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A value at risk analysis of credit default swaps

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Conference on the Interaction of Market and Credit Risk

6–7 December 2007, Berlin

Thursday, 6 December

8:30 – 9:00	Registration (Harnack Haus)
9:00 – 9:15	**Welcome Address by Hans Reckers (Deutsche Bundesbank)**
Session 1	**Banking and Securitization** **Chair: Myron Kwast (Federal Reserve Board)**
9:15 – 10:15	**Recent Financial Market Developments** **Keynote address by E. Gerald Corrigan (Goldman Sachs)**
10:15 – 11:05	**Banking and Securitization** Wenying Jiangli (Federal Deposit Insurance Corporation) Matthew Pritsker (Federal Reserve Board) Peter Raupach (Deutsche Bundesbank) Discussant: Deniz O. Igan (International Monetary Fund)
11:05 – 11:30	**Refreshments**
Session 2	**Integrated Modelling of Market and Credit Risk I** **Chair: Klaus Duellmann (Deutsche Bundesbank)**
11:30 – 12:10	**Regulatory Capital for Market and Credit Risk Interaction: Is Current Regulation Always Conservative?** Thomas Breuer (Fachhochschule Vorarlberg) Martin Jandačka (Fachhochschule Vorarlberg) Klaus Rheinberger (Fachhochschule Vorarlberg) Martin Summer (Oesterreichische Nationalbank) Discussant: Simone Manganelli (European Central Bank)

12:10 – 13:00	**An Integrated Structural Model for Portfolio Market and Credit Risk**
	Paul H. Kupiec (Federal Deposit Insurance Corporation)
	Discussant: Dan Rosen (R^2 Financial Technologies Inc.)
13:00 – 14:30	**Lunch**
Session 3	**Integrated Modelling of Market and Credit Risk II** **Chair: Til Schuermann (Federal Reserve Bank of New York)**
14:30 – 15:20	**The Integrated Impact of Credit and Interest Rate Risk on Banks: An Economic Value and Capital Adequacy Perspective**
	Mathias Drehmann (European Central Bank) Steffen Sorensen (Bank of England) Marco Stringa (Bank of England)
	Discussant: Jose A. Lopez (Federal Reserve Bank of San Francisco)
15:20 – 16:10	**An Economic Capital Model Integrating Credit and Interest Rate Risk**
	Piergiorgio Alessandri (Bank of England) Mathias Drehmann (European Central Bank)
	Discussant: Andrea Sironi (Bocconi University)
16:10 – 16:40	**Refreshments**
16:40 – 18:00	**Panel discussion** **Moderator: Myron Kwast (Federal Reserve Board)** **Panelists: Pierre Cailleteau (Moody's),** **Christopher Finger (RiskMetrics),** **Andreas Gottschling (Deutsche Bank),** **David M. Rowe (SunGard)**
20:00	**Conference Dinner (with Gerhard Hofmann, Deutsche Bundesbank)**

Friday, 7 December

Session 4 — **Risk Measurement and Markets**

Chair: Thilo Liebig (Deutsche Bundesbank)

9:00 – 9:50 — **A Value at Risk Analysis of Credit Default Swaps**

Burkhard Raunig (Oesterreichische Nationalbank)

Martin Scheicher (European Central Bank)

Discussant: Alistair Milne (Cass Business School)

9:50 – 10:40 — **The Pricing of Correlated Default Risk: Evidence From the Credit Derivatives Market**

Nikola Tarashev (Bank for International Settlements)

Haibin Zhu (Bank for International Settlements)

Discussant: David Lando (Copenhagen Business School)

10:40 – 11:10 — **Refreshments**

11:10 – 12:10 — **Structural Models and the Linkage between Equity and Credit Markets**

Keynote Address by Hayne Leland (The University of California, Berkeley)

Session 5A — **Securitization, Regulation and Systemic Risk**

Chair: Hayne Leland (The University of California, Berkeley)

12:10 – 13:00 — **Solvency Regulation and Credit Risk Transfer**

Vittoria Cerasi (Milano-Bicocca University)

Jean-Charles Rochet (Toulouse University)

Discussant: Loriana Pelizzon (University of Venice)

13:00 – 14:30 — **Lunch**

14:30 – 15:20 — **Determinants of Banks' Engagement in Loan Securitization**

Christina E. Bannier (Frankfurt School of Finance and Management)

Dennis N. Hänsel (Goethe University Frankfurt)

Discussant: Gabriel Jimenez (Bank of Spain)

15:20 – 16:10	**Systemic Bank Risk in Brazil: An Assessment of Correlated Market, Credit, Sovereign and Inter-Bank Risk in an Environment with Stochastic Volatilities and Correlations**
	Theodore M. Jr. Barnhill (The George Washington University)
	Marcos Rietti Souto (International Monetary Fund)
	Discussant: Mathias Drehmann (European Central Bank)
Session 5B	**Credit Dependencies and Market Risk** **Chair: Kostas Tsatsaronis (BIS)**
12:10 – 13:00	**Interaction of Market and Credit Risk: An Analysis of Inter-Risk Correlation and Risk Aggregation**
	Klaus Böcker (UniCredit Group)
	Martin Hillebrand (Sal. Oppenheim)
	Discussant: Rüdiger Frey (University of Leipzig)
13:00 – 14:30	**Lunch**
14:30 – 15:20	**Market Conditions, Default Risk and Credit Spread**
	Dragon Tang (Kennesaw State University)
	Hong Yan (University of South Carolina)
	Discussant: Til Schuermann (Federal Reserve Bank of New York)
15:20 – 16:10	**The Effect of Seniority and Security Covenants on Bond Price Reactions to Credit News**
	David D. Cho (State University of New York at Buffalo)
	Hwagyun Kim (Texas A&M University)
	Jungsoon Shin (State University of New York at Buffalo)
	Discussant: Joerg Rocholl (European School of Management and Technology in Berlin)
16:10 – 16:30	**Final Remarks by Philipp Hartmann (European Central Bank)**
16:30 – 17:00	**Refreshments**

A Value at Risk Analysis of Credit Default Swaps

Burkhard Raunig[1] and Martin Scheicher[2]

This version: December 2007

Abstract

We study the risk of holding credit default swaps (CDS) in the trading book. In particular, we compare the Value at Risk (VaR) of a CDS position to the VaR for investing in the respective firm's equity. Our sample consists of CDS – stock price pairs for 86 actively traded firms over the period from March 2003 to October 2006. We find that the VaR for a stock is usually far larger than the VaR for a position in the same firm's CDS. However, the distance between CDS VaR and equity VaR is markedly smaller for firms with high credit risk. The distance also declines for longer holding periods. We also observe a positive correlation between CDS and equity VaR.

JEL classification: E43, G12, G13;

Keywords: Credit default swap, Value at Risk, Capital structure arbitrage

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Non-technical summary

Credit derivatives such as Credit Default Swaps (CDS) have significantly simplified the trading of credit risk over the last few years. A standardised contract design, low transaction costs and a large and heterogeneous set of market participants have helped the CDS to hold the benchmark function for the price discovery process in the corporate debt market. Today the CDS is the most popular traded credit derivative.

We study the risk of holding credit default swaps (CDS) in the trading book. In particular, we compare the Value at Risk (VaR) of a CDS position to the VaR for investing in the respective firm's equity. Our sample consists of CDS – stock price pairs for 86 actively traded firms over the period from March 2003 to October 2006. We find that the VaR for a stock is usually far larger than the VaR for a position in the same firm's CDS. However, the distance between CDS VaR and equity VaR is markedly smaller for firms with high credit risk. The distance also declines for longer holding periods. We also observe a positive correlation between CDS and equity VaR.

Nichttechnische Zusammenfassung

Kreditderivate wie Credit Default Swaps (CDS) haben in den letzten Jahren den Handel mit Kreditrisiko signifikant vereinfacht. Ein standardisiertes Kontrakt-Design, niedrige Transaktionskosten und eine große and heterogene Gruppe von Marktteilnehmern haben dazu beigetragen, dass CDS die Benchmark - Funktion für die Preisbestimmung im Markt für Unternehmens-Verschuldung erreichen. Heute ist der CDS das am meisten gehandelte Kreditderivat.

