Credit Derivatives

Prepared by the Derivatives Working Party
of the Faculty & Institute of Actuaries

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Report by the Derivatives Working Party

The report contains the following Sections and Appendices.

1 Introduction

1.1 The Derivatives Working Party is a permanent working party set up by the Life Research Committee of the Faculty and Institute of Actuaries with the aim of considering how life assurance companies are using, or might like to use, derivatives and establishing if their use is unduly constrained. The Working Party's terms of reference and its current members are set out in Appendix A.

1.2 There is increasing interest amongst UK life insurers in using derivatives to manage the risks to which they are exposed. However, their experience of, and familiarity with, credit derivatives is often lower than for equity and interest rate derivatives. Some of the instruments used are complex and the regulatory requirements are not always clear. We hope this paper will go some way to addressing these issues.

1.3 Section 2 provides a brief overview of the credit derivatives market. In Sections 3 and 4 we describe two basic credit derivatives – credit default swaps and collateralised debt obligations – in some detail. Section 5 highlights some of the other credit derivative products that are currently available which may be of interest to insurers. This is not intended to be exhaustive and just describes other common types of product. Section 6 looks at some reasons why a life insurer might want to make use of credit derivatives as well as potential barriers to use. We then cover some of the regulatory considerations in Section 7 before setting out our conclusions in Section 8.

1.4 This paper is intended as a general guide to credit derivatives. This paper is not intended to form a basis of any decision by a third party to do or omit to do anything. It does not constitute and should not be construed as advice or recommendations. The Derivatives Working Party accepts no responsibility for any consequences arising from any third party relying on these materials or the opinions expressed in this report.

2 Overview of the credit derivative market

2.1 The credit derivatives market has grown explosively over the past decade. It has generally more than doubled every two years. It is estimated (BBA (2003/04)) that at the end of 2004, the global credit derivatives market, excluding asset swaps, was some US$5 trillion (measured in terms of outstanding principals). For comparison, the total size of the international debt securities market was approximately US$1.5 trillion at June 2005 (BIS Quarterly Review for September 2005).

2.2 However, despite this impressive growth in size, the market is by many still considered embryonic by many (Baggs et al (2003)). The US$5 trillion of credit derivatives trades compares with a massive US$125 trillion of global OTC derivatives trades (all types of derivatives), which is itself growing at a healthy rate of some 20% p.a. Also, Baggs et al suggest that the trading volume figures are in part swollen by inter-bank trading as banks seek to exploit perceived opportunities or manage aggregate exposures in broad rating, industry or rating band classes.

2.3 The BBA 2003/ 04 report notes that the London market continues to be the largest market, accounting for some 45% of the global trading volume, with the Americas (lead by New York) accounting for the next 40%. The balance of global trade is spread mainly across the Far East, Australia and the major Continental European centres.

2.4 As might be expected, banks are both the major buyers and sellers of credit protection. During 2003 banks accounted for approximately 50% of credit protection purchases and just under 40% of credit protection sales. Securities houses and hedge funds were the second largest buyers of credit protection (roughly 15% market share each), while insurance companies were the second largest sellers of credit protection (approximately 20%). Interestingly, the report notes that the continental insurers (especially German insurers) were far more active in the London credit derivatives market than UK insurers. Baggs et al (2003) suggest that this might be due to UK insurers traditionally having greater exposure to corporate credit through equity investments rather than defaultable bonds. The Working Party believes that recent changes in UK legislation, which require UK insurers to set aside capital for credit risk, may increase the demand for credit derivatives in the UK.

2.5 There is a wide range of products available in the market. According to the BBA 2003/04 Survey, single name credit default swaps have been the most popular type of credit derivatives, accounting for just over 50% of the market volume (this is up from 45% in 2001). The 2003/04 report noted a declining proportion of portfolio/synthetic CDO structures, which accounted for 16% of trading volume in 2003 compared with 22% in 2001. It is widely believed that the introduction of various credit indices was the single most important development since 2001, with derivatives based on these indices already accounting for over 10% of total trading volume during 2003. Other products, such as total return swaps, yield spreads or equity-related products have generally accounted for around 5% to 10% of total market volumes.

Survey Period	**1999/2000**	**2001/2002**	**2003/2004**	
	End 1999	End 2001	End 2003	2006 (forecast)
Single name CDS	38%	45%	51%	42%
Portfolio CDOs	18%	22%	n/a	n/a
Synthetic CDOs – full capital	n/a	n/a	6%	5%
Synthetic CDOs – partial capital	n/a	n/a	10%	11%
Full index trades	n/a	n/a	9%	12%
Tranched index trades	n/a	n/a	2%	5%
Credit linked notes	10%	8%	6%	6%
Total return swaps	11%	7%	4%	4%
Basket products	6%	6%	4%	5%
Asset swaps	12%	7%	4%	3%
Credit spread options	5%	5%	2%	3%
Swaptions			1%	1%
Equity linked credit products	n/a	n/a	1%	3%
Source: BBA Credit Derivatives Surveys				

2.6 Some statistics on default experience within the London market are also available from the BBA 2003/04 survey. Of the 30 main institutions included in the survey, nearly all experienced a credit event during the survey period with an average of 11 events per participant. The major credit events related to Worldcom, Parmalat, Marconi, Railtrack and British Energy stock. The default experience over the survey period was relatively high by historic standards; this was undoubtedly related to the sharp decline in the equity stock markets prior to and after 11 September 2001.

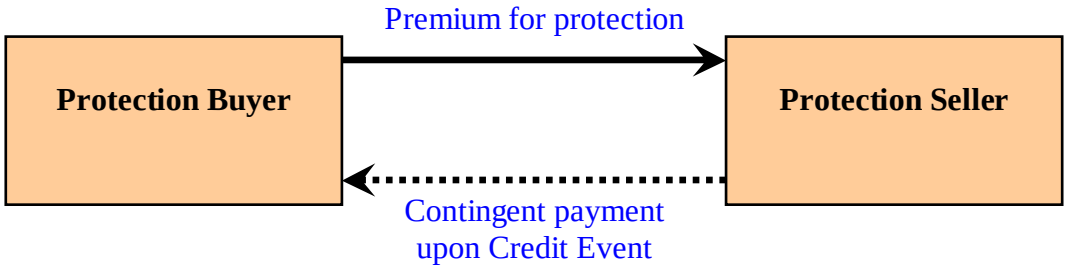
2.7 One of the major limitations on growth in the industry has been the restricted range of underlying entities. There is a limited universe of reference entities, which in 2003 was around 2,000 names. The most frequently cited were the major US automobile manufacturers (General Motors, Ford, Daimler Chrysler), General Electric and the major indebted European telecom companies (DeutscheT, FranceT, BT). It is expected that the range of entities will grow as the market grows. In 2003 the majority of deals were for 3 to 5 year terms. It is expected that this range will widen over time.

2.8 In addition to the introduction of index products, increased standardisation of product documentation, settlement methods and the use of exchange traded products are likely to be contributory factors to the growth in the market.

3 Credit Default Swaps

Introduction to Credit Default Swaps ("CDS")

3.1 A credit default swap is a bilateral contract under which one counterparty (known as the "**Protection Seller**") agrees to compensate another counterparty (the "**Protection Buyer**") if a particular company or sovereign (the "**Reference Entity**") experiences one of a number of defined events (the "**Credit Events**").



3.2 The contract has some similar economic characteristics to an insurance contract in that:

- for the credit cover provided, the Protection Buyer (insured) pays a regular premium to the Protection Seller (insurer);
- the premium ceases at the contract expiry or earlier upon the occurrence of a Credit Event (insured event); and
- should a Credit Event occur, the Protection Seller makes a payment to the Protection Buyer based on the value of an obligation (the "**Reference Obligation**") issued by the Reference Entity (see the section on settlement below).

However, there are important legal distinctions between CDS and insurance – see 3.40 below.

3.3 In market terminology the Protection Seller is long the credit risk of the Reference Entity and, therefore, has a similar risk to someone buying an appropriate Reference Obligation. Conversely the Protection Buyer is short the credit risk and has a similar risk to someone short of an appropriate Reference Obligation.

