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THE RELATION BETWEEN CREDIT DEFAULT SWAP SPREAD AND CORPORATE BOND SPREAD: ARBITRAGE OPPORTUNITIES IN THE FINNISH MARKET

Bachelor's Thesis

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CONTENTS

1 INTRODUCTION

1.1 Background

Credit risk has been a much examined topic during recent years. The capital requirements placed in Basel II, Several unexpected great bankruptcies and last sub-prime crisis have raised the awareness on importance of protection. Lenders and investors can reduce credit risk by netting and using collaterals, however the hedge gained is rarely enough. Credit derivatives have offered more efficient and cheaper ways to this problem. Especially banks and insurance companies have been tempted to manage their risk portfolios and transfer credit risk to other market parties, while other counterparties like hedge funds have used credit derivatives to gain leverage.

Credit derivatives market developed in the United States in the beginning of the 1990's. Since the conference of the International Swap Dealers Association held in 1992 the credit derivatives market has turned to an explosive growth, especially during the last decade, and it is now the fastest growing financial market. According to International Swaps and Derivatives Association (ISDA) mid-year 2007 market survey, credit derivatives market has grown over 75 percent from mid-year 2006 reaching notional amount of $45 trillion of outstanding credit derivatives by June 2007.

Credit derivatives are instruments developed to transfer credit risk between market participants (Bomfim 2001), while they also remove market imperfections by improving the market transparency and help in credit risk pricing (Choudry 2004). They allow companies to trade credit risk almost the same way as market risk and enable banks and other financial institutions to manage their portfolios of credit risk more efficiently (Hull 2006). Most of the credit derivatives are traded in over the counter market. Credit default swap (CDS) is the dominant credit derivative type with over 50 % market share, and therefore it is natural to concentrate on it in this study. Total return swap (TROR), credit-linked note (CLN) and collateralized debt obligation (CDO) are other common types of credit derivatives, but dynamic market is constantly creating new instruments. In addition to ordinary credit derivatives, there are also completely standardized index credit derivatives such as iTRAXX.

In spite of the fact that credit derivatives improve market efficiency, there are still some imperfections in the credit risk market. One market imperfection regards to the relation of CDS and Bond spreads. According to theory, there should be equivalence between these spreads, however it holds only approximately. Blanco et al. (2004) and Zhu (2006) prove that from time to time CDS market and bond market tends to price credit risk differently, especially on short-term. Although this parity relation between CDS spreads and bond spreads is still quite poorly examined, these previous studies give strong reason to assume that there might exist arbitrage opportunities in the credit risk markets. There are no previous studies based on the Finnish market data, however former examinations lead to assumption that this parity could be violated, especially in illiquidity market such as in Finland. This violation could open arbitrage opportunities for the investors.

1.2 Objectives of the Study

The objective of this study is to create an overview on credit derivatives market and most used derivative types, while concentrating on the relation between credit default swap spread and corporate bond spread. In addition, this study compares these spreads using three case companies in the Finnish market and seeks if the parity relations have been violated in the past. Study also considers the usage of the possible arbitrage opportunities. This study exploits the former studies of Blanco et al. (2004) and Zhu (2006), which have clarified the existence of short-term violation in parity relation.

In this test I will compare 5-year CDS mid prices to 5-year bond yield with equal maturity. The bond yield will be reduced with risk-free interest rate using government bond yield and 5-year swap-rates. The sample includes three Finnish companies which have fairly functional CDS and bond markets. Observation of the hold of the parity relation is on daily basis during time period of 2.1.2006-2.1.2007, while the direction of the spreads is also considered up till November 2007.

1.3 Structure of the Study

The study is divided into six sections. Second section presents the credit risk introducing the main types, pricing, modeling and typical credit events. Section 3 is dedicated to credit derivatives market and supply of current credit derivative instruments, while briefly presenting the current bond market. Fourth section defines the relation between CDS and bond market. This section also presents the concept of an arbitrage and the results of the previous studies. The empirical study starts in the fifth section. This introduces data, hypothesis and methodology. Results of the empirical analysis are presented in section 6 and the seventh section concludes the study.

2 CREDIT RISK

Credit risk is the risk behind credit derivatives, including their prices, applications and credit spreads. Definitions and risk movements are also intrinsically related to the activation of these instruments. Credit risk arises from the possibility that an obligator may default his payments (Schönbucher 2003). It is one of the major risks that banks and bond holders are facing, and it is one the main factors that determines the price of the borrowed money. There are three main types of credit risk: default risk, credit deterioration risk and recovery risk (Abaffy et al. 2007). Longstaff (2005) presents that the default component indicates the majority of the corporate spreads representing more than 50% of the total corporate spread even for the highest-rated investment-grade firms. In addition, the amount issued can affect and raise a liquidity risk for secondary market instruments (see Duffie and Singleton (1999). Changes in credit risk are changes in a firm's credit quality. It can be linked to changes in financial ratios (such as equity ratio), future prospects, economic downturn or it can occur in a form of a credit event. BIS (2006) defines following possible credit events:

- *failure to pay the amounts due under terms of the underlying obligation that are in effect at the time of such failure (with a grace period that is closely in line with the grace period in the underlying obligation);*

- *bankruptcy, insolvency or inability of the obligor to pay its debts, or its failure or admission in writing of its inability generally to pay its debts as they become due, and analogous events; and*

- *restructuring of the underlying obligation involving forgiveness or postponement of principal, interest or fees that results in a credit loss event (i.e. charge-off, specific provision or other similar debit to the profit and loss account). When restructuring is not specified as a credit event.*

Credit ratings are a common way to approach credit risk, therefore they are also used in several credit risk models and pricing models. In addition, they are very useful tools to describe the creditworthiness of a company or measure the credit migration on a company or bond. Table 1 presents the ratings of two major credit raters, which Norden and Weber (2004) prove to have the largest impact on credit default swap market spreads, when combining different rating events within and across agencies.

Table 1. Rating Classes for Different Agencies. This table presents rating classes for two major credit rater agencies.

	Moody's	**S&P**	**Description**
Investment grade	Aaa	AAA	Best level of creditworthiness; extremely reliable
	Aa	AA	good level of creditworthiness; very reliable
	A	A	Good level of creditworthiness
	Baa	BBB	Lowest rating in investment grade
Speculative grade	Ba	BB	There is a chance to fulfil payments if
	B	B	unexpected events do not take place
	Caa	CCC	Risk of bankruptcy, speculative features
	Ca	CC	Highly vulnerable to a payment default
	C	C	Bankruptcy is on the way
	D	D	Default – bankruptcy

(Source: Moody's and Standard & Poor's)

However, when using credit ratings as a measurement for credit risk, the studies about market anticipation to downgrades have to be noted. Norden and Weber (2004) discover that markets anticipate rating downgrades approximately 90–60 days before the announcement day. It is in line with the study of Hull et al. (2004) which show that CDS spread changes have predictive power on downgrades. In addition, Hite and Warga (1997) also find evidence on market anticipation for S&P's and Moody's downgrades in the corporate bond market.

2.1 Default Risk

Default risk is the risk that debtor will fail to meet its obligations. There is always a certain possibility to this very costly event to happen. This possibility is usually measured with probabilities. These probabilities are consequences from the current financial standings of the firm and time horizon of the debt. Besides these two factors, the economical cycle has strongly influenced to defaults occurred. In addition to influence of economical cycle, Bruche and González-Aguado (2006) claim that it appears in recessions or industry downturns, that default rates are high and recovery rates are low (Figure 1 in Section 2.3), as a result the default will be also more expensive. The most common way to estimate default probabilities is using historical data. Besides historical data, there are also other ways to estimate default probabilities such as market data analyzing from bond, stock or credit derivative prices, however those probabilities have frequently exceeded the historical probabilities. Theoretically, in these calculations bond spread (default component) is default probability multiplied (1-recovery rate) plus risk-free rate. (Hull, 2005) Bond spreads have been higher because they are also affected by other factors (non-default component) such as illiquidity from the bid–ask spread and the outstanding principal amount. In addition, there is also a weak support for the hypothesis that the non-default component is due to taxes. (Longstaff et al., 2005)

Table 2 presents the historical average cumulative default probabilities according to Moody's working paper (Hamilton, 2005). Table 2 shows that default probabilities are fairly low for companies with strong financial standings even over a long time-horizon. But then again, very low rated companies such as Caa-C have almost a 60% probability to default within five years.

Table 2. Average Cumulative Default rates. Table presents average cumulative default probabilities for Moody's whole letter rated companies during 1970-2004.