Wir analysieren das Risiko von CDS, die im Handelsbuch gehalten werden. Wir vergleichen den Value at Risk (VaR) der CDS Position mit dem VaR für eine Position in der Aktie der gleichen Firma. Unsere Stichprobe umfasst CDS – Aktien Paare für 86 aktiv gehandelte Firmen im Zeitraum von März 2003 bis Oktober 2006. Wir finden, dass der VaR der Aktie meistens den VaR der CDS - Position deutlich übersteigt. Die Distanz zwischen dem CDS - VaR und dem Aktien - VaR ist jedoch bei Firmen mit hohem Kreditrisiko deutlich geringer. Die Distanz sinkt auch bei längeren Haltedauern. Wir beobachten weiter eine positive Korrelation zwischen dem CDS - VaR und dem Aktien - VaR.

Introduction

Credit derivatives such as Credit Default Swaps (CDS) have significantly simplified the trading of credit risk over the last few years[3]. A standardised contract design, low transaction costs and a large and heterogeneous set of market participants have helped the CDS to hold the benchmark function for the price discovery process in the corporate debt market. Today the CDS is the most popular traded credit derivative.

A CDS provides insurance against losses arising to creditors from a firm's default and the CDS market quote is the cleanest available measure for the market price of corporate default risk. Historically, individual bond features such as seniority, coupon structure, embedded options and the fact that many investors follow a buy and hold strategy have contributed to the comparatively low liquidity in the corporate bond market. In contrast, the standardisation of CDS contracts has supported the development of an active market and therefore reduced the liquidity premia observed in corporate bond spreads.[4] In addition, CDS data remove the need to specify a risk-free term structure in order to calculate credit spreads. Before the advent of a liquid credit risk transfer market, credit risky instruments such as loans or corporate bonds could not reliably be marked to market. Now, credit risky instruments can be actively traded, leading to a "convergence" of the formerly divided banking and trading books.

In this paper we study the risk of holding a CDS in the trading book. Thus, we focus on the risk of CDS trading rather than on using a CDS to hedge credit risk. As we treat the credit risky investment as a pure tradable claim we apply a mark-to-market approach for its valuation. In particular, we compare the Value at Risk (VaR) of a CDS protection seller to the VaR for the same notional amount in the respective firm's equity. Our sample consists of CDS – stock price pairs for 86 actively traded firms over the period from March 2003 to October 2006. We measure CDS and equity VaR by means of historical simulation (HS) and study the time series behaviour of the two risk measures as well as their comovement.[5]

The combined risk modelling of stock prices and credit spreads is specifically relevant for the recently popular trading strategy of capital structure arbitrage. This strategy relies on relative pricing differences between a firm's debt and equity and is commonly used by hedge funds and banks' proprietary traders. [6]

One of our main findings is that the VaR for a stock is typically far larger than the VaR for a position in the same firm's CDS. However, the distance between the two VaRs shrinks for firms with higher credit risk and declines with increasing holding period. Moreover, both risk measures are significantly positively correlated. Based on a simple analysis of the Merton

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[3] In this paper, default risk is defined as the exposure to losses arising from a borrower's default, whereas credit risk also captures the losses arising from a borrower's downgrading.
[4] Blanco et al. (2005) document that CDS premia lead bond spreads and are taking an increasingly important role in the price discovery process.
[5] Some of the recent papers on market pricing of CDS are Ericsson et al. (2005), Zhang et al. (2005), Acharya and Johnson (2007) or Huang and Zhou (2007).
[6] Yu (2006) offers an empirical analysis of the profitability of this trading strategy.

(1974) model we argue that our empirical results are in accordance with the structural modelling approach to default risk.

The rest of the paper is organised as follows. In section I we describe the mechanism of credit default swaps, the sample and the VaR model. Section II contains our empirical analysis. In Section III we summarize our main results and provide some conclusions.

I. Sample and methodology

A. The CDS market

CDS transfer the risk that a certain individual entity defaults from the "protection buyer" to the "protection seller" in exchange for the payment of a premium. They are the most frequently traded credit derivative.[7] Commonly, CDS have a maturity of one to ten years with most of the liquidity concentrated on the five year horizon. The details of a CDS transaction are recorded in the CDS contract, which is usually based on a standardised agreement prepared by the International Swaps and Derivatives Association (ISDA), an association of major market participants. The contract defines all "credit events" where the protection seller needs to compensate the protection buyer. Typically five events are included[8]:

- the reference entity fails to meet payment obligations when they are due
- Bankruptcy
- Repudiation
- Material adverse restructuring of debt
- Acceleration or Default of Obligation

In a CDS transaction, the premium, which the buyer of credit risk (i.e. the protection seller) receives is expressed as an annualised percentage of the notional value of the transaction and this value is recorded as the "market price" of the CDS in data bases such as Bloomberg.

CDS have become the most commonly used credit derivative because they enable investors to synthetically trade pure credit risk. Using no-arbitrage arguments, Duffie (1999) shows that the CDS premium theoretically equals the spread over LIBOR on a par floating rate note. Hence, the risk – return structure of a CDS protection buyer resembles a trade where the investor buys a corporate bond and hedges the interest rate risk in order to isolate the credit risk component in the bond.

If any of the events stipulated in the contract occurs, then the compensation will be transferred, either through cash settlement where the price difference between the current value and the nominal value of the reference asset is transferred or through physical

[7] See Fitch (2006) for a detailed survey of the credit derivatives market.
[8] Packer and Zhu (2005) discuss different contract specifications and their impact on observed CDS prices.

settlement where the bond specified in the CDS contract is delivered from the protection buyer to the seller. Most contracts specify physical settlement.

The launch of harmonised CDS indices has been a major step in the evolution of the credit risk transfer market. In June 2004 a new family of indices was introduced, namely iTraxx in Europe and Asia and CDX in North America. This harmonisation has led to generally accepted benchmarks and therefore increased market transparency and market liquidity in the credit market.

The composition of this index family provides the basis for our sample selection. The indices are calculated on a daily frequency and are divided into several subgroups, ranging from sector categories to a high-yield segment. In the investment grade corporate segment, the indices contain the equally weighted CDS premia of the 125 most liquid firms. Selection of index constituents is based on a semi-annual poll of the main CDS dealers, which then leads to an update of the index composition in March and September of each year.

B. Sample construction

The empirical analysis comprises individual European firms in the investment grade and high yield segment. Our sample covers financial firms as well as industrial firms and is designed to be representative across ratings and industry sectors. The starting point for the firm selection is the set of 125 investment grade corporates in the iTraxx Europe and the iTraxx Europe Crossover with the composition as of October 2005.[9] In order to remove potential exchange rate effects we restrict our analysis to firms from the Euro area.

To construct the hypothetical trading book positions we need a matched sample of CDS premia and stock prices. For this purpose, we remove all those firms where the equity ticker and the CDS ticker are not exactly equal. This filter is necessary because after take-overs, companies take over debt from the firms they acquired. If the ex-ante difference in issuers is neglected, then the date of the merger would be ignored. Next, we check the number of available observations for the CDS and stock prices in Bloomberg. We find satisfactory data coverage from March 2003 onwards; hence, our sample period is March, 1 2003 to October, 11 2006.

After this filter procedure, the sample consists of 86 European companies. Appendix 1 lists the individual firm names and their median CDS premium. The sample is diversified across sectors, as it contains energy firms, industrial entities, consumer cyclical and non-cyclical firms, insurance companies, banks, telecoms as well as automobile firms. The ratings at the end of the sample range from AA to B, therefore covering a sizable fraction of the range of credit quality. Overall, we have nearly 67.000 daily observations.

[9] This index contains the 30 most liquid non-financial names from Europe which are rated Baa3 or lower and are on a negative outlook.