Credit Events

3.4 For a default swap to be triggered a Credit Event on the Reference Entity has to occur (but not necessarily be continuing) with respect to a Reference Obligation of the Reference Entity. Credit Events are defined as:

- **Bankruptcy**: the Reference Entity voluntarily or involuntarily files for bankruptcy or insolvency protection (widely defined and including a reorganisation of debts under Chapter 11 of the US Bankruptcy Code);

- **Failure to Pay**: the Reference Entity fails to make a payments of at least US$1 million on any obligation (defined as "borrowed money") that is "due and payable";

- **Obligation Acceleration**: an asset has been accelerated due to the occurrence of an event of default (excluding failure to pay);

- **Repudiation/Moratorium**: Repudiation or Moratorium must be accompanied by a Failure to Pay or a Restructuring to constitute a Credit Event; and

- in some cases, **Restructuring**: the Reference Entity agrees to or announces a restructuring or deferral of a material obligation of at least $10 million (eg a reduction in the interest rate or principal of the obligation or a maturity extension).

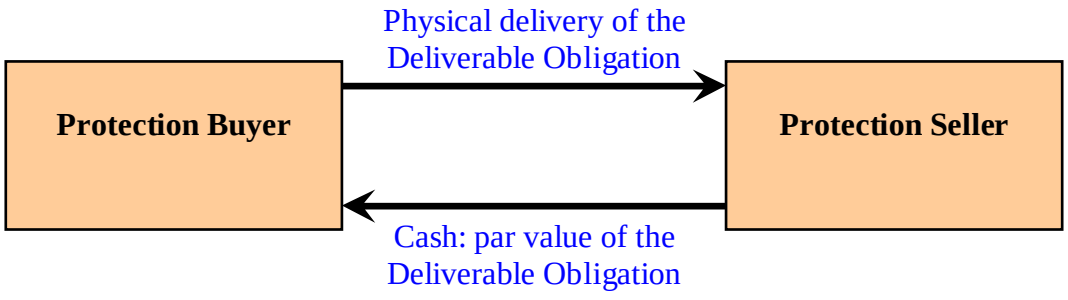
Obligations

3.5 The choice of obligations depends on the type of Reference Entity but can include any payment, borrowed money, a specified Reference Obligation, a bond or a loan. Normally, Reference Obligations are defined as senior, unsecured 'borrowed money' in G7 currencies but credit default swaps are also traded on subordinated debt and on wider payment obligations.

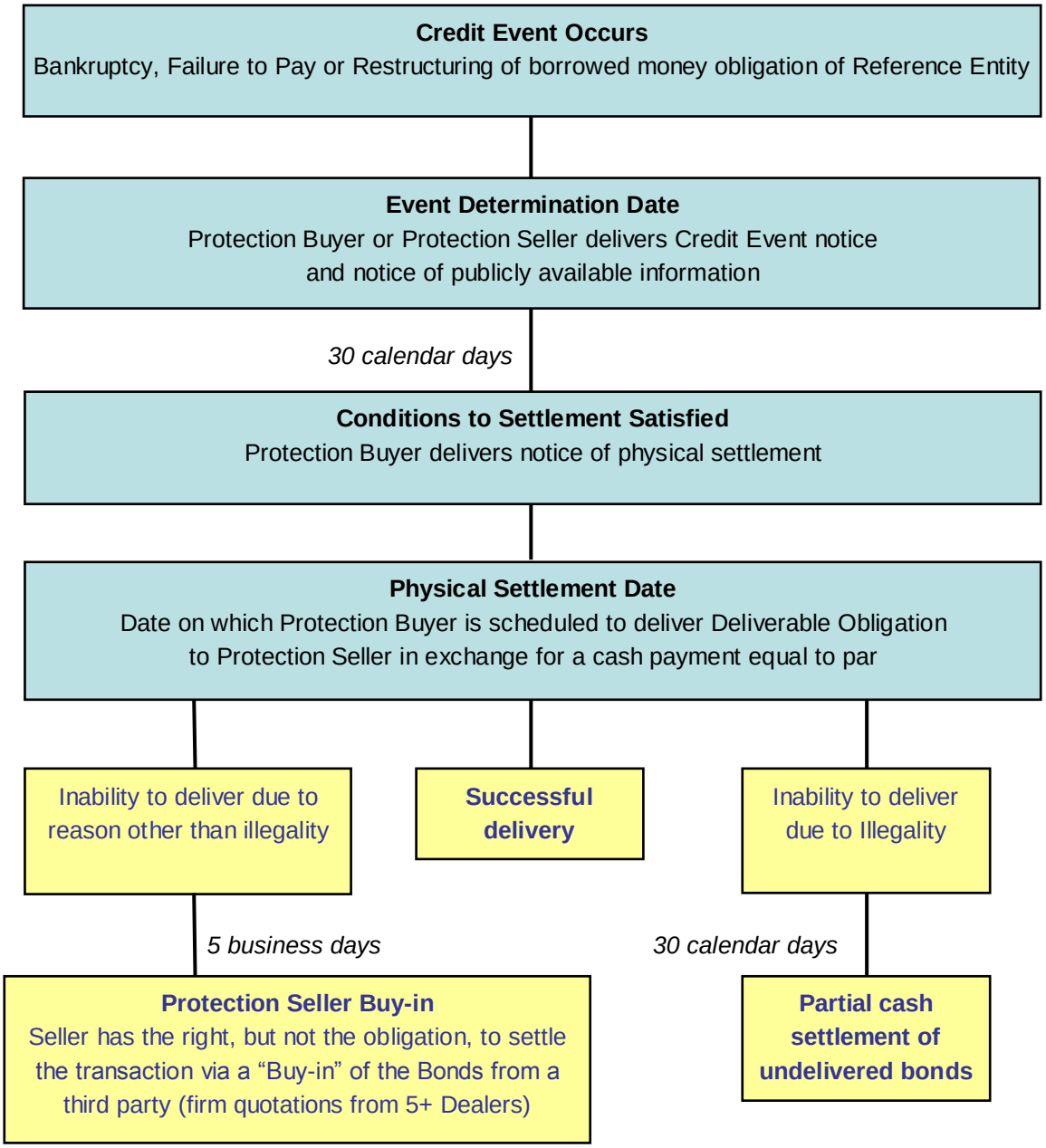
Settlement

3.6 Credit default swaps will be subject to either "**cash settlement**" or "**physical settlement**" under the settlement method. If a CDS is triggered by a credit event then the Protection Buyer and Protection Seller will normally ensure that the terms of the contract covering settlement of the CDS are followed precisely.

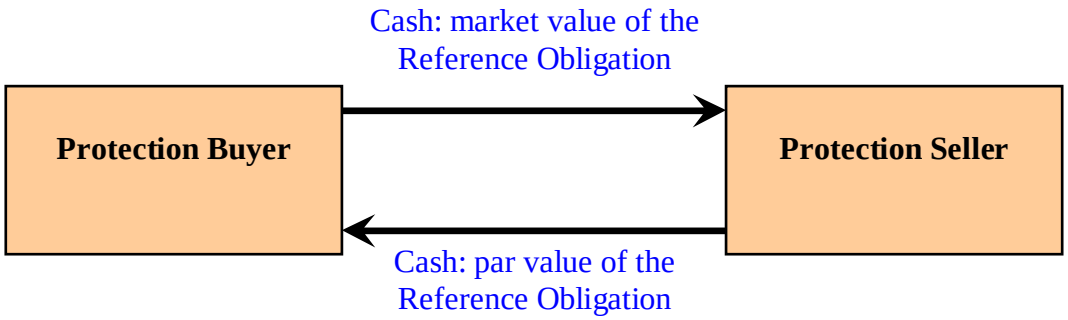
3.7 The current market standard documentation is for credit default swaps to be physically settled. The Buyer delivers to the Seller the Deliverable Obligations and receives 100 per cent par value up to the notional amount of the CDS. A Deliverable Obligation is any asset that the Buyer and Seller have agreed can be used to settle the CDS. For example this may be the Reference Obligation or it may be one of a range of bonds issued by the Reference Entity.