	Time Horizon (Years)								
Rating	**1**	**2**	**3**	**4**	**5**	**7**	**10**	**15**	**20**
Aaa	0.00	0.00	0.00	0.04	0.12	0.30	0.63	1.22	1.54
Aa	0.00	0.00	0.03	0.12	0.20	0.37	0.61	1.38	2.44
A	0.02	0.08	0.22	0.36	0.50	0.85	1.48	2.74	4.87
Baa	0.19	0.54	0.98	1.55	2.08	3.12	4.89	8.73	12.05
Ba	1.22	3.34	5.79	8.27	10.72	14.81	20.11	29.67	37.07
B	5.81	12.93	19.51	25.33	30.48	39.45	48.64	57.72	59.11
Caa-C	22.43	35.96	46.71	54.19	59.72	68.06	76.77	78.53	78.53
All	1.56	3.15	4.60	5.86	6.94	8.62	10.53	13.51	16.13

(Source: Hamilton et. al. (2005))

Moody's considers three possible prospects in default rate calculation; survival to next time period, rating withdrawal and default. They formulate calculation of cumulative default rate for a time horizon T as:

$$D(T) = 1 - \prod_{t=1}^{T} (1 - d_t)$$

Where d_t is the marginal default rate:

$$d_t = \frac{x_t}{n_t - w_t / 2}$$

Where x_t is the number of defaulters in year t, w_t presents the number of rating withdrawals in year t. n_t becomes from ($n_t = n_t - 1 - x_t - 1 - w_t - 1$), the number of issuers in the group at time t. When the time horizon T is equal to 1, the cumulative default rate and the marginal default rate are equal, and resulting rate represents the annual default rate. (Hamilton, 2005)

2.2 Credit Deterioration Risk

Credit deterioration risk is the risk that firm's creditworthiness will decrease. This decrease will cause a faulty priced situation to underlying loan or bond, because the same loan issued now would bring higher premium. Consequently, the value of the loan or bond will fall. The possibility of downgrading company exposes the lender to significant value changes in the bond portfolio. The probabilities of downgrading during one, five and ten years are presented in Table 3. It shows that the longer maturity of a bond does not necessarily raise a probability of default in investment-grade bonds, but the probability of credit migration will rise significantly within longer maturity. For investment-grade bonds the probability of downgrading is also relatively higher than upgrading, while speculative-grade bonds have higher possibility of upgrading. However, speculative-grade bonds have also higher change to drift in to default. In addition, Table 3 shows that during one year, movements larger than one category have been quite rare.

Table 3. The Average Annual 5-Year and 10-Year Migration Matrix. Table presents average probabilities to rating migration in different maturities during 1970-2004 according to Moody's whole letter rating migration matrixes.

		Rating at the end of the period							
Initial rating	**Average year**	**Aaa**	**Aa**	**A**	**Baa**	**Ba**	**B**	**Caa-c**	**default**
Aaa	1	89.48	7.05	0.75	0.00	0.03	0.00	0.00	0.00
	5	56.88	23.78	5.58	0.46	0.4	0.04	0.08	0.11
	10	32.38	30.47	10.41	2.97	0.76	0.1	0.05	0.6
Aa	1	1.07	88.41	7.35	0.25	0.07	0.01	0.00	0.00
	5	4.16	53.86	23.13	3.58	0.9	0.29	0.02	0.21
	10	4.83	30.2	28.25	7.94	2.32	0.58	0.09	0.78
A	1	0.05	2.32	88.97	4.85	0.46	0.12	0.01	0.02
	5	0.25	8.15	57.83	14.2	2.95	0.82	0.16	0.43
	10	0.36	10.4	38.29	15.66	4.32	1.53	0.24	1.24
Baa	1	0.05	0.23	5.03	84.50	4.60	0.74	0.15	0.16
	5	0.24	1.51	15.64	47.05	9.58	2.65	0.47	1.72
	10	0.21	2.38	17.33	26.84	7.81	3.08	0.38	3.63
Ba	1	0.01	0.04	0.46	5.28	78.88	6.48	0.50	1.16
	5	0.08	0.25	2.98	12.53	32.12	11.1	1.07	8.12
	10	0.2	0.81	5.26	11.37	11.3	6.82	0.7	13.67
B	1	0.01	0.03	0.12	0.40	6.18	77.45	2.93	6.03
	5	0.05	0.08	0.51	2.82	12.55	29.56	2.31	20.58
	10	0.06	0.03	1.62	3.98	8.58	9.41	0.75	27.39
Caa-C	1	0.00	0.00	0.00	0.52	1.57	4.00	62.68	23.12
	5	0.00	0.00	0.00	3.03	5.62	7.06	42.85	42.85
	10	0.00	0.00	0.00	4.49	1.92	1.85	2.14	50.42

(Suorce: Hamilton et. al. (2005))

Nevertheless, credit derivatives are efficient instruments to hedge against credit migration. For example, using credit default swaps or credit spread options it is possible to achieve quite complete hedge against credit deterioration risk.

2.3 Recovery Risk

Recovery rate comes to significant in a case of bankruptcy. When a company announces this credit event, the remaining assets of the company will divide among creditors in liquidation trying to fill company's obligation as far as possible. Claims have different priorities and the recovery received depends on the priority status. (Hull, 2005) The value is defined as a ratio of defaulted debt prices relative to par. Moody's measures recovery rates using bid prices on defaulted debt obligations observed 30 days after the date of default (Hamilton, 2005).

The amount of expected recovery rate affects to price and risk of a bond or loan, because a higher expected recovery rate protects the lender if default occurs. The average recovery rate for Sr. secured bonds have been 57.4 % between 1982 and 2003, where it starts to decrease in relation of priority, these average recovery rates are presented in Table 4.

Table 4. Issuer-Weighted Recovery Rate Statistics. Table describes the historical average recovery rates and rates with standard deviation in year 2004.

Priority	Mean (1982-2003)	Mean (2004)	StDev (2004)
Sr. Secured	57.4%	80.8%	25.5%
Sr. Unsecured	44.9%	50.1%	22.3%
Sr. Subordinated	39.1%	44.4%	25.7%
Subordinated	32.0%	NA	NA
Jr. Subordinated	28.9%	NA	NA
All	42.2%	54.3%	26.1%

(Hamilton et al. (2005))

There is relatively high recovery rate (80.8 %) e.g. in 2004. These high deviations are in consequence of the negative correlation between average recovery rates and annual default rates (see e.g. Hamilton, 2005; Altman et al., 2005 and Acharya et al., 2007). This correlation is illustrated in Figure 1.

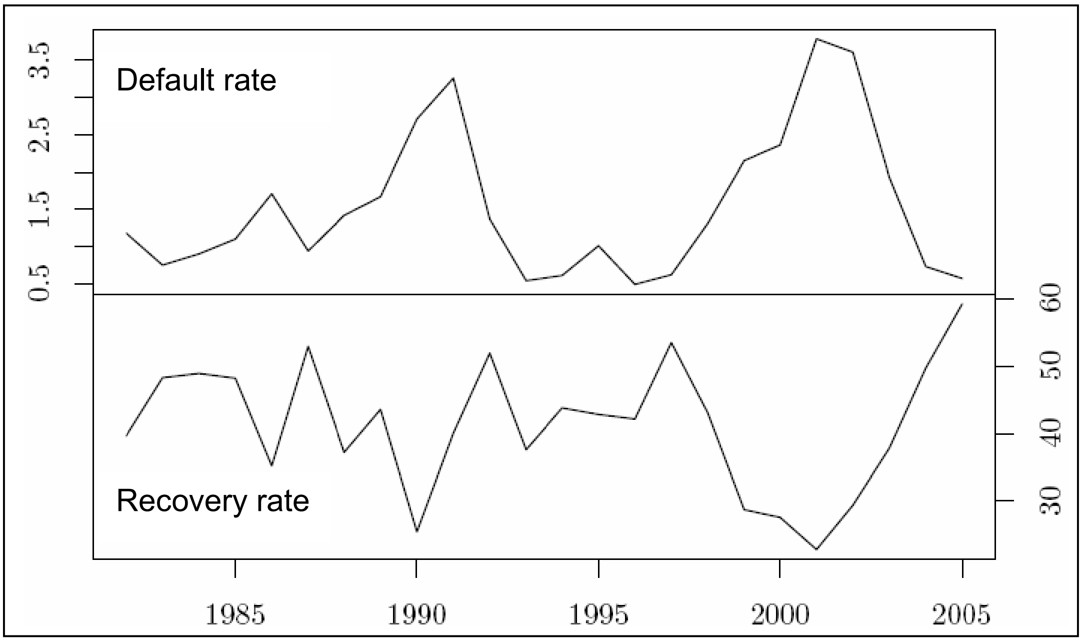

Figure 1. Correlation of Historical Default Rates and Average Recovery Rates. Figure illustrates historical default rates (fraction of defaulting firms) compared time and average recovery rates based on Standard and Poor's (2005), Altman (2005) and González-Aguado (2006).