C. Sample description

Several periods of market turmoil and an overall decline in CDS premia occurred during the sample period. Graph 1 plots the median daily premia and Table 1 provides the associated descriptive statistics. For instance, in March 2003, the median CDS premium for the firms in our sample is around 90 basis points whereas it is only around 25 basis points in October 2006. Main factors behind this decline in risk premia were a benign macroeconomic environment, low equity market volatility and the 'hunt for yield', a phenomenon which describes institutional investors' strong demand for higher yielding assets in the aftermath of the collapse of stock prices, which had started in March 2000. The search for higher yielding assets manifested itself in many asset classes. In the credit markets, this demand pressure together with low default rates and the steadily declining equity market volatility contributed to a sharp decline in credit spreads.

An upward jump in CDS premia occurred in May 2005 after S & P downgraded Ford and General Motors to the high-yield segment of the credit market. The market turbulence following this announcement drove CDS premia up for a limited period of time. This market turmoil had an adverse impact on the functioning of the credit derivatives market, reportedly causing large losses among some hedge funds.[10]

The CDS premia of individual companies display a sizable crossectional dispersion. The table in annex 1 shows that financial firms are the group with the lowest median CDS premium with a level of 10 to 20 BP. The highest premia are recorded for Alcatel, Koninklijke Ahold, HeidelbergCement, Fiat and Rhodia. For these five firms, the median premium exceeds 100 BP.

In order to illustrate firm-specific characteristics in more detail we show the CDS premia and stock prices of Deutsche Bank (AA-rated) and Fiat (BB-rated) in Graph 2. Here the left axis refers to the CDS premium and the right axis refers to the stock price (in inverted scale). Thus in both variables, an upward movement can be interpreted as a sign of financial distress. Over the sample period, the median CDS premium for Deutsche Bank is around 15 BP whereas for Fiat it is around 380 BP. For both firms the CDS premium takes its maximum in the first half of 2003. Here, the premium for Deutsche Bank peaked at a value of 24 BP, whereas the premium for Fiat climbed above 1000 BP. At the end of our sample, in October 2006, premia for Deutsche Bank are around 11 basis points and those for Fiat at around 150 basis points, demonstrating the remarkable decline in credit spreads.

The two firms' stock prices do not share clear common trends, but the graphs indicate some evidence of a comovement between CDS premia and stock prices. For Deutsche Bank and Fiat, there are several episodes where the CDS premium has declined and the stock price simultaneously saw an upward movement.

[10] ABN AMRO (2005) offers a concise discussion of this episode.

D. Value at Risk and Expected Shortfall Calculation

We analyze the risk of taking the credit risk of a firm by selling a CDS and taking market risk by buying shares of the firm with two risk measures routinely used in the banking industry, namely Value at Risk (VaR) and Expected Shortfall (ES). VaR is a certain predefined quantile of the profit/loss distribution of a portfolio of financial instruments. Formally VaR can be defined as

$$VaR_h = F^{-1}(p)\,, \qquad (1)$$

where F^{-1} is the inverse of the cumulative probability distribution $F(\Delta V_h)$ of the changes in the value ΔV_h of a given portfolio over a fixed time horizon h and p is a pre specified small probability such as 0.1 or 0.05. Thus, losses exceeding VaR (so called "tail events") should only occur with probability p over the next h trading days. For the purpose of our risk comparisons calculating VaR reduces to calculating the VaR of a position in the CDS and a position in the shares of a firm, respectively.

Although VaR is widely used it has the disadvantage that it is not a coherent risk measure i.e. it may not be sub-additive (see Artzner et al. (1999) for details). Moreover, VaR provides no information about the expected size of the loss if a tail event occurs. Expected Shortfall, defined as the conditional expected loss given that the loss L is at least as large as a certain level l

$$ES = E(L \mid L \geq l) \qquad (2)$$

is coherent and provides information about the size of tail events. We set l = VaR_h and therefore measure the expected loss over a given horizon from investing in the CDS or the shares of a firm if VaR is exceeded.

To empirically implement (1) and (2) we have to calculate the changes in the value of the shares and the CDS over a given time horizon h and then estimate the probability distribution F of these changes. The change in the equity value is simply the difference in the stock price between time t and time t-h. For the CDS contracts we need to mark - to - market the position with a valuation model because the market quote does not represent the value of the position.

To limit the computational burden we make some simplifying assumptions for our reduced-form model. In particular, we assume a constant interest rate r (i.e. a flat term structure) over the remaining life of the swap, a constant hazard rate λ (i.e. the rate of default at a future time given that the firm has not defaulted up to now[11]) following a Poison process, a recovery rate R (i.e. the percentage of the claim amount of debt which becomes payable on default) that is the same for all firms, no counterparty default risk and continuous premium payment until either the CDS matures or the underlying bond defaults.

Under these assumptions the value at time t of a CDS position for a protection seller is given by

[11] We estimate the hazard rate from the CDS premium by assuming a constant LGD.

$$V(t) = [p_M - p_0]\frac{1-\exp[-(r+\lambda)T]}{r+\lambda} \quad (3)$$

where p_0 is the fair CDS premium at t = 0, p_M is the premium observed in the market at time t and T is the remaining life of the swap. Calculations in Phillips (2006) suggest that (3) provides a fairly accurate approximation to "exact" CDS values despite the simplifying assumptions underlying (3). Appendix 2 outlines the derivation of (3).[12] The change in the value of the CDS h days later is then given by $\Delta V_h = -V(h)$ since we assume protection selling. Thus for a seller of protection (i.e. credit risk taker) the value of the CDS rises if $p_M < p_0$ and falls if $p_M > p_0$.

Intuitively, the valuation of the CDS in equation (3) can be interpreted as follows. The first part of the expression equals the difference in CDS premia from 0 to time t and the second part represents the risky duration which is driven by – among other factors – the firm's default intensity.

Next we estimate the probability distribution of ΔV_h for both investments. We do this by computing the empirical distribution $\hat{F}$ of ΔV_h over the last 200 trading days (i.e. we compute $\hat{F}$ from $\Delta V_{N,N-h}, \Delta V_{N-1,N-1-h}, \ldots, \Delta V_{1,1-h}$). This method is known as "Historical Simulation" in the risk management literature.

The main reason for using Historical Simulation is that the ΔV_h are typically skewed, fat tailed or both which makes simpler analytical calculations based on the normal distribution unattractive. Thus we avoid strong distributional assumptions but we assume that $\hat{F}(\Delta V_h)$ obtained from historical observations accurately reflects the probability distribution of future changes. Jorion (1997) and Dowd (1998) among others outline alternative methods for calculating VaR and Pritsker (2001) provides a critical assessment of the historical simulation method.

We then calculate VaR and ES via the empirical distribution $\hat{F}$. The VaR for a specified probability p and horizon h is the p-quantile $\hat{F}^{-1}(p)$ of the estimated probability distribution and ES is the average of the historical losses equal or larger then the estimated VaR. We set p equal to 0.1 and 0.05, i.e. we assume a 90% and 95% confidence level, respectively.

To compare the risk between equities and CDS we require a metric which makes the equity and credit market positions refer to the same underlying amount of money. For this purpose we express the VaR as a percentage of the notional which we define as EUR 10 million for the CDS contract and as the daily adjusted value of the stock position which also starts with EUR 10 million. Thus, we assume that the investor enters positions of the same magnitude in the credit and the equity market. Since we focus on the market risk incurred by a protection seller, the CDS position resembles a transaction where a trader buys EUR 10 million of a

[12] Hull and White (2000), Duffie and Singleton (2003) and Chaplin (2005) provide further details about CDS valuation. Fair CDS pricing at t = 0 implies V(0) = 0.

firm's corporate debt and hedges the interest rate risk in the bond position by means of interest rate swaps.[13]

II. Results

A. Aggregate results

We first pool all the 86 firms in the sample. Later we discuss the results for specific firms. Table 2 shows some summary statistics for the pooled data and graph 3 plots the crossectional medians of the equity and CDS VaR over time. All results refer to a twenty day horizon and a loss given default of 60%.

