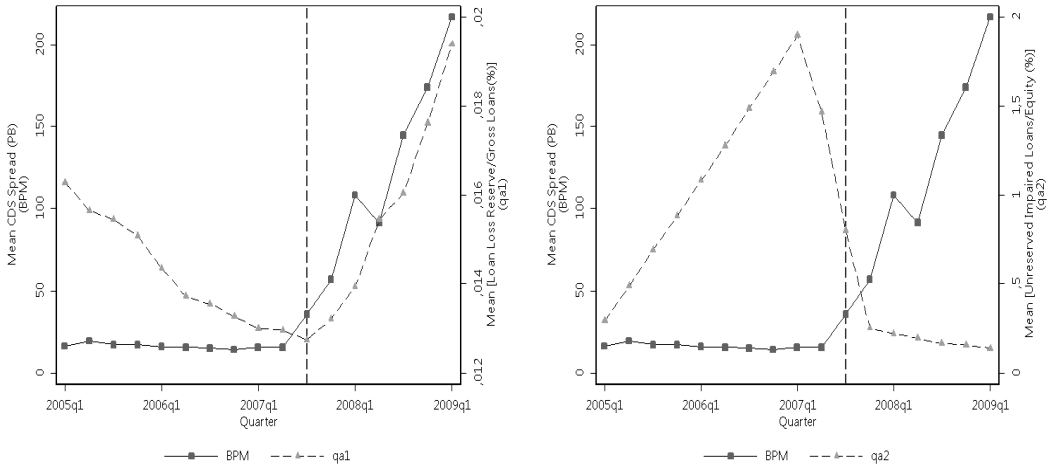
Banking Corporation (AU)	(1.93)	(48.52)	(20.83)

	Pre-crisis period		During the crisis period		"Post" crisis period	
Country Average	**Mean (Std. Dev.)**	**Min. – Max.**	**Mean (Std. Dev.)**	**Min. – Max.**	**Mean (Std. Dev.)**	**Min. – Max.**
Austria (2)	**28.56 (25)**	**1 - 150.02**	**145.87 (99.84)**	**42.29 - 511.06**	**199.57 (72.49)**	**122.72 - 426.42**
Belgium (3)	**11.84 (2.88)**	**7.13 - 20.44**	**122.57 (88.05)**	**10.66 - 520**	**165.55 (54.88)**	**102.65 - 314.80**
Denmark (1)	**7.08 (3.11)**	**3.50 - 21**	**68.67 (61.87)**	**4.10 - 225**	**101.16 (36.45)**	**60.56 - 217.10**
Espania (6)	**15.57 (2.34)**	**11.76 - 24.69**	**184.93 (136.92)**	**18.16 - 496.45**	**252.31 (57.19)**	**175.17 - 431.21**
France (5)	**20.38 (12.66)**	**4.70 - 64.88**	**71.89 (37.58)**	**9.81 - 175.61**	**91.02 (27.41)**	**57.22 - 159.58**
Germany (2)	**17.05 (3.08)**	**7.60 - 27.60**	**68.82 (31.09)**	**16.40 - 145.75**	**72.74 (13.64)**	**52.83 - 116.23**
Ireland (3)	**12.54 (3.35)**	**4.56 - 24.33**	**199.75 (165.15)**	**11.50 - 755.66**	**336.76 (97.33)**	**207.40 - 669.35**
Italy (5)	**15.58 (3.90)**	**7.88 - 25.59**	**62.84 (36.51)**	**11- 173.76**	**84.07 (19.84)**	**57.13 - 166.67**
Netherlands (1)	**6.21 (2.01)**	**2.50 - 10**	**69.21 (50.96)**	**5 - 204.30**	**82.71 (29.56)**	**52.18 - 189.07**
Norway (1)	**-**	**-**	**100.27 (45.30)**	**37.50 - 188.11**	**86.53 (32.07)**	**49.53 - 185.60**
Portugal (1)	**13.33 (3.10)**	**8.20 - 22.70**	**91.32 (44.56)**	**12.50 - 230**	**134.62 (30.91)**	**92.18 - 263.97**
Sweden (4)	**16.02 (5.87)**	**7 - 26.35**	**70.55 (62.59)**	**13.16 - 242.97**	**119.81 (40.43)**	**73.19 - 218.75**
Switzerland (1)	**14.90 (3.73)**	**9.20 - 25.50**	**98.42 (55.14)**	**17.50 - 262.88**	**88.37 (30.27)**	**52.80 - 190.33**
U K (8)	**11.95 (5.25)**	**4.07 - 33.08**	**119.91 (85.61)**	**13.49 - 448.46**	**150.46 (30.28)**	**108.44 - 230.67**
U S (7)	**19.56 (5.67)**	**10.33- 34.19**	**486.84 (569.96)**	**19.58 - 1,930**	**1,072 (22.30)**	**1,026 - 1,160**
Japan (3)	**18.79 (6.05)**	**7.63 - 29.70**	**58.97 (29.62)**	**9.10 - 120.76**	**60.37 (10.93)**	**40.86 - 91**
Australia (4)	**8.38 (2.12)**	**4.50 - 15.20**	**83.67 (49.92)**	**5.22 - 223.32**	**85.83 (20.89)**	**58.51 - 161.23**