2.4 Credit Risk Models and Pricing

This theoretical framework has attained interest for several decades creating models to price credit risk. Credit risk models are a complex combination of influencing factors. These models can be used to price defaultable securities and to estimate current risk. While credit risk is centered on probabilities of default, to estimate these probabilities we need a number of other models. We need a model for investor uncertainty, a model for the available information and its evolution over time, and a model to define the default event. In addition, for pricing credit sensitive securities we need models for the risk-free interest rate, a model of recovery upon default, and a model for premium that investors require as compensation for bearing systematic credit risk. To achieve accurate prices it is also relevant to use model that links defaults of several entities, because some securities are sensitive to the credit risk of multiple issuers. There are three main quantitative approaches to analyzing the credit: 1) the structural approach, 2) the reduced form approach and 3) the incomplete information approach. (Giesecke, 2004)

The basis of the structural approach is in option pricing theory introduced by Black & Scholes (1973) and it was extended to structural model by Merton (1974). Structural model basis is relation between corporate liabilities and assets. The firm defaults if its assets are insufficient according to its liabilities. This liability can be characterized as an option of the firm's asset, because if firm's liabilities exceed its assets a share holder does not have obligation to redeem the "option". In addition to Merton's classical model, structural model is extended, e.g. to first-passage models first introduced by Black & Cox (1976) and to model with stochastic interest rates by Longstaff and Schwartz (1995). In addition, Das (1995) and Pierides (1997) apply structural models to the pricing of credit derivatives.

Reduced-form models also referred to as intensity-based models are the other major approach to credit risk modeling. This approach assumes that the timing of default is specified in terms of a hazard rate. Firms default time is unpredictable and default occurs without warnings at an exogenous default rate. It is driven by a default intensity that is a function of hidden state variables like CDS spreads, bond prices and credit ratings. Reduced-form modeling go back to approaches of Jarrow, Lando and Turnbull (1995), Duffie and Singleton (1999). It has been also applied to credit derivatives by Das and Sundaram (2000), Duffie (1999), Houweling and Vorst (2002) and Hull and White (2000a, 2000b). According to Zhu (2006) reduced-form representation provides a suitable framework to connect bond spreads with CDS spreads, because using the risk neutral default probability and no-arbitrage conditions leads to establishing the parity relationship between the two spreads.

In addition to traditional approaches, there is an incomplete information approach introduced by Duffie & Lando (2001), Giesecke (2001) and çetin, et al. (2002). In this approach, framework provides a regular perspective on the structural and reduced form approaches to analyze the credit risk. It combines previous model families and tries to find the best features of previous approaches providing structural/reduced form hybrids.

3 CREDIT DERIVATIVES MARKET AND BOND MARKET

3.1 Credit Derivatives Market

Credit derivatives have been a remarkable innovation in the credit risk market. Credit derivatives market has turned into a rapid growth during the past ten years and has become an important tool for financial institutions to shed or take on credit risk (Rule, 2001a). The total amount of outstanding credit derivatives has now outreached 45 trillion, See Figure 2. These over-the-counter financial contracts are primarily used to transfer, hedge and manage credit risk. Most of these instruments have a default-insurance feature and are therefore very suitable for hedging (Shcönbucher, 2003). Credit derivatives are mainly contracts between two parties; a protection seller and a protection buyer. Protection seller is also referred to as credit risk buyer and again protection buyer as credit risk seller, while there can be also a group of protectors as in credit-linked note contracts (CLN). Other main credit derivative types are total-rate-of-return swaps (TROR), credit default swaps (CDS), credit options and collateralized debt obligation (CDO). In addition, there are also several variations of these derivatives such as basket, digital and equity products. Credit default swap type single name CDS contract is clearly the most used derivative contract holding over 50 % of the total credit derivative market, (See figure 2). Besides these instruments, tradable CDS indexes such as iTRAXX have also attracted new participants, especially among hedge funds and capital structure arbitrageurs.

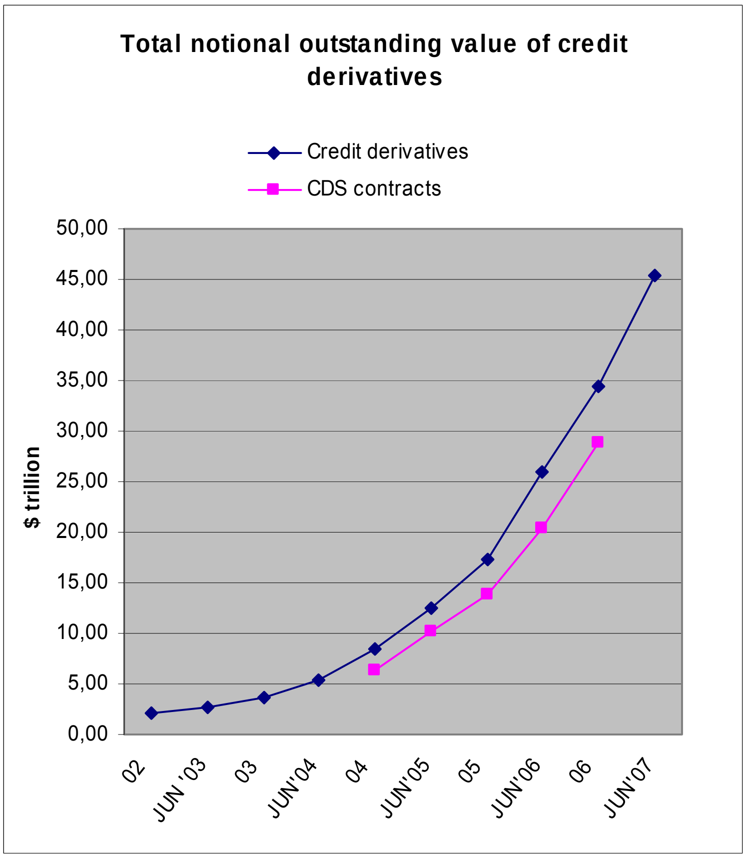

Figure 2. The Growth of the Credit Derivative Market. Figure shows the growth in amounts of outstanding over-the-counter (OTC) credit derivatives during December 2002 – June 2007. Total amount comprises credit default swaps referencing single names, indexes, baskets, and portfolios (Source: ISDA Market Surveys (2002-2007))

Payoffs of credit derivatives are linked to changes in the credit quality of an underlying asset (known as the reference entity). In many cases the triggering incident is credit default; however, payoff can be also linked to another credit event (see, section 2). Besides default, various instruments protect as well from credit deterioration. Details such as payoff dates, credit events, calculations, definitions and other standard market practices are defined in ISDA Master Agreements, which are usually signed by both counterparties.

As stated before credit derivatives are mainly used within hedging, speculating and risk management techniques, while enabling better portfolio diversification. However, they also have improving influence to the whole credit market. This innovation has increased market efficiency by intensifying pricing, improving liquidity and boosting the transparency of the whole market. (BIS, 2003)

3.1.1 Credit Default Swap

Credit default swaps (CDS) are traded in OCT market. It is the simplest and the most popular credit derivative with an account more than 50 % of all credit derivatives. This bilateral contract is created to provide insurance against a default of a particular company, also known as the reference entity. Marketable bonds of the companies are generally used as the reference asset, because they have better price transparency and liquidity (Kiff & Morrow, 2000). Protection buyer is a bond holder which transfers risk to another party, the protection seller. The buyer makes periodic payments to the seller in compensation for insurance obtained. He has a right to sell the referred bond to the seller for its face value if a credit event occurs or alternatively, this could be made under cash settlement. In case of default digital swap settlement, the protection seller will pay a pre-agreed fixed payoff. The figure 3 illustrates the form of CDS contract. The periodic payment is typically made quarterly, half yearly or yearly. It is also known as CDS spread or CDS premium. The spread is announced in basis points and it is a certain proportion paid periodically from the notional value. (Hull, 2005; Schönbucher, 2003)

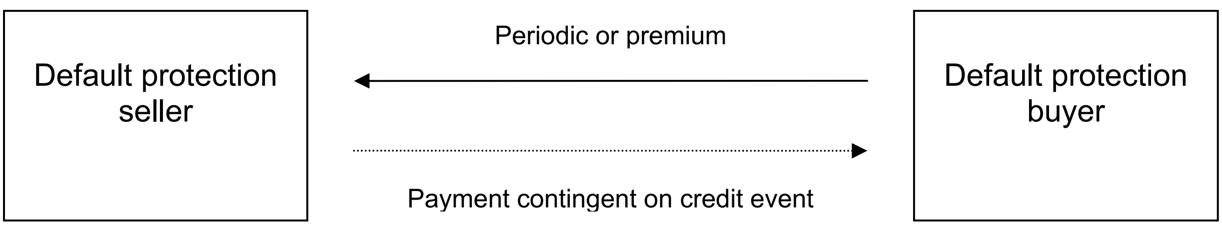

Figure 3. The Structure of the Credit Default Swap. Protection buyer pays periodic premium to counterparty and in case of credit event the protection seller is obligated to buy the referred bond for face value.