Overall, we observe that the equity VaR exceeds the CDS VaR by a sizable portion. In total, i.e. across time as well as across all 86 firms, the 95 % VaR for the equity position equals -7.5%, whereas the VaR for the CDS position is -0.35%. At the 90% level, the median equity VaR equals -5.54% and the CDS VaR is -0.2% of the notional volume. Thus, in the medians of the two VaR measures differ by a factor of around twenty.

Both VaR measures show sizable variation. In particular, the standard deviations of the equity risk measures exceed the standard deviations for the CDS positions. Thus, the VaR for the equity market not only exceeds the VaR for the CDS segment but it is also more volatile.

Despite the differences in first and second moments, the VaR estimates display a sizable linear comovement. Table 3 shows the bivariate unconditional correlations between CDS and equity VaR. For the 95 % and 90% VaR we estimate bivariate correlation coefficients of 0.67 and 0.53, respectively. These numbers suggest that the comovement is stronger the smaller the coverage of the tail area in the distribution of value changes.

The time series perspective in graph 3 also illustrate this comovement. In both markets, the risk measures have an upward trend. Given that the VaR is by definition negative (see equation (1)), this upward movement implies that the market risk in both markets has declined from 2003 to 2006. The graphs for the CDS VaR also show the impact of the market turbulence in May 2005 as this period was characterised by an increase in estimated market risk.

The comovement between the VaR estimates basically reflects the comovement between the CDS premium and the stock price. As already Kwan (1986) has shown for corporate bond spreads, there is a significant correlation between the credit and the equity market.[14]

The difference between the VaR estimates has changed over time. Specifically, graph 3 indicates that the distance between CDS and equity VaR (in absolute terms) has declined. The risk of the equity positions relative to the CDS positions was biggest in the first half of 2003 and then declined steadily.

[13] This comparison is only intended for the purpose of illustration because there are a number of differences between the hedged corporate bond position and the protection seller's side in the CDS transaction.
[14] In our sample, the pair-wise correlation between log CDS and log stock prices is -0.16.

Let us now turn to the aggregate results for expected shortfall again expressed in percent of the notional. As already mentioned ES is a coherent risk measure which provides information about the expected size of the loss if a tail event occurs. Due to the rather small number of observations in the tail of the empirical distribution of value changes, we only estimate ES at the 90% level. We find that the ES for the equity portfolio equals -8 % and – 0.39 % for the CDS portfolio. Thus despite using a different risk measure, the orders of magnitude are nearly unchanged.

Before we discuss firm-specific results we briefly summarise the results from a simple back-testing exercise in table 4. Here we count for each firm the percentage of outliers at the 95 and 90 % level. For the 95 % VaR we find crossectional median values of 7.6% for the CDS and 6.5 % for equities. At the 90 % level, the medians are 8.7 % for the CDS and 10.5% for equity respectively.

B. Firm-specific results

In the firm specific analysis we look at the results obtained for Fiat and Deutsche Bank in more detail. Graph 4 plots the time series of the VaR estimates using the 95 % level.

Historical Simulation produces a constant VaR if there are no new realisations in the relevant tail of the distribution of value changes. This characteristic of the HS approach is apparent when comparing the CDS and the equity VaR for Fiat. In the latter case, there are more new realisations in the tail of the distribution and therefore, the VaR series is more volatile on a day-to-day basis.

The firm-specific results suggest that the distance between CDS and equity VaR is markedly smaller for lower rated firms than for higher rated firms. The median of the 95 % CDS VaR for Fiat is -5.5% whereas the equity position has a median VaR of -11%. Thus in the case of the lower rated Fiat company the risk for both positions is of the same order of magnitude. In contrast, for the higher rated Deutsche Bank, median VaR estimates are -8.8% for the equity position and -0.13 for the CDS position. Hence, the riskiness of the CDS position here is an order of magnitude smaller.

As in the aggregate results, a common upward trend is present. For example, the CDS VaR for Fiat starts at – 11% and ends up around -1%. Over the same time period the equity VaR for Fiat moved from -28 % to -6%. At the end of our sample, in October 2006, the CDS VaR for Deutsche Bank is - 0.075 % and the equity VaR equals -6.8%. Thus at the end of the sample period the relative orders of magnitude of trading credit risk versus the risk of trading equity remain roughly the same for both companies although the absolute risk in both markets declined. In addition, the CDS VaR of both firms captures the impact of the May 2005 turbulence.

For a more general comparison of firms with high credit risk to those with low credit risk we construct two subsamples of ten firms each, based on the individuals firms' median CDS premia. In particular, we define the set of the ten firms with the lowest and highest credit risk by means of their rank in the order of median CDS premia. The low-credit risk firm set contains mostly banks and has a median CDS premium of 12 BP whereas the high-risk set has a median CDS premium of 102 BP. Table 5 contains the summary statistics for these two subsets.

Table 5 indicates that the distance between CDS and equity VaR declines with rising credit risk. For the 95 % VaR of the ten "low-risk" firms we find crossectional median values of - 0.1 % for the CDS and - 6.4 % for equities of the top ten firms and values of - 1.6% for the CDS and - 10.9 % for equities of the bottom ten firms respectively. These values translate to a ratio between the CDS and eth Equity VaR of 60 for the low-risk set and 7 for the high risk set.

C. Robustness tests

We carry out two robustness checks. First, we change the holding period from 20 to 60 days. Second, we vary the recovery rate from 40% to 60 %. Table 6 contains the summary statistics for these two cases.

Overall, our results are robust to these two modifications in the estimation procedure. However, the distance between CDS and equity VaR declines at the 60 day horizon indicating that the CDS becomes relatively more risky the longer the assumed holding period. In contrast, the impact of LGD variation is minimal.

D. Discussion of results

A number of factors help to explain the considerable difference in the market risk between equities and CDS premia. First, due to the short holding period an investment grade company's default probability is very low. This can be illustrated by the fact that according to Moody's (2006) the annual Baa-default rate is just 0.18%.[15] Given that this rate refers to a one-year horizon, the corresponding two-week number is very small. Hence the protection seller for an investment-grade firm faces only a low risk of losing the underlying principal amount when the holding period is short. As a consequence, the main risk involved is not the default risk but rather the risk arising from the volatility in CDS premia and the corresponding mark-to market valuation.

Another factor is that our sample period is characterised by low realised defaults and by the 'search for yield', i.e. the persistent decline in credit spreads with the exception of early 2003 and May 2005 (see, graph 1).[16]

From a theoretical perspective, our results are consistent with the Merton (1974) model. The approach of Merton (1974) is the most commonly used structural model for pricing claims whose payoff is determined by default risk. In this model, the capital structure of the firm consists of a zero coupon bond and common equity, which pays no dividends. The model specifies a continuous stochastic process for the value of the bond-issuing firm's asset, where

[15] This example from Moody's (2007) refers to the average One-Year Letter default rate computed over the period from 1970 to 2006.
[16] See chapter VI in BIS (2004) for a discussion of the "search for yield".

default occurs when the firm's log-normally distributed value falls below the face value of the outstanding debt. [17]

Merton (1974) shows that in the absence of market frictions, bankruptcy costs and taxes the payoff structure of a default risky zero coupon bond maturing at time T equals the profile of a portfolio containing a risk free bond and a written put option on the firm's value. Equity represents a call option on the value of the firm's assets. The strike price of these options equals the face value of debt. Hence, the theoretical values of equity and debt are as follows:

Value of equity = $VN(d_1) - De^{-rT}N(d_2)$ *(4)*

Value of debt = V - E

With:

V *Asset Value*

N(•) *Normal distribution*

$$d_1 = \frac{\ln(V/D) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

E *Equity*

D *Nominal amount of corporate debt*

σ *Volatility of Asset Value*

r *Risk-free interest rate*

We use this model to compare how the market values of debt and equity react to a change in the asset value. This analysis of the "delta" of the two positions can thus provide information on the relative riskiness of the two instruments:

Delta of call = N(d1) *(5)*

Delta of short put = 1 – N(d1)

Hence, for an investment grade firm the equity delta by far exceeds the delta of the credit instrument. This result is also shown graphically in graph 5, where we compare a junk firm, which is very close to the default boundary and an investment grade firm, where the asset value is very far from the default boundary.