3.8 The following diagram illustrates the process of physical settlement.



3.9 Credit default swaps can also be documented to be cash settled. A Calculation Agent usually obtains a market price from quotations from dealers, usually a bid price, for the Reference Obligation, which is then used to determine the "**Final Price**". The Seller would then pay the Buyer the Notional Amount less the Final Price. For example, were the Final Price to be 76%, the Buyer would receive 24% from the Seller. The Seller effectively compensates the Buyer for the erosion in value of the Reference Obligation as a result of the Credit Event.



3.10 In practice, the Protection Seller would pay the net amount to the Protection Buyer.

3.11 Cash settlement is hardly ever used for single name default swaps but is useful when the Protection Seller wants exposure to assets that it cannot easily hold in physical form (eg loans). Cash settlement is also applied if physical delivery proves impossible or illegal, usually due to a change in law making it illegal to transfer the relevant assets or because the clearing system is disabled for a long period. In 2003 over 85% of transactions used physical settlement.

Pricing and valuation

3.12 The market pricing of credit default swaps will be determined according to supply and demand. In many cases there will be reasonable congruence with the price of other instruments, in particular bonds issued by the Reference Entity, since it will be possible to arbitrage away any significant pricing anomalies between the different instruments.

3.13 From a theoretical standpoint the basic formula for pricing a CDS is given by the following simple equation:

Default Swap Premium or Spread = Default Probability x (1 – Recovery Rate)

This is an intuitive formula. If the default probability over 1 year is thought to be 2.50% and the recovery rate is expected to be 40%, then the premium for the default swap should be 1.50%.

3.14 The spread observed in the market for a credit default swap can, to the extent that these exist, be compared against the spread available from cash bonds of equivalent term issued by the relevant Reference Entity. The difference between the default swap spread and the spread on corresponding bonds and asset swaps is known as the "**Basis**". The most commonly traded CDS generally trade tighter compared to comparable bonds and asset swaps.

3.15 Basis is determined by subtracting the bond "**z-spread**" from the matched maturity CDS premium. The Basis can be either positive or negative and, depending on its

causes, could give investors an indication of the relative value between the bond and the CDS market for a credit. Market convention is that the Basis is negative when the CDS trades inside (lower or tighter than) the bond z-spread for the same maturity.

3.16 When there is a negative basis it appears that an investor who buys the bond and buys protection can earn a return in excess of the risk-free rate with virtually no risk. As we know, however, there are rarely 'free lunches' in the capital markets and price differences are usually present for a reason.

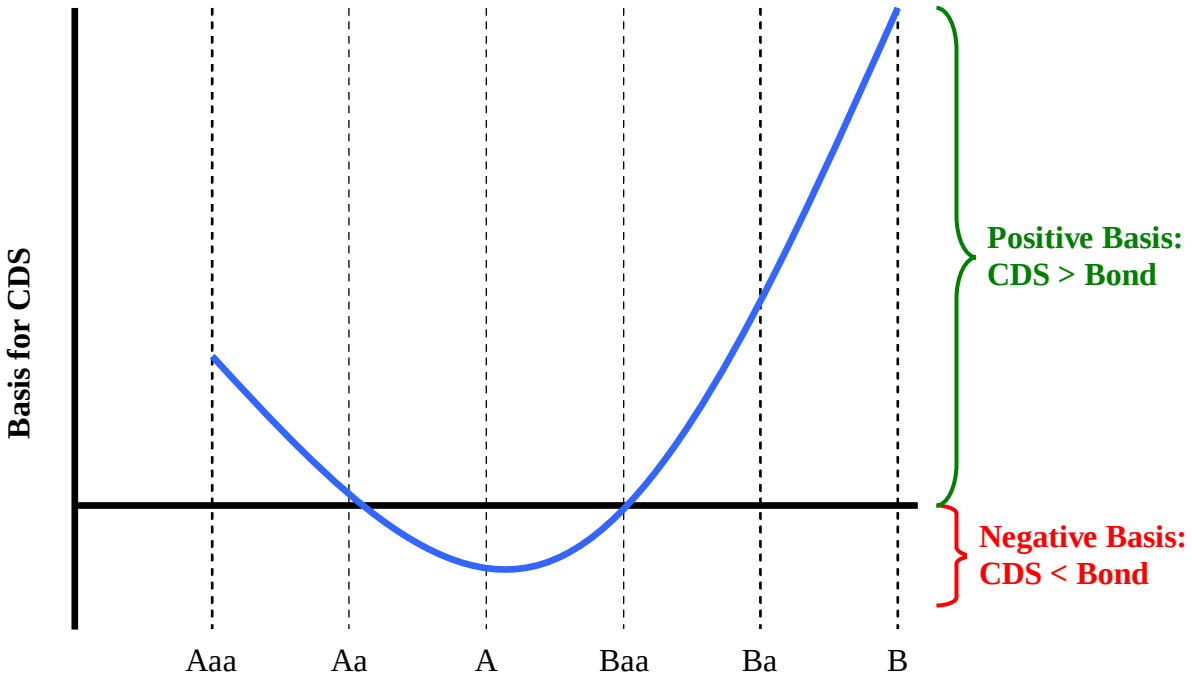
3.17 There are a number of reasons why the Basis exists, linked to the fact that there is not a perfect arbitrage between buying (or selling) a bond and simultaneously selling (or buying) the corresponding CDS. These include:

- *Documentation differences:* CDS and Bond documentation are not identical and, therefore, will have different risk profiles. The documentation differences include (i) the "**Cheapest to Deliver option**" held by CDS Protection Buyers whereby they have the option to choose the cheapest (lowest price) Obligation to deliver on a Credit Event and (ii) differences in the events that trigger repayment – for example Restructuring being classified as a Credit Event under a CDS.
- *Imbalances in the demand for CDS protection:* for both systematic reasons (for example buyers of protection outweighing the number of sellers of protection as in the summer of 2002 at the depths of that credit downturn) and idiosyncratic reasons (for example convertible bond arbitrageurs buying credit protection on a reference credit in order to remove credit risk and focus on the embedded equity option value). As an example of an effect which tends to widen the Basis, an investor with a negative view of a particular credit risk may find it easier to buy a CDS than to sell a cash bond short.
- *Reaction to new information:* there is evidence that the CDS market is quicker to react to financial distress in underlying entities than the cash bond market, perhaps reflecting the different nature of investors (eg traders going long bonds and executing protection via CDSs).
- *Macro factors:* for example liquidity issues and segmentation between the bond and the CDS market.
- *Bonds that trade a long-way above or below par (eg high or low coupon bonds):* since, following a Credit Event, the settlement for a CDS will be based on par. As an example, if interest rates are higher than the coupon on a bond, then, since the bond routinely trades at a discount to par, the Protection Buyer would gain on a Credit Event even if the event did not actually impact the market value of the bonds (eg a technical default).
- *Funding costs:* unlike cash bonds, CDS are unfunded transactions which lock in an effective funding rate of LIBOR. Most market participants have a cost of funding greater than LIBOR and are therefore willing to accept narrower CDS spreads than cash spreads.

- *Counterparty risk:* a CDS Protection Buyer is exposed to the credit risk of the Protection Seller and the CDS premium will tend to reduce to compensate for this.

3.18 Understanding the reasons for the existence of a Basis between the CDS spread level and the bond spread level will give investors the chance to use credit derivatives to manage positions efficiently and determine the relative value between the bond and the credit derivative.

3.19 The graph below shows how Basis typically varies according to the rating of the Reference Obligation.



3.20 The generic shape of this graph can be explained as follows:

- Highly rated bonds (Aa or higher) often trade at very tight spreads in the asset swap market whereas CDS protection may not trade with an equivalently low premium. Hence, the Basis typically increases on high quality bonds.
- Credit default swaps with A and Baa ratings are the most commonly traded in single name form or as "assets" in synthetic CDOs (see Section 4). Hence, the Basis has a tendency to be flat to negative on A and Baa bonds.
- The Cheapest to Deliver option may carry greater value as the potential for a Credit Event increases. Hence, the Basis typically increases as credit quality drops (below Baa).

3.21 Historically the Basis tended to be positive on most names. Since early 2003 arbitrage has become more efficient and the Basis for most names has narrowed. Basis

fluctuates with market conditions and from name to name but is now generally within a couple of basis points unless there is some clear difference in risk between the CDS and bonds.