There are also several variations of CDS, for example default digital swap (DDS), basket CDS, equity default swap (EDS). The default digital swap is similar to other digital instruments such as digital options and digital swaps. In this instrument there is predetermined fixed cash payment, when default occurs. Usually the payment is the notional amount of DDS (Shcönbucher, 2003). Basket default swap is similar to CDS except it has rather a number of entities than just a single entity. Most popular basket default swap types are first-to-default, second-to-default and nth-to-default. First-to-default protects the buyer against first occurred default and second-to-default against second (but not first). Nth-to-default protects the first n defaults out of the q. When the relevant default occurs, the payments are settled and calculated in the same way as for a regular CDS. (Hull, 2005; Choudhry, 2004) Equity default swap differs from regular CDS in reference asset, which is rather equity than a bond or loan. Because of this specification in EDS the triggering event is a specific value barrier not a credit default, and the recovery rate is predetermined fixed amount. (Choudry, 2004)

CDS contract gives protection in occurrence of default and credit deterioration. If the rating of the company decreases the protection buyer benefits by paying a lower CDS spread compared to new market spread, on the other hand the buyer will not be able to benefit from the improvement of the credit quality (Hull, 2005). According to study of Skinner and Townend (2002) the swap contract can actually be seen as a put option, because a long position in a credit swap combined with a long position in the underlying asset effectively replicates a form of put-call parity.

3.1.2 Total-Rate-of-Return Swaps

The total return swap or total-rate-of-return swap (TROR) is a very efficient instrument in use for credit quality preservation from the perspective of the original lender. It does not only protect from default but also from the quality of the original bond or loan. TROR is an agreement to exchange the total return on a bond to some specific rate, for example LIBOR or EURIBOR plus spread. Total return includes also the gain or loss on the bond over the life of the swap, which is delivered at the end of the life of the swap. Therefore in case of protection buyer, it gives protection from depreciation or alternatively blocks the possible gain from appreciation. (Hull, 2005; Batten & Hogan, 2002) Gain or loss arising from marking-to-market the value of the loan, can be also settled within the same intervals as the periodic payments or alternatively, using upfront fee (Kiff & Morrow, 2000). The valuations of bond or loan have caused problems within these contracts, because the lack of liquidity can have substantial effects on the price of the asset (Batten & Hogan, 2002)

Figure 4 provides a schematic representation of the total return swap contract. The spread over the reference rate depend on the credit quality of the receiver and the bond issuer in proportion to default correlation of them. TROR contracts are also used as financial tools, because they enable counterparties to take synthetically constructed positions. Protection seller can take long position and buyer can take short position even if they do not own the bond. (Hull, 2005)

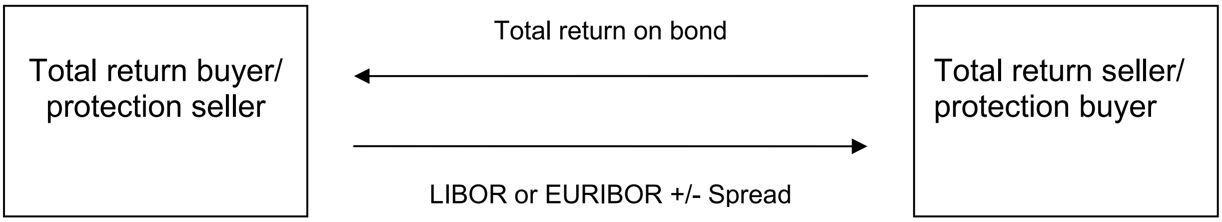

Figure 4. The Structure of the Total Return Swap. Protection buyer sells the total return on bond to counterparty including revaluation or devaluation. In return, protection seller provides a regular cash flow over or under a benchmark such as LIBOR or EURIBOR.

3.1.3 Credit-Linked Note

Credit-linked note (CLN) is similar to credit default swap. In this contract the issuer is protection buyer which is typically a bank or a financial institution and the investor is protection seller. While issuer is protecting credit balance, to investor CLN is a combination of bought bond and sold CDS. Figure 5 shows the typical form of CLN.

When buying the note investors pay principal or upfront in order to receive periodic interest during the maturity plus principal at the end of the maturity. In case of default in reference security or entity, the issuer will return the nominal value reduced with loss caused in credit event at the end of the maturity (cash settlement). CLN can be also under physical settlement. Then on occurrence of a credit event, the note will be terminated and issuer delivers the reference asset, and investor receives the value of the original purchase proceeds minus the value of the delivered asset. (Choudhry, 2004; Kiff & Morrow, 2000)

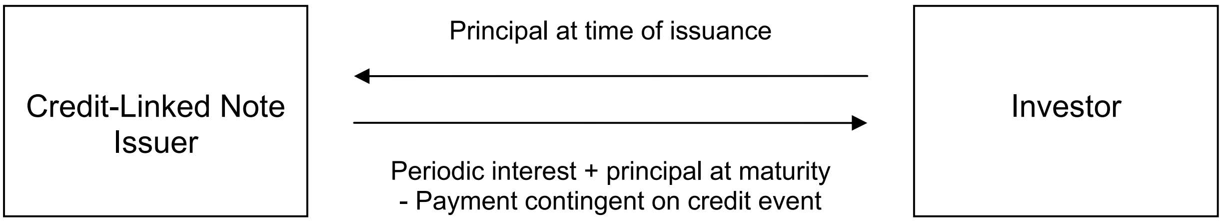

Figure 5. The Structure of the Credit-Linked Note. This figure illustrates the relationships between counterparties in a credit-linked note. Investor pays a principal of the CLN and receives periodic interest. At the end of the maturity investor receives principal minus the cost of contingent credit event.

3.1.4 Credit Options

Credit options are similar to other bilateral OTC financial contracts. Like in other options, there are put options and call options, which give the right but not the obligation to sell or buy the underlying asset to predetermined price and time. As with conventional options there are also plain vanilla and exotic credit spread options and they are used to hedging and speculating (Choudry, 2003). The strike and payout of a credit option may be set in terms of credit ratings, rate spreads or financial ratios.

Credit risk options (CRO) encompass a vast variety of contracts. The strike and payout are often linked to credit ratings and hence they are not necessarily dependent on default like CDS. The triggering event is usually a downgrading. (Francois & Hübner, 2003)

The more used credit spread option allows the holder to take a view on credit spread movements without risk of a default, while issuer seeks to earn premium income. Credit spread option is also a very suitable instrument for bond holders or CDS protection sellers to hedge against the credit deterioration risk. (Choudhry, 2003, Giacometti & Teocchi 2004) Figure 6 illustrates the structure of the credit spread European option. Buyer purchases the option and pays the premium at the beginning of maturity. When the spread exceeds the strike the option will be exercised and the seller will compensate the spread over the strike at the end of the maturity.

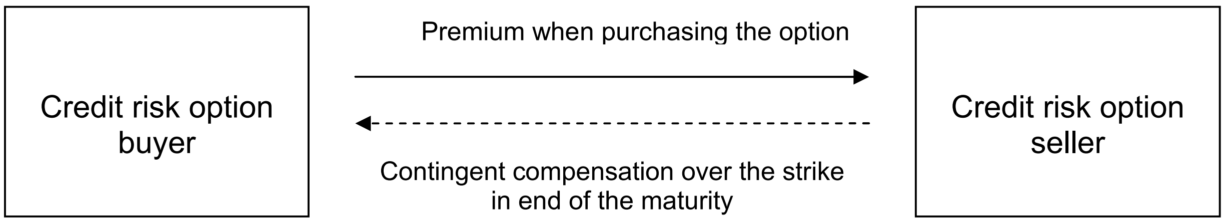

Figure X. The Structure of the Credit Spread Option. Figure shows the typical structure of the basic credit spread option.

3.1.5 Collateralized Debt Obligation

A collateralized debt obligation (CDO) is an instrument with securitized portfolios of defaultable assets, such as loans, bonds and credit default swaps (Schönbucher, 2003). CDO enables to create securities with different risk characteristics from a portfolio of debt instruments. CDO is usually structured by a special-purpose vehicle (SPV). This special financial institution creates a basket using different rated bonds and sells them forward to investors using tranches with specified return and obligation. (Hull, 2005)

Figure 7 shows an example of a typical cash CDO structure. SPV buys n amount of bonds with different risk profiles and returns. It pools these bonds to a portfolio with given risk and average return. The portfolio is sold forward using four tranches with specific risk and return. Investor can choose a suitable tranche to its risk position. First tranche covers 5 % of loss of the total bond principal and second tranche the next 10 % exceeding the 5 %. The third tranche suffers loss if the amount of defaults exceeds the 15 % of the principal, and it goes up to 25 %. The fourth tranche will pay all the possible residual loss after that. The yields 25 %, 12 %, 7 % and 5 % are calculated in relation to estimated default probability.