The fact that equity is more risky than debt can also be illustrated by the subordination in the capital structure. As the equity pay offs are subordinated to the cash flows promised to bond holders, the former claims must be more risky than the latter.

III. Conclusions

Using equally weighted Historical Simulation we compared the risk of trading a CDS with the risk of holding the respective firm's equity by estimating the Value at Risk and the Expected

[17] Numerous extensions and refinements of Merton's basic formulation have been presented. (cf. Uhrig-Homburg (2002)).

Shortfall for both trading positions using daily CDS – stock price pairs for 86 firms recorded over the period from March 2003 to October 2006. We used a reduced-form model to mark to market the CDS position. We find that the equity VaR is usually substantially larger than the CDS VaR. Thus, the potential losses in the equity market may on average be bigger than the potential losses arising from trading the same firm's CDS. In other words, in a pure market to market perspective the equity position is more risky than the credit position.

A key factor behind our finding is that we assumed a holding period of 20 days. This assumption appears to be acceptable since both markets are liquid during "normal" times. However, over this rather short horizon an investment grade company's default probability is simply very low and the CDS VaR reflects this low default probabilities. Indeed, robustness checks indicate that the difference between CDS and equity VaR shrinks as we increase the holding period and hence implicitly the probability of default.

Our firm specific findings further suggest that the distance between CDS and equity VaR may be much smaller for firms with higher credit risk. We also find that CDS and equity VaR is significantly positively correlated.

For future research, a number of issues seem promising. First, we intend to look at alternative approaches to the Historical simulation, such as the Monte Carlo approach. Second, the valuation of CDS in a Merton-type framework may also offer some interesting insights.

Appendix 1: List of individual firms

Firm	Median stock price	Median CDS premium (BP)
ABN Amro Bank NV	18.82	11.53
Accor SA	35.50	64.08
Aegon NV	11.12	24.93
EADS Finance BV	22.02	28.55
Koninklijke Ahold NV	6.39	157.12
Allied Irish Banks Plc	14.41	11.33
Akzo Nobel NV	31.51	31.56
Alcatel SA	10.22	127.24
Allianz AG	29.77	33.86
Assicurazioni Generali SpA	95.00	22.26
AXA SA	23.48	19.63
BASF AG	17.95	26.80
Bayer AG	50.69	15.10
Banco Bilbao Vizcaya Argentaria SA	22.84	34.26
Banca Intesa SpA	12.27	11.76
Banco Comercial Portugues SA	3.39	16.32
Fortum Oyj	2.01	16.25
Banca Monte dei Paschi di Siena SpA	9.43	27.58
Bayerische Motoren Werke AG	35.40	25.04
BNP Paribas	52.59	10.92
Banco Santander Central Hispano SA	9.20	12.79
Groupe Danone	70.15	17.25
Credit Agricole SA	21.39	10.94
Carrefour SA	39.99	22.90
Casino Guichard Perrachon SA	62.73	73.99
Commerzbank AG	16.01	20.78
Continental AG	45.45	43.33
Deutsche Bank AG	65.35	16.32
DaimlerChrysler AG	35.36	77.49
Koninklijke DSM NV	22.61	30.00
Deutsche Telekom AG	14.06	45.55
Endesa SA	16.41	31.48
Enel SpA	6.53	22.77
E.ON AG	64.15	20.82
Energias de Portugal SA	2.21	27.36
Banco Espirito Santo SA	10.44	17.28
Sodexho Alliance SA	24.66	57.06
Fiat SpA	6.37	387.06
Finmeccanica SpA	13.64	49.67
Fortis Bank SA/NV	20.17	20.00
France Telecom SA	21.07	48.65
Cie de Saint-Gobain	43.76	35.69
Hannover Rueckversicherung AG	27.94	31.80
HeidelbergCement AG	42.14	175.51
Henkel KGaA	68.09	23.00
Bayerische Hypo-und Vereinsbank AG	17.87	24.40
Iberdrola SA	17.50	24.53
ING Bank NV	21.15	11.41
Royal KPN NV	6.58	52.22
Lafarge SA	71.39	46.50

Firm	Median stock price	Median CDS premium (BP)
Linde AG	45.07	41.28
Arcelor Finance SCA	15.68	60.03
Deutsche Lufthansa AG	11.19	61.79
Suez SA	18.19	32.49
Compagnie Financiere Michelin	44.69	39.77
LVMH Moet Hennessy Louis Vuitton SA	58.10	36.92
Metro AG	38.42	47.72
Muenchener Rueckversicherungs AG	92.33	23.41
Nokia OYJ	14.04	22.68
Hellenic Telecommunications Organization SA	12.51	47.75
Peugeot SA	46.32	32.69
Koninklijke Philips Electronics NV	21.74	36.38
Portugal Telecom SGPS SA	8.51	37.04
PPR	82.28	89.58
Renault SA	64.98	42.69
Repsol YPF SA	18.23	38.77
Rhodia SA	1.64	446.75
Capitalia SpA	3.02	23.83
RWE AG	40.64	21.62
Sanpaolo IMI SpA	10.59	14.80
Siemens AG	61.35	21.40
Societe Generale	73.61	11.72
STMicroelectronics NV	15.17	29.53
Stora Enso Oyj	10.99	50.17
ThyssenKrupp AG	15.65	88.65
Telecom Italia SpA	2.43	58.10
Telefonica SA	12.73	41.21
Unilever NV	17.77	21.52
Union Fenosa SA	19.13	40.54
UniCredito Italiano SpA	4.27	15.23
UPM-Kymmene Oyj	15.92	53.29
Veolia Environnement	24.32	34.46
Vivendi Universal SA	22.83	63.81
Valeo SA	32.37	54.25
Volkswagen AG	38.17	55.82
Wolters Kluwer NV	14.38	51.86

Appendix 2: Derivation of CDS valuation

Following Chaplin (2005) we outline the derivation of the CDS valuation formula (3). A standard CDS has two legs. One leg consists of the present value of the CDS premium payments (fee leg) that a protection buyer makes to the protection seller. The other leg is the present value of the payment on default (contingent leg) that the protection seller makes in case of default. At origination of the contract the present value of both legs are equated and the CDS has a market value V(0) of zero. After origination the value V(t) of the CDS usually differs from zero due to changes in the credit quality of the underlying entity, changes in interest rates and the passage of time. Assuming no counterparty default risk, a constant hazard rate λ, a constant interest rate r and continuous premium payment the value of the contingent leg at time s > t is

$$\int_t^T (1-R)\lambda D(s)S(s)ds$$

where S(s) = exp(-λs) is the survival probability, R is the recovery rate, D(s) is the discount factor. The value of the fee leg is

$$p\int_t^T D(s)S(s)$$

where p is the CDS premium per annum. Subtracting the fee leg from the contingent leg and assuming fair valuation of the trade (i.e. V(0) = 0) yields

$$V(t) = \left[(1-R)\lambda - p_0\right]\int_t^T D(s)S(s)ds.$$

Finally, evaluating the integral gives

$$V(t) = \left[p_M - p_0\right]\frac{1-\exp[-(r+\lambda)T]}{r+\lambda}$$

where p_M is the fair CDS premium observed in the market at time t.

References

ABN AMRO (2005) Correlation Correction. *Credit in Focus*, May 12, 2005.

V. Acharya and T. Johnson (2007) Insider Trading in Credit derivatives. *Journal of Financial Economics* 84, 110–141.

J. Amato and E. Remolona (2003) The credit spread puzzle. *BIS Quarterly Review*, December 2003, 51 - 63.

R. Blanco, S. Brennan and I.W. Marsh (2005) An empirical analysis of the dynamic relationship between investment-grade bonds and credit default swaps. *Journal of Finance* 60, 2255 - 2281.