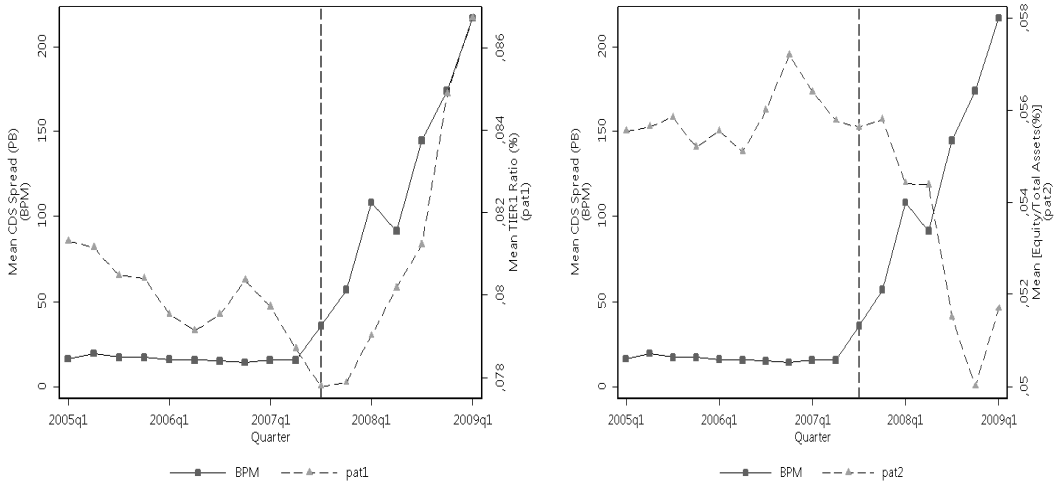
Notes: This table reports summary statistics on five year senior CDS spreads for the 57 sample banks per for the pre-crisis period (1 January 2005 - 30 June 2007), for the crisis period (1 July 2007 - 31 March 2009) and for the "post" crisis period (1 April 2009 - 31 March 2010).
Mean, Standard Deviation (Std. Dev.), Median, Minimum (Min.) and Maximum (Max.) are expressed in basis points.
AT: Austria; AU: Australia; BE: Belgium; DE: Germany; DK: Denmark; ES: Spain; FR: France; IE: Ireland; IT: Italy; NL: Netherlands; NO: Norway; PT: Portugal; SE: Sweden; SW: Switzerland; UK: United Kingdom; US: United States. JP: Japan.
CDS spread values for DNB NOR ASA start on 6 May 2008.
CDS spread values for US Bancorp start on 11 marzo 2008.
Banco Popolare SCARL had no CDS contract in the "post" crisis period.
With reference to the Country Average, the number of observations is indicated in brackets.
Source: Datastream Database, authors' calculations.