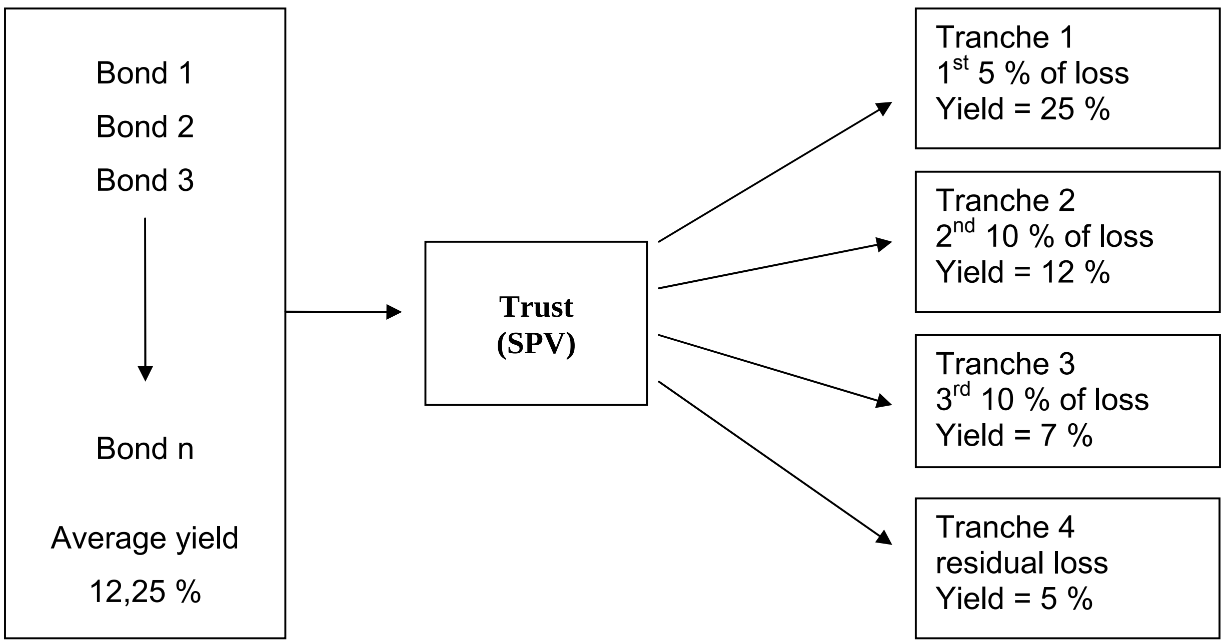

Figure 7. The Structure of the Cash CDO. This figure shows how bonds are sold to pooled portfolio of SPV (special-purpose vehicle) and sold forward to investors in divided four tranches. In every tranche there are different return and obligation.

Synthetic CDO has become also a popular instrument during last years. These instruments are constructed using credit default swaps instead of loans or bonds. It allows a larger flexibility, because the protection can be purchased in form of a pure derivative transaction. The yield is paid in basis points and no legally complicated ownership transaction needs to be made.

3.1.6 iTRAXX

iTRAXX was introduced in consequence of merged main CDS indexes iBoxx and Trac-x. iTraxx indexes are similar to a stock index created as a portfolio of individual stocks. It is created using equally weighted most liquid single name CDS contracts. E.g. iTRAXX Europe is made up of 125 equally weighted European names, and is used as a benchmark index for the divided sector indexes such as industrial sector. These indexes enable investors to buy and sell market-wide or sectoral credit risk, therefore a specific index can be used in hedging a specific portfolio.

iTraxx index has certain advantages. It brings more liquidity, transparency and diversification. In addition, it enables to manage large exposures of negative or positive diversified pool of credit risks much easier. Besides hedging, iTRAXX can be used to exploit market beliefs by executing relative-value trades between sectors or alternatively, a single name CDS against its sector. The iTraxx indexes typically trade with 5 as well as 10-year maturities and new series are issued every 6 months, so they are quite easy to match with suitable contract. (Byström, 2005)

3.2 Application and Users of Credit Derivatives

The risk has been one of the longest standing in the balance sheet of financial intermediaries (Batten & Hogan, 2002), but now the development of credit derivatives has offered a useful tool to manage credit exposures. For main users, such as banks, financial institutions, insurance companies and larger companies the credit derivatives offer a way to transfer risk from their balance to other market parties. There are various types of credit derivatives and various objectives to exploit them, while for specific purposes there are also naturally several suitable credit derivative types. Credit derivatives were initially created as tools to hedge credit risk exposure, as supplement Choudry (2003) presents also yield enhancement and arbitrage as applications for these instruments. In addition, Meissner (2005) names cost reduction and regulatory capital relief.

Hedging against credit risk is obviously the most common application for credit derivatives. These instruments enable efficient credit risk management by diversifying the credit portfolio and reducing credit exposure. Investors or banks can theoretically get close to zero risk portfolios using different types of credit instruments. For example a bond holder can buy a CDS, TROR or credit spread option to neutralize the risk position. Banks can diversify the risk of a big client by using default swap or reduce risk of portfolio by using CDO, whereas credit portfolios can be hedged with iTRAXX. However, it is important to notice that there are also a slight probability that protection seller will default with reference entity, which drifts the whole loss to the original bond holder (protection buyer).

Credit derivatives not only enable the more versatile way to hedging, but also make it cheaper. Shorting in bond market can be often very difficult and expensive, however with derivatives the credit exposure can be reformed with smaller capital and often in more efficient market with lower costs. For some regulated institutions derivatives can be also the only way to reform risk position.

Asset managers can enhance the return of portfolio by using credit derivatives. Credit derivatives are efficient tools for changing risk position to desired level and investment banks, hedge funds and speculators are common exploiters of this yield enhancement. For example they can attain higher yield without investing extra capital by selling protection to bond holders or alternatively, they can use a more risky CDO tranche to gain leverage to a portfolio. Asset managers can also derive premium income by exploiting derivatives issued with synthetic structured notes. For example using credit-linked notes tied to the assets in the reference pool, the trading of the credit exposures will add fixed income to portfolio by transferring gain of a credit exposure to other market participant and leaving the other aspects of the portfolio to holder, without the need to hold the asset (Choudhry, 2003). Credit spread options are also efficient instruments to take view of the assets credit exposure or to strengthen the position.

Credit derivatives are also important instruments to arbitrators. There are parity relations between bond risk spreads and credit derivate risk spreads, and when there are deviations in this parity it opens arbitrage possibilities to investors. This thesis concentrates on CDS and bond spread relation, therefore definitions and applications of the arbitrage are presented more precisely in section 3.

Basel Committee on Banking Supervision (2004) presents the new minimum capital requirements. Because of these regulations, banks use credit derivatives to relief the risky capital from their balance sheets to achieve better financial position. According to Basel II the regulated capital ratio is calculated using the definition of regulatory capital and risk-weighted assets. The total capital ratio must be at least 8% of notional amount of risk weighted assets in the balance sheet. Basel II permits banks to choose from two alternative methodologies to calculate capital requirements for credit risk. Bank can either use an internal rating system for credit risk approved by supervisor or a standardized manner. In this standardized manner the risk weight is related to ratings of external credit assessments. Table 5 presents the risk weights for different ratings.

Table 5. Risk Weights for Credit Ratings. Table shows the risk weights for rated risky assets in balance sheet.

Credit assessment	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-	Unrated
Risk Weight	0%	20%	50%	100%	150%	100%

(Source: BIS (2006))

Banks can relief capital e.g. by buying protection to BBB rated loan from another AA rated bank. In this case protecting 100M € loan a bank will relief capital 4M € (100M € x 50 % (BB) x 8 % (capital requirement) = 4M €).

3.3 Bond Market

The bond market is a financial market where participants buy and sell debt securities in the form of bonds. Issuing bonds is one of the most used ways to raise capital from the market. The bond market in the U.S. outreached 27 trillion of the total value of outstanding bonds at the end of 2006 and the size of the market has more than doubled within ten years. The Securities Industry and Financial Markets Association (SIFMA) classifies five particular bond markets; 1) corporate, 2) government & agency, 3) municipal, 4) mortgage backed (MBS), asset backed (ABS), collateralized debt obligation (CDO) and 5) Funding. They are traded in over-the-counter markets and sometimes in exchanges. Figure 8 illustrates the growth of different types of bonds.