G. Chaplin (2005) Credit Derivatives Risk Management, Trading and Investment, Wiley Finance, John Wiley and Sons.

K. Dowd (1998) Beyond value at Risk: The New Science of Risk Management, John Wiley and Sons.

D. Duffie (1999) Credit Swap Valuation. *Financial Analysts Journal* January-February 1999, 73-87.

D. Duffie and K J Singleton (2003) Credit risk: pricing measurement and management, Princeton University Press.

J. Ericsson, K. Jacobs, and R. Oviedo-Helfenberger (2005) The Determinants of Credit Default Swap Premia. Working paper, McGill University.

FitchRatings (2006) Global Credit Derivatives Survey. Special Report.

J. Huang and H. Zhou (2007) Specification Analysis of Structural Credit Risk Models. Mimeo.

J. Hull and A. White (2000) Valuing Credit Default Swaps I: No Counterparty Default Risk. *Journal of Derivatives*, Fall 2000, 29 – 40.

P. Jorion (1997) Value at Risk: The New Benchmark for Controlling Market Risk, Irwin.

S. Kwan (1996) Firm-Specific Information and the Correlation between Individual Stocks and Bonds. *Journal of Financial Economics* 40, 63-80.

R. Merton (1974) On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *Journal of Finance* 29, 449-470.

Moody's (2007) Corporate Default and Recovery Rates, 1920-2006; Special Comment, Moody's Investor Service – Global credit Research.

L. Norden and M. Weber (2004) The comovement of credit default swap, bond and stock markets: An empirical analysis. *CEPR discussion paper* No 4674.

F. Packer and H. Zhu (2005) Contractual terms and CDS pricing. *BIS Quarterly Review*, March 2005, 89 - 100.

T. K. Philips (2006) An Approximate Valuation Formula for a Credit Default Swap, SSRN Working Paper.

M. Pritsker (2001) The Hidden Dangers of Historical Simulation, Finance and Economics Discussion Series, Board of Governors of the Federal Reserve System.

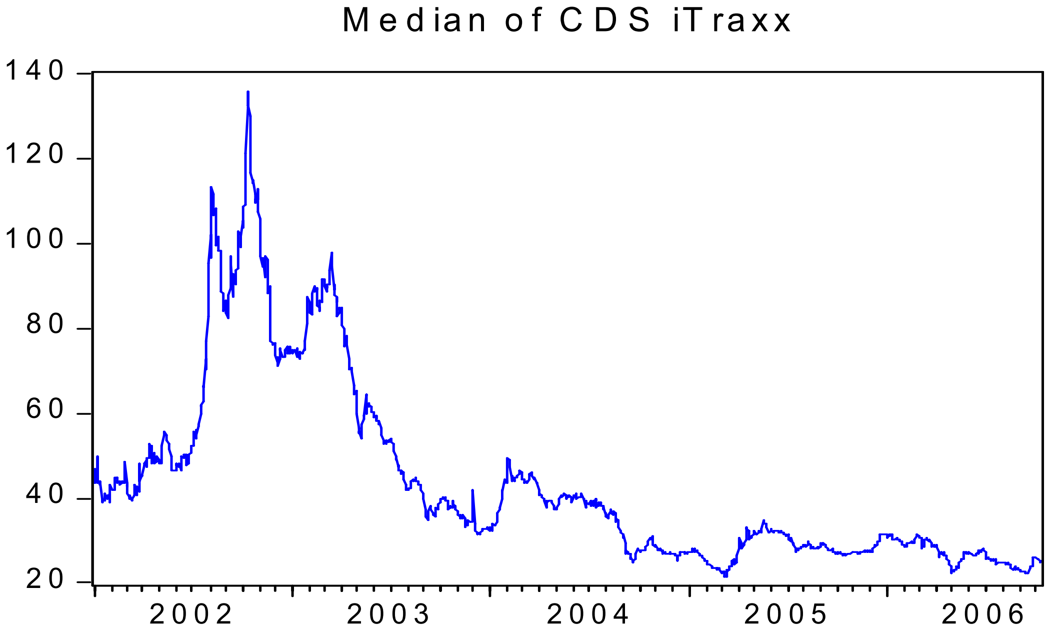
J. Rosenberg and T. Schuermann (2006) A general approach to integrated risk management with skewed, fat-tailed risks. *Journal of Financial Economics* 79, 569 – 614.

M. Uhrig-Homburg (2002) Valuation of Defaultable Claims - A Survey, Schmalenbach Business Review 54, 24-57.

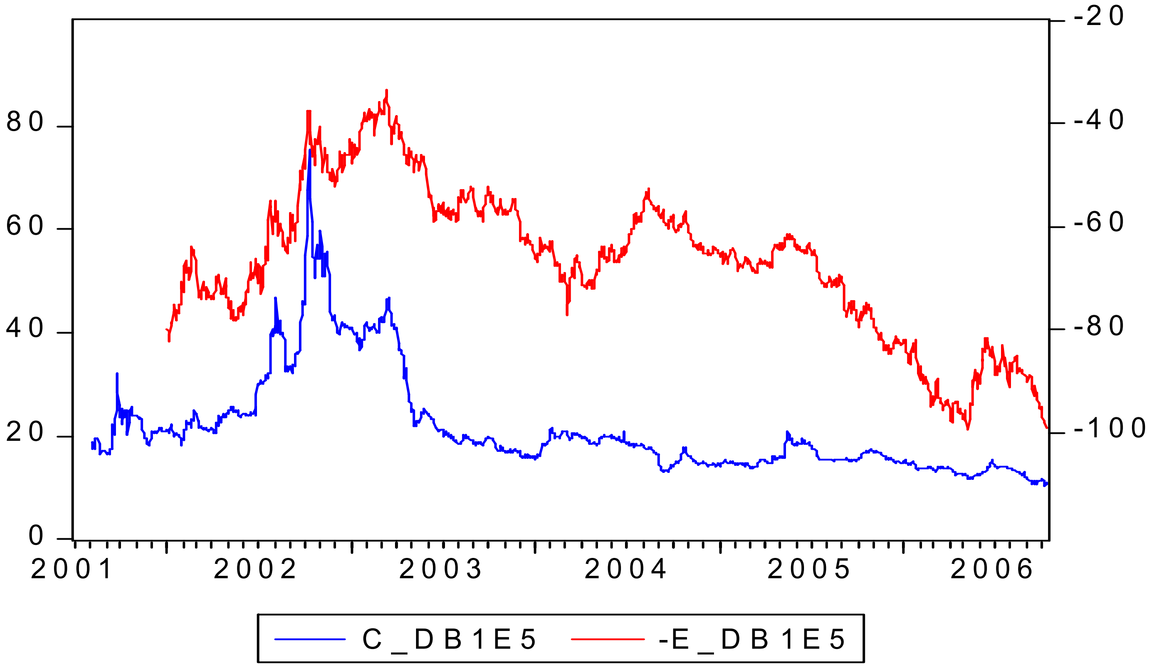
F. Yu (2006) How Profitable Is Capital Structure Arbitrage? Mimeo.