3.22 The mark-to-market ("MTM") of a credit default swap is the net present value of the difference between the initial spread and the current spread for a default swap on the same Reference Entity, allowing for the fact that this spread is payable until the earlier of default or maturity.

$$MTM(T) = \{ S(T) - S(0) \} \times \Sigma_N \ DF(N) \times P(N)$$

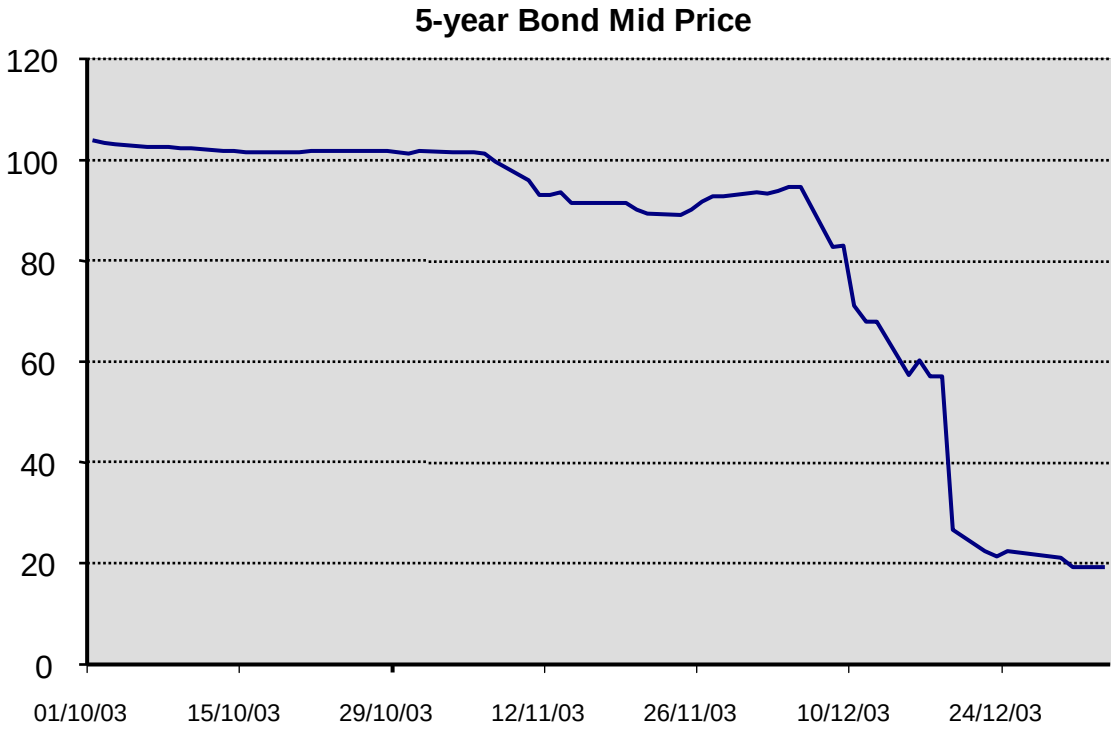
where:

MTM(T)	is the mark-to-market of the credit default swap at time T;
S(0)	is the initial spread;
S(T)	is the spread at time T;
DF(N)	is the risk free discount factor; and
P(N)	is the probability that no credit event will have occurred to time N.

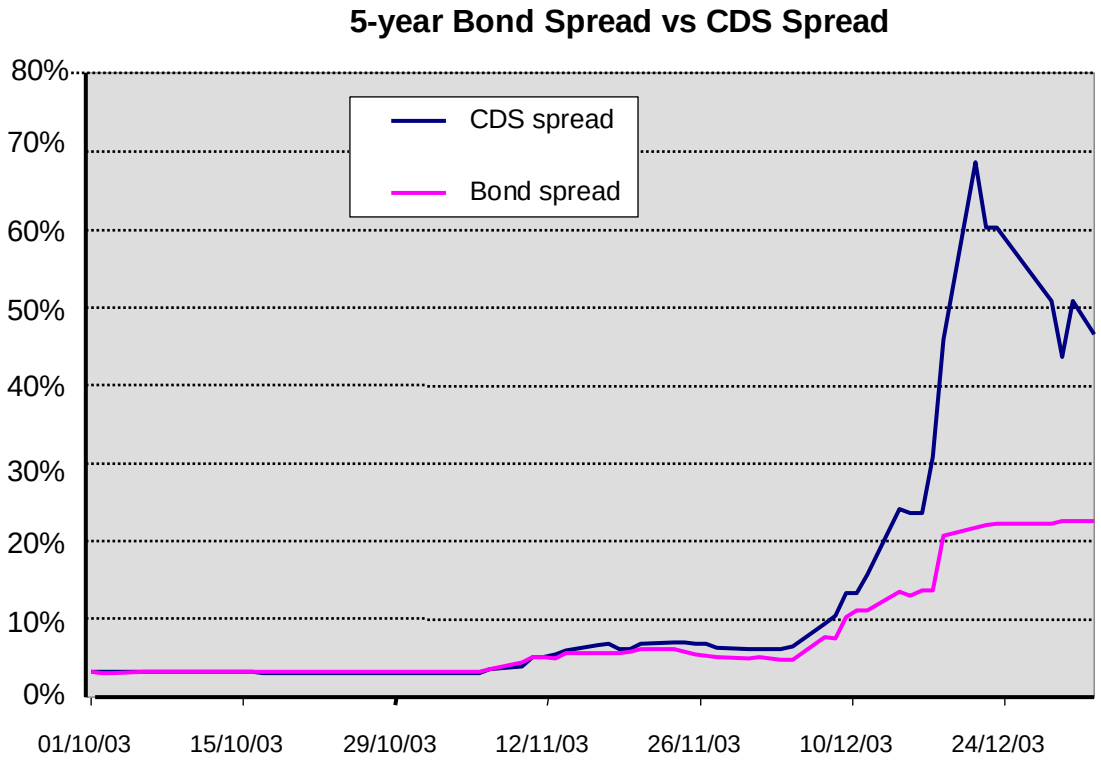
Case study: recovery under a CDS

3.23 There have been a number of credit defaults where the CDS market has been tested and has operated as expected. We look here at Parmalat which defaulted in December 2003 revealing a EUR4.2bn hole in its balance sheet.

3.24 The graph below shows the movement in bond price of a 5 year bond EUR PARFIN 6.8% 07/08 over the period leading up to default.