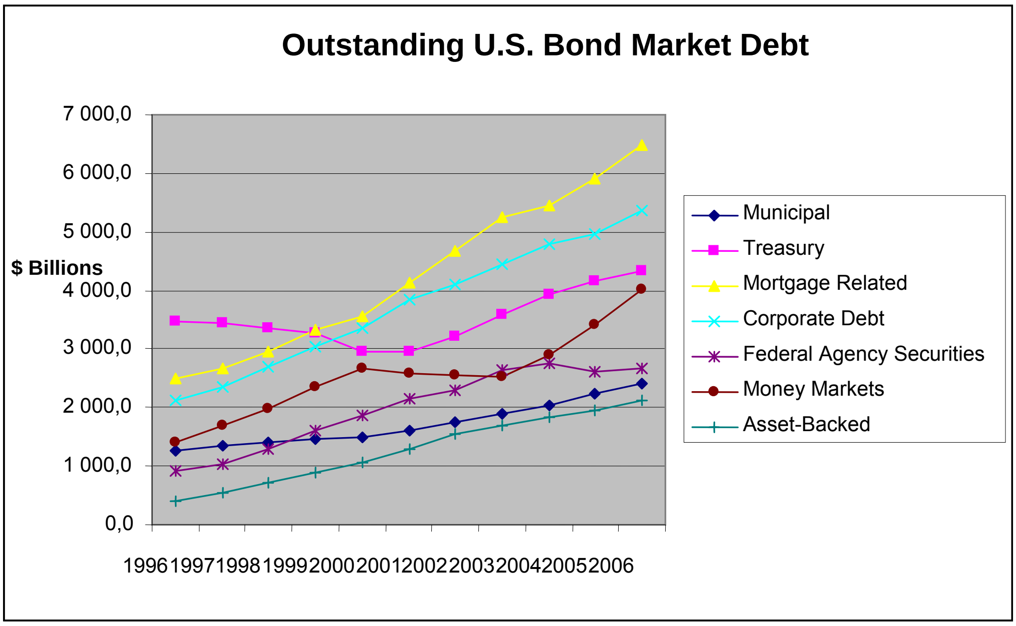

Figure 8. The Outstanding U.S. Bond Market Debt. Figure shows a recent growth for a different bond types. (SIFMA, Cross Market Statistics, 2007)

Comparing to credit derivative market, bond markets have lower liquidity. This arises from the matter that bond holders tend to hold these instruments until the maturity. In bond market it is also more difficult to short instruments and it is even impossible in several cases. These characteristic affects corporate bond risk components including its relation to CSD spread. This thesis concentrates on these issues later in section 5.

4 RELATION BETWEEN CDS SPREADS AND BOND SPREADS

Credit default swap spread is usually presented in basis points. The spread corresponds the risk part of the debt, caused by possibilities of default and risk changes. There is the same risk component consisting in bond yield in addition to risk-free rate. In theory there should be equivalence between the CDS spread and the bond yield reduced with risk-free interest rate. This equation is called the parity relation. In this relation the risk-free rate is usually considered as government bond yield. However, in practice this relation holds only approximately, and when this parity is violated it opens exploiting opportunities to arbitrators.

This relation has been previously studied by Blanco et al. (2004) and Zhu (2006). They found evidence that equilibrium holds on average in most companies, while they also found deviations in this parity in shot-term. Longstaff et al. (2005) examine the default and nondefault components in corporate spreads and find that price differentials between bond spreads and CDS prices can be largely explained with illiquidity of corporate bonds.

4.1 Determinants of Credit Spread

A number of papers have studied the determinants of corporate yield spreads. For example Duffie and Singleton (1997), Duffee (1999), Elton et al. (2001), Collin-Dufresne, et al. (2001), Delianedis and Geske (2001), Eom et al. (2004), among many others. However, these studies are based on bond market data while e.g. Ericsson et al. (2005), Zhang et al. (2005) and Longstaff et al. (2005) have studied these determinants using credit default swap market data.

There are several result differences in previous studies affected by different types of data and models. Several structural approach studies have found evidence that leverage, volatility, jump risk and risk-free rate influence the spread. Longstaff et al.

(2005) used reduced form model and found that default risk accounts for more than 50% of the total corporate spread. However, Cossin and Hricko (2001) tested determinants to the bond and CDS data, and showed that the determinants of CDS premium are quite similar to those on bond spreads, including ratings, yield curves, stock prices and leverage ratios.

4.2 PREVIOUS EMPIRICAL STUDIES

After the millennium, there a have been growing number of studies regarding credit risk. While the credit risk modeling and pricing have attained more concern, the relation between credit spread and CDS spread has stayed quite poorly examined. There are so far only two studies concentrating strictly to this relation, while some studies are partially examining this matter. Studies of Blanco et al. (2004) and Zhu (2006) compare the pricing of credit risk in the bond market and the credit default swap market. In these studies they have found similar results while studying equilibrium, dynamic relation and price discover. Zhu (2006) also looks for the underlying factors that explain the price differentials, extending the study of Longstaff et al. (2005).

Blanco et al. (2004) used panel data consisting 33 U.S. and European reference entities with suitable CDS and bond yield data. The data run from January 2, 2001, through June 20, 2002. The data is collected using the most liquid CDS contracts, which are 5-year physical settlement contracts with notional value of $10 million. Suitable bond yield data was formed by interpolating the bonds with maturity of 3-5 years and over 6.5 years. As the risk-free reference rate yield data they used government bond yields and 5-year swap rates. Zhu’s (2006) data is similar to the study of Blanco et al. (2006), except that it uses longer sample period from January 1999 to December 2002. Blanco et al. (2004) find that the parity relation holds on average over time for most companies, and that the analysis confirms the theoretical prediction that the bond and CDS markets price credit risk equally. This is in line with the later study of Zhu (2006). However, both of them also find that there can be short-lived pricing discrepancies between the two markets, suggesting that when this relation is violated, CDS spread moves ahead in price discovery. So, if there are deviations from the equilibrium, spreads tend to converge in the long run. Although this convergence is rather slow (Zhu, 2006), this leaves opportunities for arbitrators.

Within previous studies, CDS spreads and credit spreads have been very close to each other. This is particularly true when swap rates are used as the risk-free benchmark for bond yields, whereas treasury rates have given much higher differences. This becomes evident clearly in studies of Houweling and Vorst (2001), Blanco et al. (2004) and Zhu (2006). In these studies average pricing discrepancies have been -11, -15 and +6 basis points respectively using swap rates, while those have been exceeded with 22 to 57 basis points when treasury rates are used. Blanco et al. (2004) and Houweling & Vorst (2001) have also noted that the mean average absolute basis over swaps rises as credit quality declines.

Regarding to price discovery, Blanco et al. (2004) and Zhu (2006) suggest that CDS price is a more suitable indicator when measuring a credit risk. Blanco et al. (2004) also add that CDS prices have a tendency to be upper bound on the price of credit risk, while credit spreads form a lower bound. In addition, Zhu (2006) shows that the deviation could be largely due to different responses to changes in credit conditions of reference entity, and derivatives market anticipates rating events more efficiently than the cash market. He also argues that because there is persistence in short-term deviation, only 10% of the price difference can be removed within a business day, and that is why price discrepancies between the two markets can exist for as long as 2-3 weeks.

Longstaff et al. (2005) used 5-year contracts and over $10 million bonds during the time period from March 15, 2001 to October 9, 2002, when they studied the size of the default and non-default components in corporate spreads. This study was based on weekly data while Zhu (2006) used daily data. The results of the study indicate that the default component represents the majority of credit spreads even in highest-rated companies. However, they also find evidence from the existence of a significant non-default component in credit spreads. They argue that non-default component of spreads is strongly related to bond-specific illiquidity such as the bid–ask spread and the outstanding principal amount. In addition, they found links to measures of treasury richness as well as to measures of the overall liquidity of fixed income markets.

Nowadays, government bonds are no longer considered as an ideal proxy for the risk-free rate. Taxation treatment, repo specials or scarcity premium may have impact on them. McCauley (2002) raises swap rate's role as a benchmark into question referring it as a more suitable reference rate. In studies of Houweling and Vorst (2001), Blanco et al. (2004) and Zhu (2006) they also find that swap rates are more suitable measurements to risk-free rate than government bond yield, and that the differences between CDS spreads and credit spreads are much smaller if swap rates are used. Zhu (2006) claims that market participants seem to use swap rates rather than treasury rates as the proxy for risk-free rates, and that the failure of treasury rates could lead to tax considerations, the separation of treasury yields from risk-free rates in recent years, or the liquidity component in swap spreads, proved by Longstaff (2005). However, swaps contain credit premium because the floating leg is indexed to LIBOR or EURIBOR, which are default-risky interest rates, while there is also some counterparty risk (Sundaresan,1991). Nevertheless, Duffie and Huang (1996) show that the risk is only 1–2 basis points.

4.3 Arbitrage

Arbitrage is a simultaneous purchase and sale of an asset in order to gain "riskless profit" from price differentials between two or more markets. As stated before, there is evidence that this price difference may occur between CDS and credit spread. Blanco et al. (2004) and Zhu (2006) show that spreads tend to converge in the long run and that CDS is actually leading the price discovery, which is consistent with the results of Longstaff et al. (2005) and Houweling & Vorst (2001).