B. Zhang, 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.

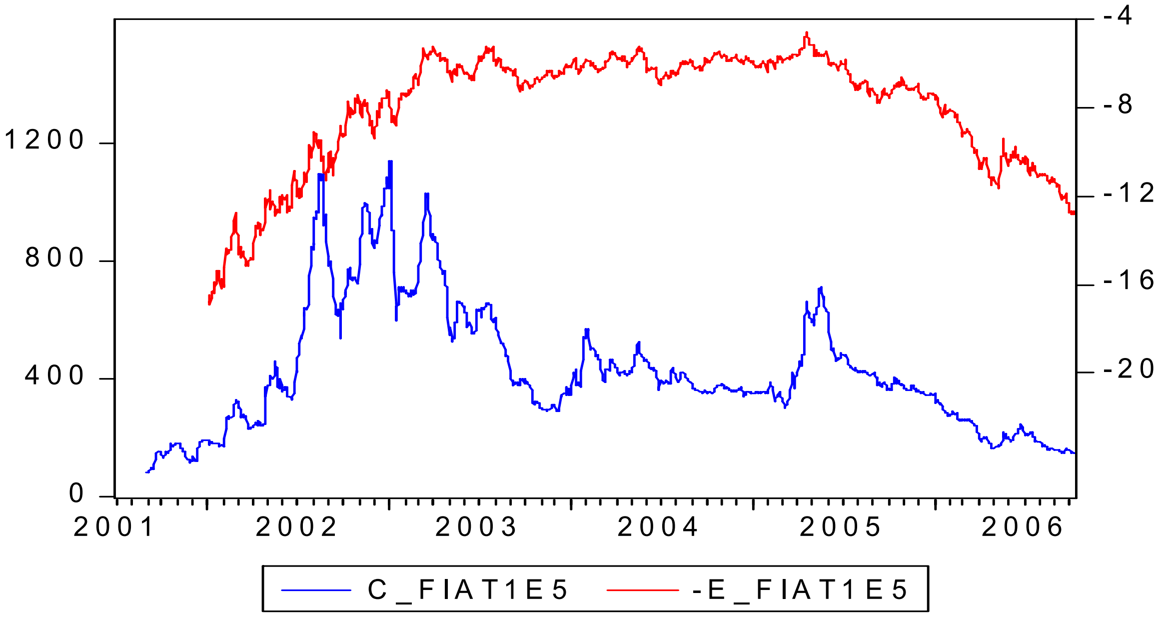
Graph 1: Median across all firms CDS series



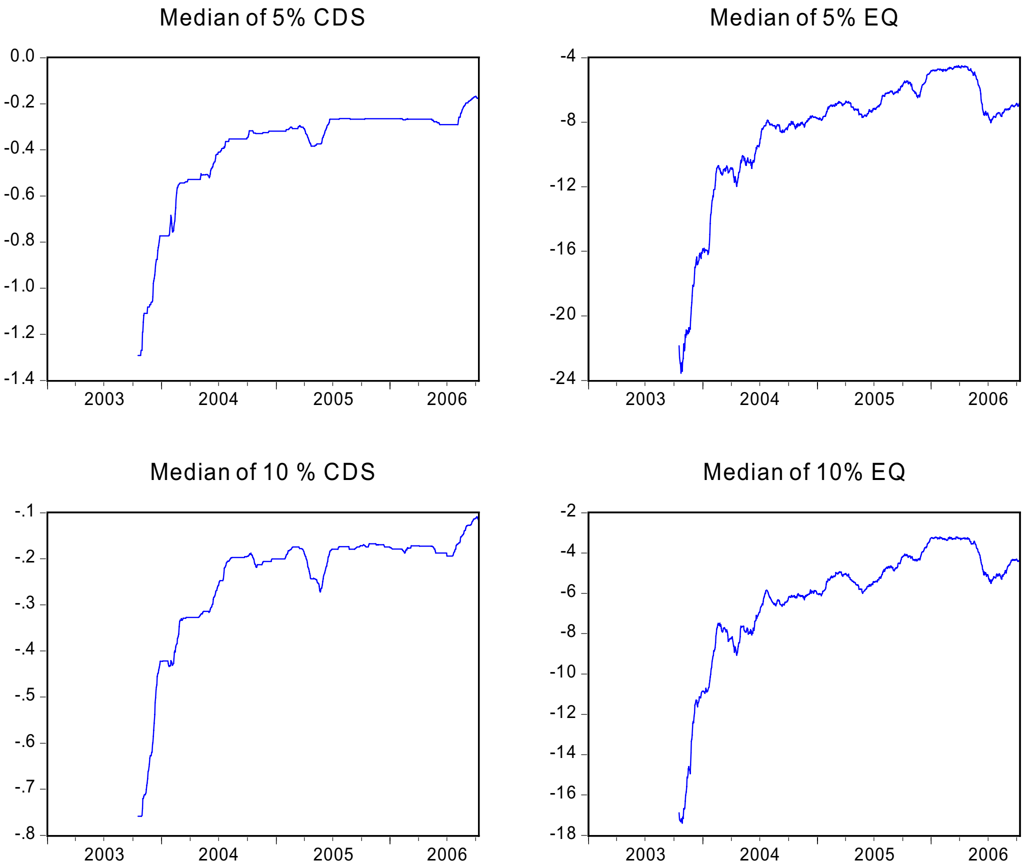
Graph 2a: CDS and stock price series (inverted) for Deutsche Bank



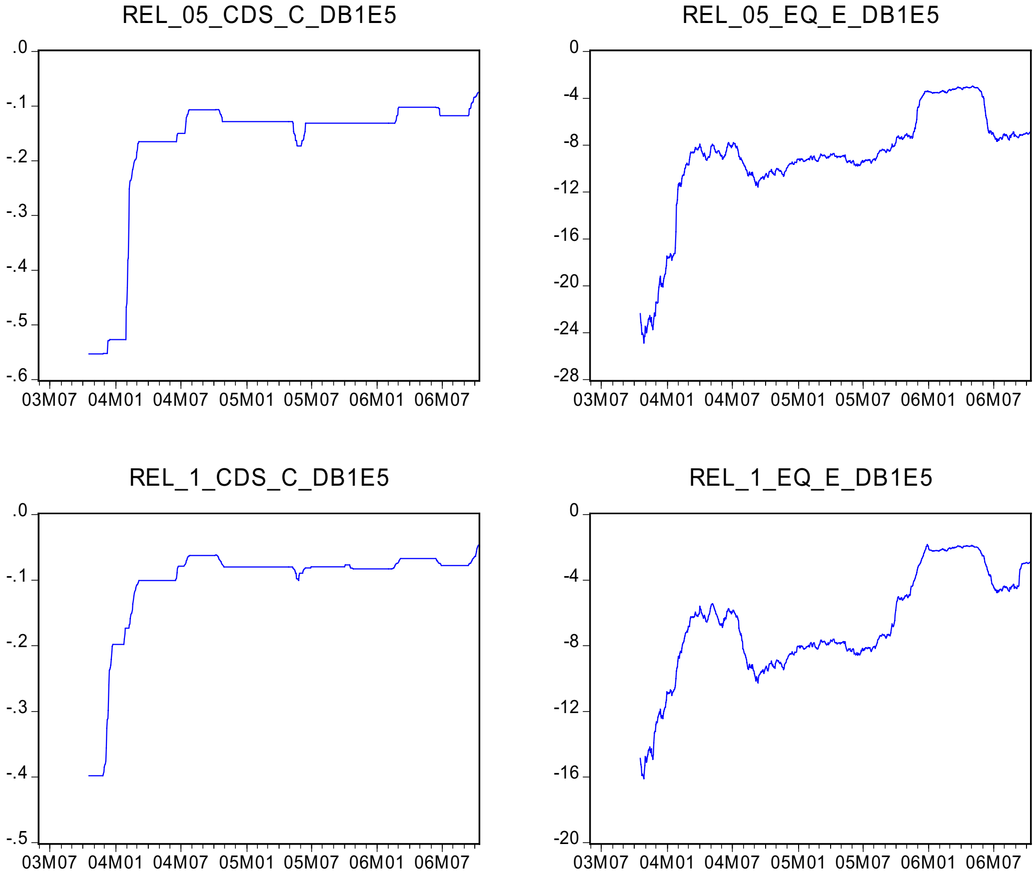
Graph 2b: CDS and stock price series (inverted) for Fiat