3.25 The following graph shows the difference between the spread on the 5 year bond versus a 5 year CDS for Parmalat.

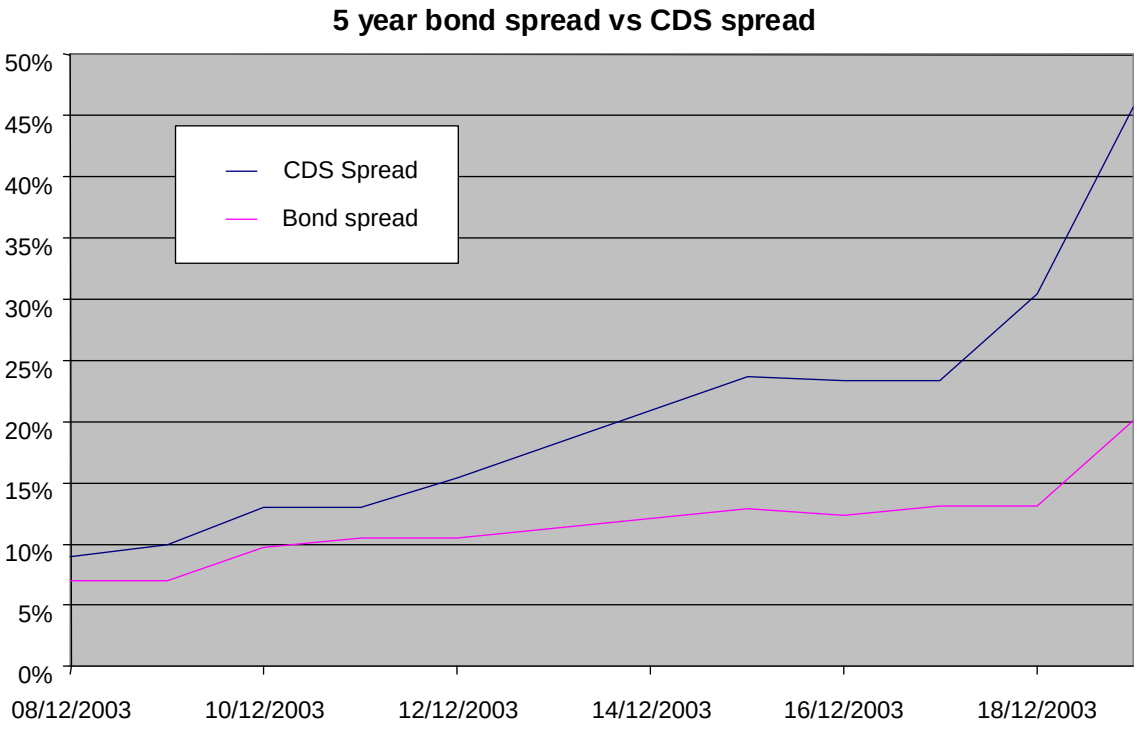


3.26 As can be seen in the above two graphs, the fall in bond price mirrors the rise in CDS spread.

3.27 The large pick up in the CDS spread in the run-up to default reflects the expected net payout on the CDS in the quarterly premium. Spread is quoted annually but is paid quarterly.

3.28 On default the price of the bond is more meaningful than the yield and again reflects the expected recovery. The CDS spread ceases to be a useful measure since, with default in progress, this spread would apply for a short (or null) period.

3.29 Looking at the key period, 8 December to 19 December 2003, in more detail:

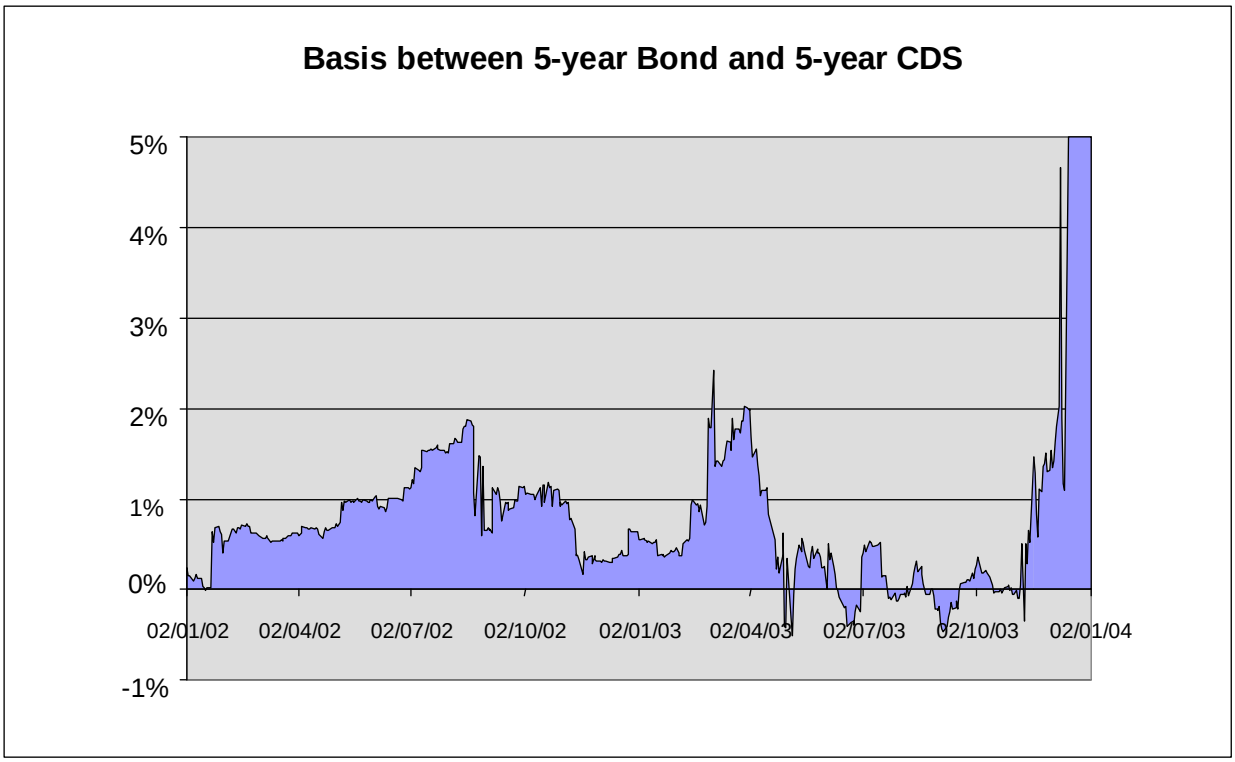


Key Dates	Event
November	Parmalat reported €4.5bn of cash and liquid assets.
8 December	Parmalat unable to repay a €150m bond due on 8 December.
9 December	S&P downgraded Parmalat to BBB-.
12 December	Parmalat management found the liquidity to redeem the €150m bond, the penultimate day of a 5 day grace period for repayment.
16 December	S&P downgraded Parmalat from BBB- to B+.
17 December	S&P downgraded Parmalat to CC.
19 December	Bank of America announced that an account with allegedly US$3.9bn in liquidity did not exist. S&P downgrades Parmalat to D.

3.30 Note the CDS reacts to news slightly ahead of the bond market. This is to be expected as the CDS is likely to be more heavily traded than the bonds.

3.31 By 19 December protection buyers had to pay a premium of approximately 50% of the CDS contract cost. At this point the bond price reflects the expected recovery and the bond spread is no longer a meaningful measure.

3.32 The graphs above show the movement in Basis over the period during which Parmalat defaulted. It is also interesting to look at Basis over a longer period as shown in the graph below.



3.33 In 2002 the Basis was positive for Parmalat (i.e. the CDS spread was larger than the equivalent bond spread). This reflects demand for credit protection during the credit downturn in 2002 as well as the in-built Cheapest to Deliver option in the CDS.

3.34 In 2003 there were a number of periods of negative Basis. One of the explanations for this is banks hedging retained CDO positions. Banks create physical CDOs by buying individual credits. They then hedge their position by selling protection through CDS. This can drive down the cost of protection creating negative Basis.

3.35 Parmalat was used in a lot of CDOs since it was cheap compared to its credit rating, i.e. had a wide spread for its credit rating perhaps reflecting market perception of a greater credit risk than was implied by the credit rating.

3.36 Following the emergence of bad news, however, the Basis tends to become increasingly positive as seen in December 2003.

3.37 The default of Parmalat had a very low recovery rate of 9.6% and this event affected more than 150 CDOs for about US$2.7bn.

Legal documentation

3.38 Most CDS are documented as a swap under an ISDA (International Swaps and Derivatives Association) Master Agreement.

3.39 The introduction of the 1999 ISDA Credit Derivatives Definitions eliminated documentation inconsistencies, increased market confidence and generally simplified trading for all users. This was enhanced by the 2003 ISDA Credit Derivatives Definitions published on 10 February 2003.

3.40 The 2003 ISDA Credit Derivatives Definitions are used in transaction documentation to define the terms of credit derivative contracts. Credit derivatives are subject to the same legal issues that generally affect other derivatives, namely the suitability of the transaction for the counterparty involved and the capacity to enter into the contract.

3.41 Other questions and legal issues have been raised and discussed in recent years:

- *Are credit derivatives insurance?* The market generally relies on an ISDA sponsored opinion from Robin Potts QC. Potts distinguished credit derivatives contracts from insurance contracts on the following basis: (a) the protection buyer does not need have an insurable interest, i.e. does not need to own the underlying reference obligation, (b) there is no reason for the protection buyer to suffer a loss in order to trigger a payoff and (c) the terms of the credit derivatives contracts are sufficiently different from insurance contracts.
- *Credit derivatives and netting:* Parties to a credit derivative usually try to ensure that they can net their exposure under a defaulted transaction with exposures arising under other transactions with the same entity. In English Law, the close out netting provisions of the ISDA Master Agreement is usually sufficient to achieve the set off treatment and most users of credit derivatives ensure that these contracts fit under the ISDA Master Agreement's netting provisions. This is important concept for credit risk and regulatory capital purposes – in particular when analysing counterparty exposure.
- *Transferability & confidentiality of credit derivatives:* It is important to understand whether the credit derivative to which you are a party is freely transferable and if there are any duties of confidentiality to third parties. For example this type of confidentiality may arise if a bank buys protection on a loan within its loan book for which it wishes to remain the lender of record and where it also wishes to keep confidential the existence of a credit derivative with the loan as the Reference Obligation. Confidentiality also affects insider dealing and the establishment of "Chinese walls" where one group of staff in the same institution has access to unpublished price-sensitive information about a Reference Entity.