4.3.1 The Parity Relation

The loose approximate arbitrage relation can be defined as the difference between equal maturity corporate CDS price and corporate bond yield y reduced with risk-free rate r, formulating the parity as:

$$pCDS = y - r$$

For example, investor buys T-year par bond with yield-to-maturity of y is issued by the reference entity and hedges it for T years in the CDS market at a cost of pCDS, while eliminating most of the default risk. Expressing the CDS percentage of the notional principal and bond yield in annual terms, then net return for investor is y — pCDS. If this margin is more or less than the T year risk-free rate r, it opens arbitrage opportunities. If y — pCDS exceeds r, arbitrage can be gained by buying the risky bond, protecting it and shorting the risk-free bond. Correspondently if y — pCDS is less than r shorting the risky bond, writing protection in the CDS market, and buying the risk-free instrument would be a profitable arbitrage opportunity.

Parity relation mentioned above is used in the empirical analysis of Blanco et al. (2004) and Zhu (2006). While this relation is not constantly perfect, it offers viable perspective to examine arbitrage opportunities. This arbitrage relation is close to perfect with a flat risk-free curve and constant interest rates, when the payout from a CDS on default equals to the principal amount added with accumulated interest on a risky par yield bond times (1 — recovery rate) (Hull and White, 2000a). According to Blanco et al. (2004) this assumption holds on average, and there have been fairly accurate arbitrage from 5 to 10 basis points for assets traded close to par, in times of reasonably low interest rates and relatively flat yield curves.

4.3.2 Limitations to Parity Relation and Arbitrage

This study concentrates on parity relation using most liquid instruments, 5 year CDS prices and fixed rate bonds. However, Duffie (1999) and Duffie & Liu (2001) showed that with some rarer and less liquid instruments there is no violation in this parity. They show that the spread on a par risky floating-rate note over a risk-free floating rate note exactly equals the CDS price. Houweling and Vorst (2002) also extended, that situation is equal when a par fixed-coupon risky bond over the par fixed-coupon risk-free bond is used, if the payment dates with CDS coincide and recovery on default is a constant part of the face value.

In some cases it is impossible to calculate arbitrage opportunities. That arises from the lack of available information or absence of suitable benchmark rate. Zhu (2006) states, that most CDS contracts are settled via physical delivery of underlying assets. For example in this case when physically settled CDS contains cheapest to deliver option (CTD) additionally to equal other characteristic, the CDS prices will be greater than the credit spread. This difference is difficult to value because of the insufficient information in post-default behavior of deliverable bonds. (Blanco et al., 2004)

When arbitrage occurs, to exploit this opportunity it might be necessary to short sell the cash bond. The imperfection between these spreads in credit market may be linked to the complicatedness of this transaction. Zhu (2006) claims that, short-sale of corporate bonds is not always even allowed, and therefore traders are not always able to gain from CDS premium price difference over bond spread. However, as stated before, this transaction is at least sometimes costly and occasionally it is not even possible to execute. These problems are related to illiquidity in corporate bond markets and repo costs. If bond is very illiquid it could be impossible to short sell or at least it will raise the repo cost, so arbitrage may not be large enough to be exploitable. This leads to a situation where CDS spread is higher than credit spread. The spread difference can be explained:

$$pCDS^t - (y^t - r^t) = RC$$

Where $pCDS^t$ is T maturity credit default swap premium, y^t is T maturity bond, r^t is T maturity risk-free rate and RC is repo costs. As stated before, CDS price tends to be higher than credit spread (Duffie, 1999; Blanco et al., 2004; Zhu, 2006).

In addition, there are several other factors influencing for market efficiency and spread differences. For example, there is evidence on the existence of liquidity premium within cash bond and CDS market; this may explain variation in credit spreads (Collin-Dufresne, Goldstein, and Martin (2001). Blanco et al. (2004) add that demand/supply imbalances may cause short-term price movements despite of the fact that there are no changes in default expectations. Zhu (2006) also presents that the conflicting views regarding to credit event definitions e.g. to restructuring, may affect CDS pricing (Zhu, 2006).

5 EMPIRICAL ANALYSIS

This study extends the studies of Blanco et al. (2004) and Zhu (2006). It compares the bond spreads and CDS spreads by using the three case companies: Stora Enso Ltd, UPM-Kymmene Ltd and Fortum Ltd. It uses the hypothesis on the parity relation between CDS spread and credit spread. The empirical part tests whether there have been deviations in this parity and if so, this led to existence of arbitrage opportunities for investors. This study also considers whether the results from the case companies strengthen the conclusions of the previous studies regarding to suitable risk-free rate and price discovery.

5.1 Data

The data is obtained from Datastream using euro currency instruments. It consists of 5-year CDS spreads, two bond yields for every case company in addition to risk free benchmark rates. Observation period runs from 2.1.2006 to 2.1.2007 when comparing the equivalence between the credit spread and CDS spread. In addition, the data from 2.1.2007-28.11.2007 is used to measure the latest changes in parity and risk. These particular case companies were chosen because of the availability in suitable CDS and bond data. This study uses a similar type of data and contracts as previous studies, because it guarantees a better comparability to previous studies and improves the exploitability of the previously proved assumptions.

CDS Data

As already stated, the 5-year CDS contracts have the best liquidity and it is the easiest to match with bond data as well. Therefore, 5-year contracts were an obvious choice. The data is observed on daily basis using mid-market prices available in Datastream.

Bond Data

The bond data is calculated from two bond yields. By linearly interpolating a bond between 3.5-4.5 years to maturity at the start of the sample period with a bond over 6.5 year maturity, it was possible to estimate yields for the 5-year bond. These yields were matched to equivalent CDS spreads.

Risk-Free Data

In order to find suitable reference rate yield data, the 5-year Germany government bond mid-market yields and 5-year swap rates for euros were obtained. As stated before, swap rates have been more accurate in previous studies, See Section 4.2. Therefore, in this study the 5-year swap rate is used as a more reliable reference rate.

5.2 Methodology

This study is made using comparative research method. It compares the calculated time series in Excel, analyzing movements in spreads and searching discrepancies in daily data. Averages and standard deviations are also considered when long-term equivalences are being examined. In addition, study exploits assumptions of the previous studies when determining the arbitrage opportunities.

6 RESULTS

This section presents the results of the empirical study. The first part concentrates on the parity relation on company basis and market basis. Second part considers the arbitrage possibilities and third part includes the comparison to previous studies and discussion. In this section it will be also considered if these results can be generalized, and how the spreads have moved within observation period.

6.1 The Parity Relation in the Case companies

The differences between CDS and credit spreads seems to be quite small during the original observation period 2006, if using swap rates as a reference rate, (See Figure 9 and 10). The spread movements have also moved hand in hand with bond reference yield, however in that case the gaps have been much larger, See Table 6. Table 6 shows that average deviation from parity has been less than 5 bps during 2006, this confirms the assumption that relation holds fairly well in stabile markets. Even the standard deviations have been rather small.

Table 6. The average Deviations from the Parity. Table presents the average differences between the spreads and standard deviation during observation period 2006 and 2007.

	UPM-KYMMENE	FORTUM	STORA ENSO
Average Deviation From Parity Using Swap Rates '06	3,8	4,7	2,6
Standard Deviation	3,6	2,9	2,1
Average Deviation From Parity Using Gov. Bond Rates '06	17,4	17,4	17,2
Standard Deviation	5,1	7,9	4,0
Average Deviation From Parity Using Swap Rates '07	15,5	9,1	24,9
Standard Deviation	13,6	10,2	16,9
Average Deviation From Parity Using Gov. Bond Rates '07	16,0	21,8	10,4
Standard Deviation	7,1	6,3	5,9

Table 6 also presents deviations for year 2007. When observing the accuracy of the reference yields it can be concluded that swap rates seems to be giving much smaller deviation figures as government bond yield. Even in a more turbulent year e.g. 2007 the figures seem to be more accurate.

6.2 Arbitrage

As stated before, there are arbitrage possibilities for investors if the CDS and credit spread parity fail. Table 6 and Figure 9 present the relation between these spreads in normal market conditions. Leaning on these numbers and figures it is showed that there were no significant or exploitable arbitrage opportunities during the year 2006. This is particularly true if the limitations presented in section 4.3 are considered.