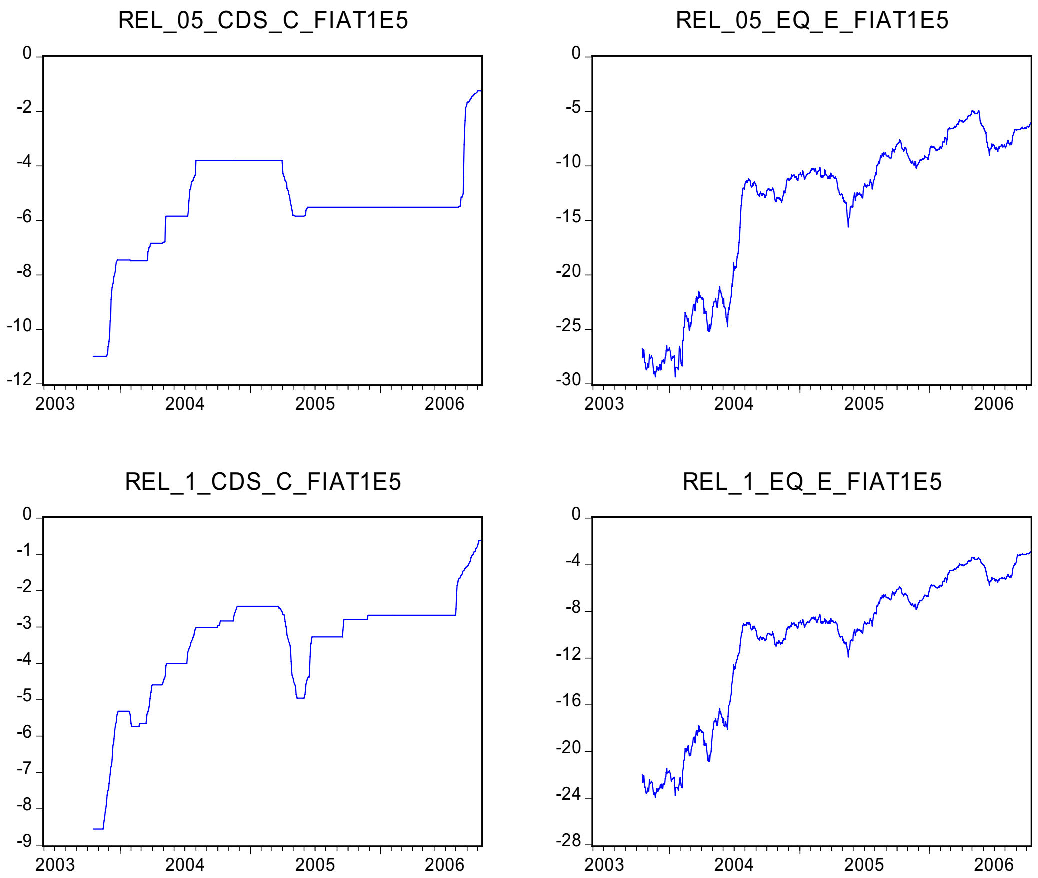
Graph 3: Median VaR at 95 % and 90%



Graph 4a: VaR for Deutsche Bank



Graph 4b: VaR for Fiat



Graph 5: Payoff profiles in Merton model

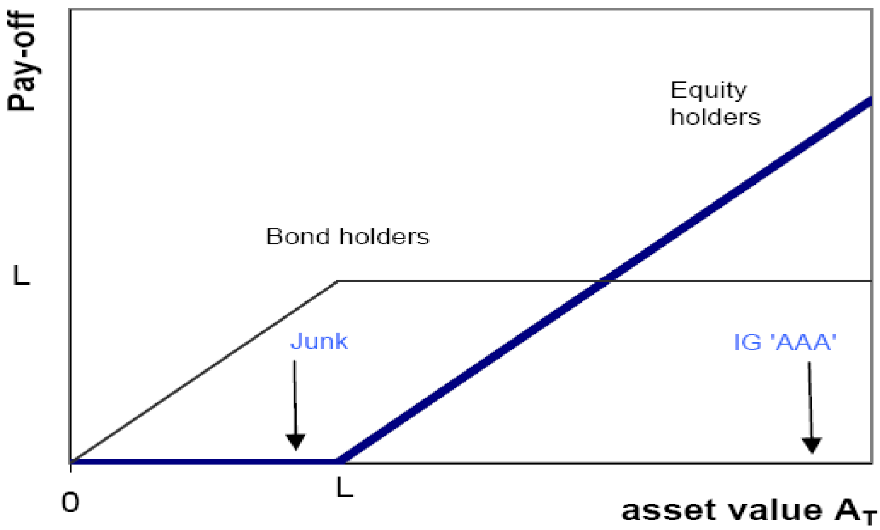


Table 1: Descriptive Statistics CDS and stock returns

	Stock returns	CDS
Mean	0.0006	46.3497
Median	0.0000	29.6550
Maximum	0.2503	853.1250
Minimum	-0.3054	5.1790
Std. Dev.	0.0138	68.4432
Observations	66994	66994
Number of firms	86	86

Table 2: Descriptive Statistics for VaR across firms and time

	VaR - 5% Equity	VaR - 10% Equity	ES – 10% Equity
Mean	-9.6884	-6.9889	-10.1819
Median	-7.5062	-5.5465	-8.0132
Maximum	-1.4137	-0.3649	-1.5341
Minimum	-113.2786	-88.0435	-105.2080
Std. Dev.	8.5870	5.8009	8.3929
Observations	66994	66994	66994
Cross sections	86	86	86
	VaR - 5% CDS	VaR - 10% CDS	ES - 10% CDS
Mean	-0.7620	-0.4275	-0.8053
Median	-0.3549	-0.2181	-0.3918
Maximum	-0.0084	0.0000	-0.0259
Minimum	-25.3498	-11.6203	-18.1083
Std. Dev.	1.7218	0.7359	1.4752
Observations	66994	66994	66994
Cross sections	86	86	86

Table 3: Correlations of VaR

	VaR - 5% CDS	VaR - 10% CDS	VaR - 5% Equity	VaR - 10% Equity
VaR - 5% CDS	1.00			
VaR – 10% CDS	0.72	1.00		
VaR - 5% Equity	0.67	0.50	1.00	
VaR - 10% Equity	0.49	0.53	0.93	1.00

Table 4: Back-testing of VaR

	VaR - 5% CDS	VaR - 5% Equity	VaR - 10% CDS	VaR - 10% Equity
Mean	0.0760	0.0648	0.0877	0.1052
Median	0.0723	0.0646	0.0830	0.1074
Maximum	0.1363	0.1199	0.1989	0.1831
Minimum	0.0000	0.0290	0.0092	0.0514
N	86	86	86	86

Table 5a: VaR estimation for the ten firms with the lowest mean CDS premium

	VaR - 5% Equity	VaR - 10% Equity	VaR - 5% CDS	VaR - 10% CDS
Mean	-7.79	-5.52	-0.22	-0.11
Median	-6.42	-4.77	-0.11	-0.07
Maximum	-1.76	-1.02	-0.01	0.00
Minimum	-37.32	-27.31	-2.93	-1.20
Std. Dev.	5.06	3.51	0.45	0.16

Table 5b: VaR estimation for the ten firms with the highest mean CDS premium

	VaR - 5% Equity	VaR - 10% Equity	VaR - 5% CDS	VaR - 10% CDS
Mean	-16.18	-11.34	-3.12	-1.63
Median	-10.95	-8.27	-1.61	-1.02
Maximum	-3.22	-1.34	-0.21	-0.14
Minimum	-113.28	-88.04	-25.35	-11.62
Std. Dev.	18.16	11.52	4.12	1.54

Table 6a: VaR estimation with a horizon of 60 days

	VaR - 5% Equity	VaR - 10% Equity	VaR - 5% CDS	VaR - 10% CDS
Mean	-14.5956	-11.1693	-1.1333	-0.8081
Median	-10.0044	-7.5335	-0.4920	-0.3515
Maximum	4.0777	5.0925	1.1122	1.1346
Minimum	-150.4430	-139.5299	-26.7431	-25.1256
Std. Dev.	15.7192	13.3748	2.3899	1.8880
N	66994	66994	66994	66994

Table 6b: VaR estimation with an LGD of 50 %

	VaR - 5% CDS	VaR - 10% CDS
Mean	-0.7452	-0.4204
Median	-0.3530	-0.2176
Maximum	-0.0084	0.0000
Minimum	-23.6531	-10.5873
Std. Dev.	1.6233	0.7043
N	66994	66994

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