3.42 The ISDA Definitions have been refined over time as they have been tested in practice by actual default events.

- In 2000, National Power spun off the majority of its assets into a new entity, Innogy, with the remaining business, renamed International Power, falling to below investment grade. This led to a technical dispute as to which company was the successor organisation, which was ultimately determined to be International Power. In response ISDA modified their Definitions so that, following a restructure, the successor organisation should follow the assets.

- In 2000, Conseco underwent a restructuring of bank debt, deferring payment for 3 months in return for increased interest and additional covenants. This Restructuring Credit Event enabled Protection Buyers of short-dated CDS to purchase long-dated, unrestructured, Conseco debt, trading at less than 70% of par, and then deliver it under the CDS in return for par. Hence, Protection Buyers were able to make significant gains even though recoveries on maturing debt were still 100% and short-dated debt, post the restructuring, was trading in excess of 90% of par. This led to the adoption of "**Modified Restructuring**" language, which limits the maturity of bonds that can be delivered on a restructuring event. "**Modified Modified Restructuring"** is a further refinement designed for the European markets.

3.43 Some cases have been settled in court. When Railtrack went into administration in 2001, Nomura (as a Protection Buyer) attempted to deliver convertible bonds, which were trading at a particularly low price, to CSFB (their Protection Seller). The courts ultimately judged, in Nomura's favour, that convertible bonds, prior to conversion, are acceptable Reference Obligations under a CDS. ISDA issued a supplement to their Definitions concurring with the opinion of the courts.

4 Collateralised Debt Obligations

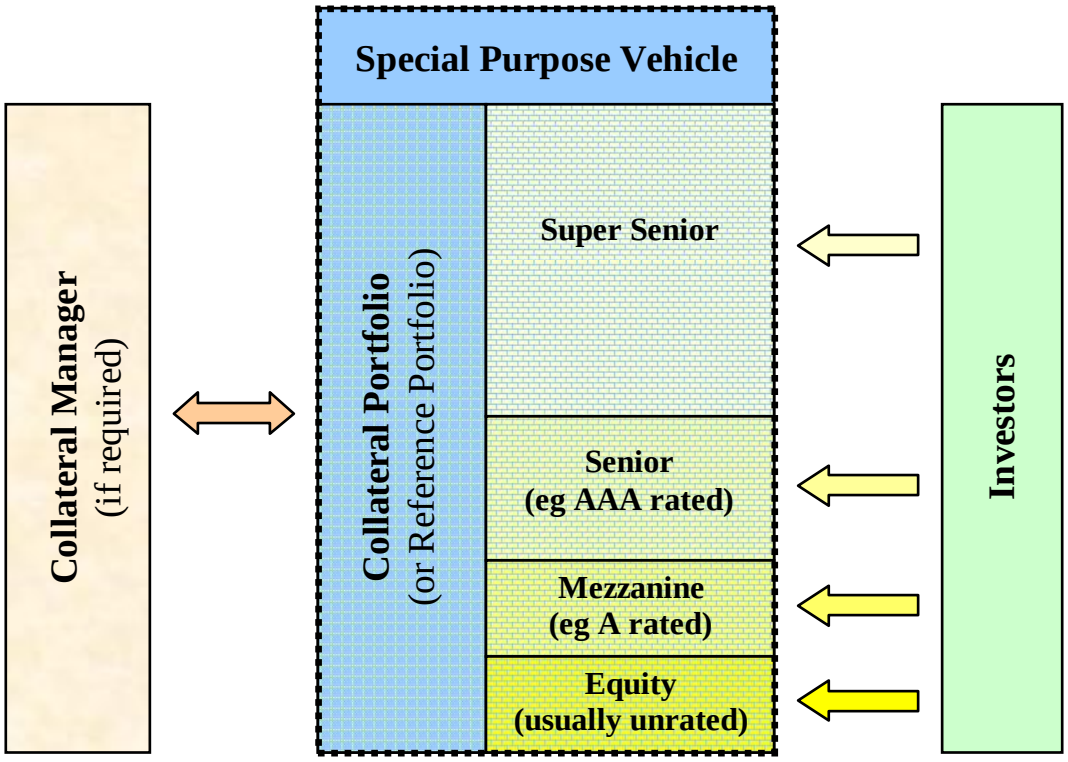
Introduction to Collateralised Debt Obligations ("CDOs")

4.1 A CDO is a form of asset-backed security that is used to separate the credit risk and return characteristics of a diversified pool of assets into multiple tranches each with a unique risk and return profile. The key elements of a CDO are:

- the pool of assets to which investors, as a group, are exposed (known as the "**Collateral Portfolio**");
- the subordination rules according to which any credit losses incurred in the Collateral Portfolio are to be allocated between different classes of investor; and
- the structure, since investors wish to assume only credit exposure to the Collateral Portfolio and so, as far as is practically possible, other risks should be eliminated.

CDO structure

4.2 CDOs are usually structured via a bankruptcy-remote special purpose vehicle ("SPV"). The SPV issues various classes of debt securities to finance its activities and applies the funds raised to purchase an asset pool. In many cases the SPV will invest directly into the Collateral Portfolio but, in the case of a "**synthetic CDO**", the SPV will take exposure to the Collateral Portfolio through a derivative transaction with a bank. In this case the Collateral Portfolio is known as the "**Reference Portfolio**".



4.3 Within the CDO structure, senior note holders benefit from the credit enhancement created by the subordination of other debt tranches. Any credit losses impact initially on the "**equity tranche**" and then, if and when this has been exhausted, progressively work through the subordination levels toward the "**supersenior tranche**". This process is known as the "**waterfall**".

4.4 For example, the equity tranche might absorb the first 3% of losses on the overall portfolio and the "**mezzanine tranches**" any losses between 3% and 9%. In this example the mezzanine tranche is said to have an "**attachment point**" of 3% and a "**detachment point**" of 9%. The "**senior tranche**" might absorb losses from 9% to 15% and the supersenior would be exposed only to any losses above 15% of the total portfolio.

4.5 Since investors in the equity tranche accept the highest default risk, this tranche receives the highest coupon rate. As one progresses to more senior tranches of the CDO the coupon rate reduces to reflect the lower risk. The yield that is required for each tranche of a CDO will be determined according to the view of investors as evidenced by the supply and demand balance for each level of risk.

The Collateral Portfolio

4.6 The most common types of assets underlying CDOs are investment grade bonds, high yield bonds and leveraged loans. There have been structures including many types of debt including:

- subordinated debt;
- stripped securities, both income only ("IOs") and principal only ("POs");
- project finance debt;
- emerging market debt;
- asset-backed securities, including mortgage backed securities;
- tranches in other CDOs ("**CDO^2**"); and
- hedge funds (collateralised fund obligations or "CFOs").

4.7 When building a CDO one of the objectives will be to maximize the weighted average spread produced by the Collateral Portfolio. When designing the Collateral Portfolio, however, it will be necessary to choose assets where the risk of default can be reasonably assessed by both investors and the rating agencies. There will therefore be limits applied to the type (eg senior or subordinated) and quality (rating level and liquidity) of the debt that can be included, or to the components of an index.

4.8 CDOs can be either "**static**", where no changes are allowed to the Collateral Portfolio, or "**managed**", where there is an asset manager (often termed the "collateral manager") appointed to adjust the Collateral Portfolio within specified parameters. For a static deal trading is limited to the sale of impaired or defaulted assets and so the investors take portfolio risk on a pre-defined portfolio of assets. For a managed deal the asset manager can adjust the Collateral Portfolio at any time subject to limits for:

- the weighted average credit rating of the portfolio;
- the weighted average spread rating of the portfolio;
- the overall diversity of the portfolio;
- the allocation to fixed and floating rate assets; and
- the proportion of the portfolio allocated to various asset types.