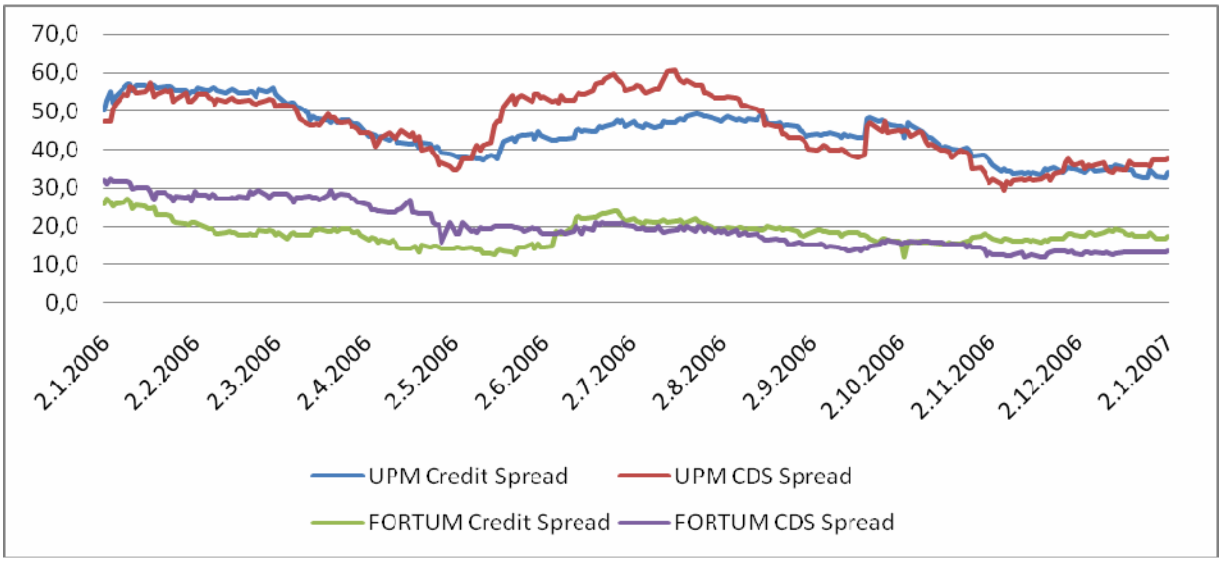

Figure 9. Credit Spread and CDS Spread Differences with UPM and FORTUM. Figure illustrates the spread movements in basis point during the obrservationperiod 2006. Swap rate is used as reference rate.

However, as presented in figure 10, the turbulence in financial market during the second mid-year of 2007 (See also Figure 11), has strongly violated the parity. The gap between the Stora Enso's spreads has been temporarily more than 50 BPS, which enables huge arbitrage possibilities. The observation of the curves and data also strengthen the evidence that CDS spreads anticipate the movements and leads the price discovery.

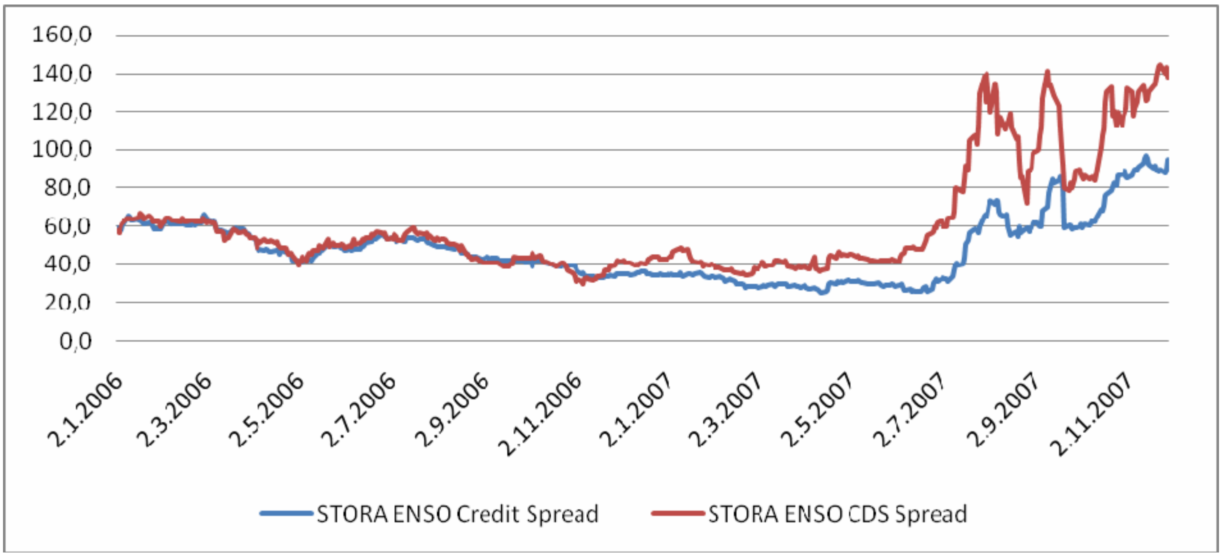

Figure 10. Credit Spread and CDS Spead Differences in STORA ENSO. Figure illustrates the spead movements between 2.1.2006 and 28.11.2007. Swap rate is used as reference rate.

6.3 Discussion

Results give evidence that the risk of these case companies are fairly well priced and that Finnish market works efficiently in pricing these instruments, especially in normal conditions. In addition, swap spreads have been a more suitable reference rate over government bond rate in this study. Also based on the figures and data it can be carefully concluded that CDS spreads seem to lead price discovery. These are all in line with the previous studies.

However, there have been a lot of turbulence in financial markets during past six months. Even though there have been also industrial restructuring in two case companies UPM and Stora Enso, the CDS spreads' movements within lower risk company Fortum (See Figure 11) indicates that the market conditions have strongly violated the parity relation. This leads to assuption that exceptional conditions offer arbitrage opportunties large enough to be exploitable.

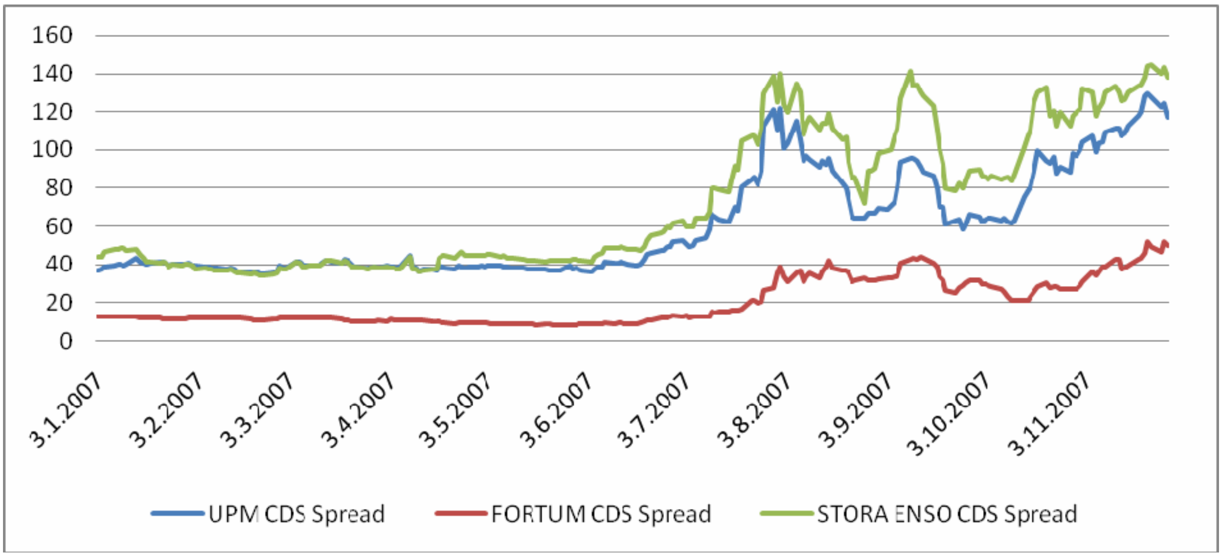

Figure 11. Changes in CDS Price during 2007. Figure shows CDS price changes in case companies during 2007.

7 CONCLUSIONS

This study investigates the relation between corporate bond spread and credit default swap spread. While this study concludes the previous studies, it also compares this relation by using time series data of three case companies. The main function is to search whether there are deviations from this parity relation and in addition, are these arbitrage opportunities exploitable.

Previous studies of Blanco et al. (2004) and Zhu (2006) have proved that there is a parity relation between these spreads and it holds in long-term. The results of this study support this view, adding that this parity tends to hold especially in stable market conditions. The existence of arbitrage opportunities is rather small and considering the limitations, they could be difficult to exploit. Regarding to the risk-free rate, this study strongly suggests congruent views with studies of McCauley (2002), Houweling and Vorst (2001), Blanco et al. (2004) and Zhu (2006) that swap rate is actually more accurate reference rate. In addition, we can cautiously support the results that CDS leads the price discovery comparing these spreads.

When comparing the first part of the data with second part, it shows strong evidence that turbulence in the financial market will violate this parity. When the volatility and overall risk in the market rises rapidly, it affects CDS spread more efficiently than credit spread, which causes at least great short-term deviations from the parity.

Although credit risk is quite well examined topic; there is a lot of space for further research, especially among credit derivatives and arbitrage conditions. This equivalence between CDS and credit spread would be interesting to investigate during a riskier market conditions and with more versatile data. In addition, the equivalence examination in emerging markets might be worthwhile. Regarding to credit derivatives, e.g. testing the efficiency of portfolio hedging using iTRAXX index could be useful. Nevertheless, there are still a lot of space to further examination regarding to credit risk models and determinants.

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