Figure A. Times-Series Graphs

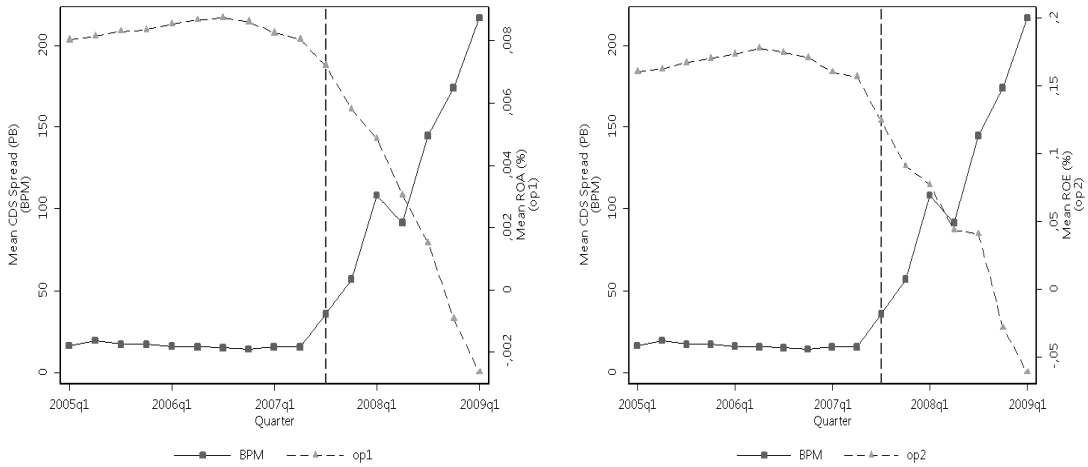
Panel A and B



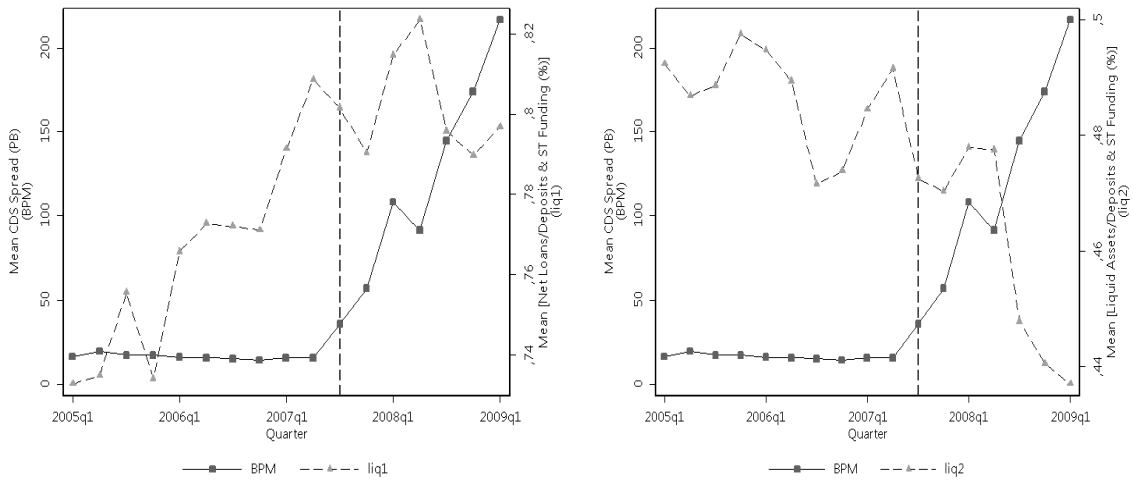
Panel C and D



Panel E and F



Panel H and G



Notes: These figures show the relationship between mean CDS spreads of sample banks and the mean of each balance sheet ratio used (qa1, qa2, pat1, pat2, op1, op2, liq1 and liq2). The sample period is from 1 January 2005 to 31 March 2009. The dashed vertical line coinciding with the start of the third quarter 2007 (July 2007) indicates the outbreak of the crisis.