Impact of spreads within the Collateral Portfolio

4.9 The value of the assets within the Collateral Portfolio will change with credit spread on the assets. This will also impact the value of the different tranches of the CDO. In particular, and based on market consistent pricing, a rise in credit spreads implies a rise in expected future defaults.

4.10 The impact of changes in the credit spreads of the Collateral Portfolio will vary between the different CDO tranches. The equity tranche is exposed to any small increase in credit spreads since this implies, in market-consistent terms, an increase in future defaults which will impact first on the equity tranche. In contrast, since losses are unlikely to impact the supersenior tranche, the value of this tranche has relatively little dependence on the underlying credit spreads unless these move substantially (when the risk of losses impacting this tranche would no longer be remote).

4.11 The impact of spread changes on different tranches is typically measured by a "**Leverage**" factor. The Leverage measures how much the theoretical spread payable on a CDO tranche would vary following a small change in the average spread in the Collateral Portfolio. An increase in the theoretical spread would reduce the value of an existing CDO tranche. For example, for a typical CDO:

- the equity tranche might have leverage of 15 to 20 times so if spreads on the Collateral Portfolio increase by 5 basis points then the theoretical spread on this tranche would increase by 75 to 100 basis points, with a consequent fall in value;
- the mezzanine tranches might have leverage of around 5 to 7 times, senior tranches from 1 to 2.5 times, and supersenior tranches leverage factors of significantly less than 1, perhaps 0.25.

Impact of Correlation within the Collateral Portfolio

4.12 One can better understand the impact of correlation on a CDO by considering two Collateral Portfolios, one fully diversified (the "Diversified Portfolio") and the other where the assets are all perfectly correlated (the "Correlated Portfolio").

4.13 Should one of the assets within the Correlated Portfolio suffer a default (or other credit event), then this will also impact upon all of the other elements of the portfolio. Hence, the only difference between the various CDO tranches will be as a result of the recovery rate on the defaulted portfolio. From the perspective of performance, this means that each of the CDO tranches will behave in a similar way to the entire Collateral Portfolio and the structure will have achieved little with respect to transforming credit risk and return for the investors.

4.14 Conversely a single default within the Diversified Portfolio will have little or no impact on the other assets within the portfolio. In this case it is highly unlikely that a substantial number of assets within the Collateral Portfolio will suffer a credit event in any single time period and the senior and super senior tranche sizes of the CDO can be substantial (as allowed by the rating agency models). One should note, however, that it is also highly unlikely the Diversified Portfolio will suffer zero credit events and so there is a relatively high risk of a default under the equity and subordinated tranches of the CDO. In this case the CDO has effectively transformed the credit risk and return for the investors in the different tranches relative to holding the Collateral Portfolio.

4.15 It is usual to design Collateral Portfolios to have a high diversity score. Any improvement to the diversification of a Collateral Portfolio is recognised by the rating agencies and results in a CDO with larger senior tranches and smaller subordinated tranches. The senior tranches are the cheapest to finance and, generally, the easiest for which to find buyers.

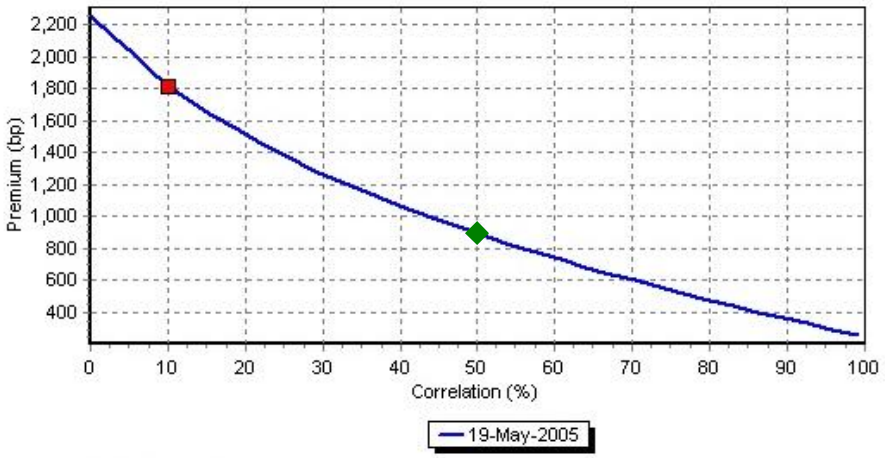
4.16 Another corollary of the above is that a change in correlation assumptions will impact differently on the various CDO tranches. A net increase in the correlations will act to the detriment of supersenior tranches but in favour of the equity tranche. Subordinated tranches may be relatively indifferent to correlation. In aggregate the valuation of the CDO should, in theory, be unchanged since the total value of the Collateral Portfolio is not affected by the correlation between the assets comprising this portfolio.

4.17 The pricing of a CDO is often quoted by reference to an "**Implied Correlation**" assumption, in addition to the spread of the underlying Reference Portfolio. The Implied Correlation is the archetypal "wrong number put in the wrong formula to give the correct answer", similar to the use of implied volatility within the Black-Scholes formula for equity options. The Implied Correlation for CDOs is based on the Gaussian Copula model – see Dorey & Joubert (2005). The Implied Correlation assumption typically varies across different tranches, just as equity implied volatility differs by the strike price of the option.

4.18 In current market conditions correlation assumptions might be around 10% for equity tranches and 40% for senior tranches. In early May 2005, dislocation in the market, related to hedge fund activity, meant that the Implied Correlation for mezzanine tranches became negative. In this situation simplistic pricing models are unable to fit the actual market pricing of the CDO tranches.

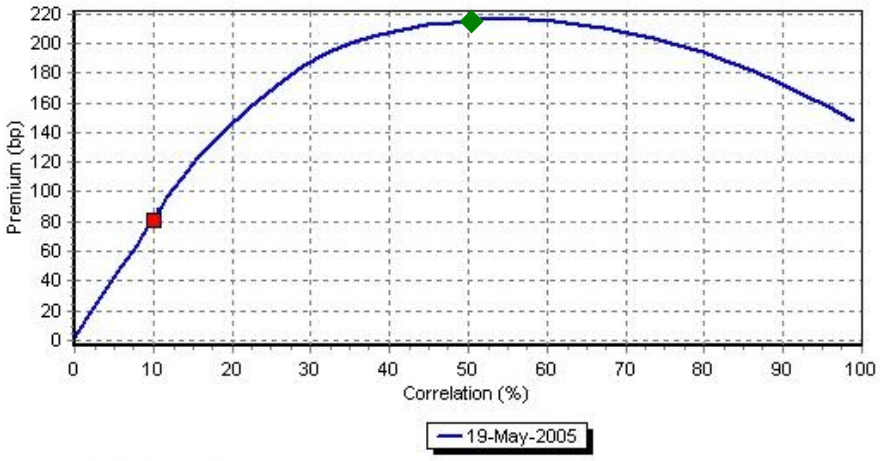
4.19 The graphs below show the sensitivity of the theoretical spread payable on typical CDO tranches to the correlation assumption used. A rise in the theoretical spread payable will correspond to a reduction in value of a tranche that has already been issued.

Example: Equity tranche – an increase in correlation from 10% to 50% would reduce the spread payable from 18% to under 9%, increasing the value of the tranche



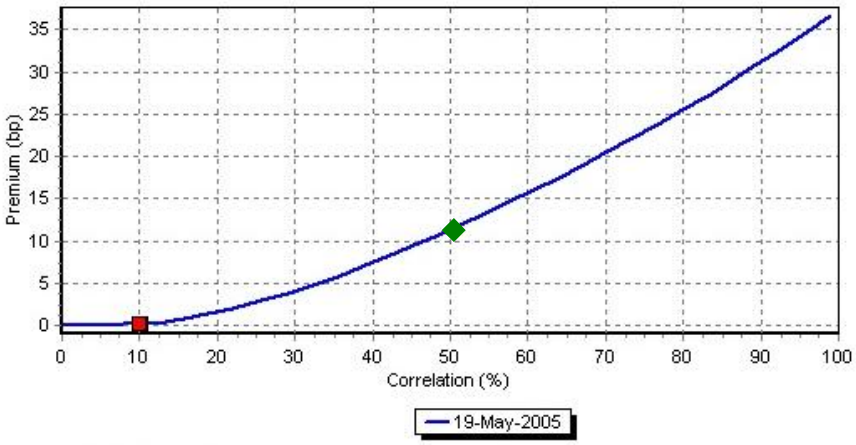
Source: CreditDelta, UBS

Example: Mezzanine tranche - non monotone dependency on correlation



Source: CreditDelta, UBS

Example: Supersenior tranche - reduces in value as correlation increases



Source: CreditDelta, UBS

4.20 Market participants increasingly refer to the "**Base Correlation**" structure, which is the Implied Correlation that solves for the price of equity tranches with varying width. This gives a more robust measure of correlation than solving for correlation for mezzanine tranches, since the dependence of price on correlation is monotone.

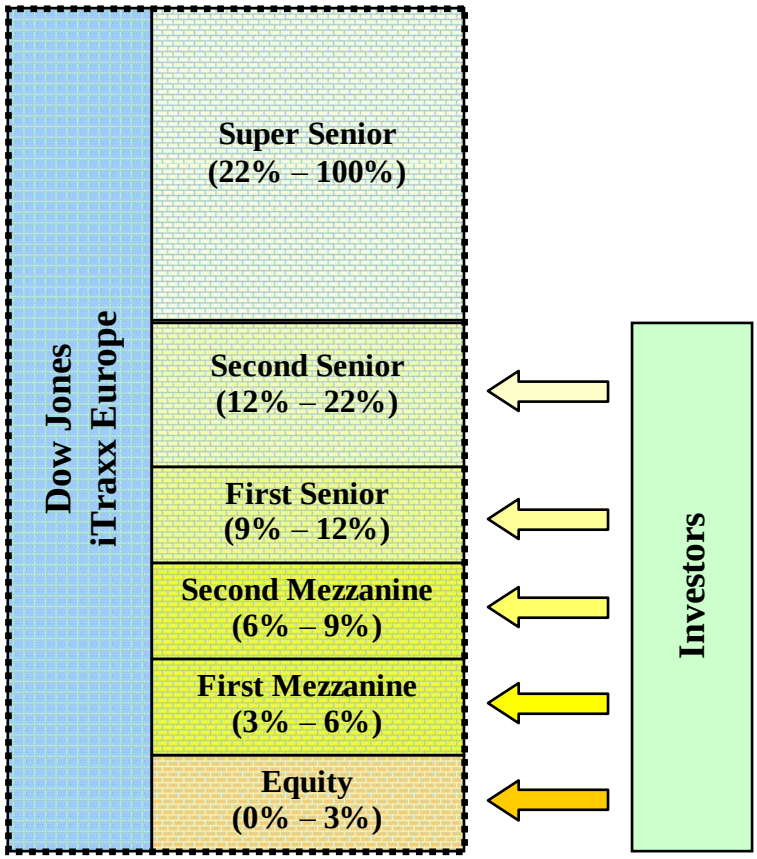
Index products – iTraxx indices

4.21 As discussed in Section 2, one of the most significant market developments in recent years has been the introduction of index-based credit derivative products. Within Europe, the most important series of indices is the Dow Jones iTraxx, created in 2004 from a merger of two previously competing indices, the Trac-x and Dow Jones iBoxx.

4.22 The iTraxx Europe index is constructed as an equally weighted index of 125 CDS. The index constituents are chosen as the European-based (including UK) issuers with the most liquid investment grade CDS within a given sector split (eg the 25 most liquid financials, the 10 most liquid autos etc.). The information on liquidity is taken from a dealer poll of 27 leading investment banks based on the previous six months trading activity.

4.23 A new series of the iTraxx index is issued every 6 months (March and September) – for example, Series 3 was issued in March 2005.

4.24 Standardised CDO tranche index products have been created based on the iTraxx index for maturities of 3, 5, 7 and 10 years. For example, for Series 3, the 5-year tranche matures on 20 June 2010 and the 10-year tranche matures on 20 June 2015. The tranching structure for all maturities is as shown below, where the most senior tranche of all, the 22%–100% tranche is not typically quoted.



4.25 So, for example, the 3%–6% mezzanine tranche is exposed to all losses between 3% and 6% on the underlying iTraxx CDS portfolio.

4.26 Investors can buy or sell protection on a particular tranche and this can be done in funded (like a bond) or unfunded (like a swap) fashion.

4.27 Note that each Series, and the resulting tranches, are based on a static index. That is, the reference entities remain constant throughout the life of a particular tranche, even though the constituents of new Series of the index may change.

4.28 For example, when Series 3 was constructed in March 2005, Carlton and Vivendi Universal replaced Pearson and Telia Sonera in the TMT Sector. However, derivatives based on Series 2 continue to remain referenced to Pearson and Telia Sonera CDS.

4.29 This is in contrast to typical equity index products such as FTSE-100 futures and options, where existing transactions are rebalanced in line with changes in the index.

4.30 A life company purchasing either an equity or credit derivative as protection on a cash portfolio would need to assess the potential tracking error resulting from two sources:

- whether the index is a close match for its portfolio at the time the option is purchased; and

- whether the index is likely to remain a close match, particularly bearing in mind the dynamics of the derivative index and the trading style for the portfolio (eg buy and hold versus sell on downgrade/deletion from index).

Rating of iTraxx tranches

4.31 At the time of issue Fitch assigned indicative ratings to the Series 3 tranches. The ratings for the 5-year and 10-year tranches were as set out below, compared to a weighted average rating of A-/BBB+ for the underlying iTraxx portfolio:

Tranche	**5 years**	**10 years**
9%–12%	AAA	AAA
6%–9%	AAA	AA-/A+
3%–6%	BBB+/BBB	BB/BB-
0%–3%	NA	NA

4.32 As would be expected, the credit rating for the 3%–6% and 6%–9% tranches are worse for the longer terms, since there is a greater risk of losses on the underlying portfolio in excess of the 3% and 6% attachment points. The most senior tranches (6%–9% and above in this example) have a higher credit rating than the underlying portfolio.

4.33 The 0%–3% equity tranche would not receive a credit rating since this is exposed to any losses on the underlying 125-name portfolio, hence is highly unlikely to suffer zero defaults. The supersenior 12%–22% tranche would typically be a strong AAA although, if longer terms do become available, the rating could fall below this level.

Example pricing

4.34 An example of pricing as at 1 August 2005 for the 5 year iTraxx is shown below. This compared to a spread on the iTraxx Europe index of 36 basis points per annum.

Tranche	**Mid Spread**	**Leverage**	**Implied Base Correlation**
12%–22%	10bp p.a.	0.5x	69½%
9%–12%	15.25bp p.a.	1.0x	51%
6%–9%	27.75bp p.a.	1.7x	43%
3%–6%	78.5bp p.a.	4.4x	32%
0%–3%	23.25%*	20x	18½%

* the pricing of the equity tranche is quoted as an upfront premium that is paid in addition to a running coupon of 500 basis points per annum.

4.35 The 3%–6% tranche had a spread of over twice that of the underlying portfolio, but with a similar credit rating.

4.36 A Protection Seller, in funded form, on the 3%–6% tranche for say £30 million notional would receive LIBOR + 78.5bp per annum, i.e. LIBOR + £235,500 per annum. The investor's principal and coupons would be exposed to default losses between 3% and 6% on the underlying reference portfolio of £1 billion invested in the iTraxx Europe index.

4.37 The spreads shown are actually mid prices. In practice, a Protection Buyer from a bank counterparty would pay a higher premium, and a Protection Seller would receive a lower premium. Bid-offer spreads on index products are tight relative to spreads on "**bespoke CDOs**", i.e. CDOs where the Reference Portfolio is chosen by the investor who invests in one particular tranche, leaving the bank to risk-manage or sell off the remaining tranches.

4.38 The table in 4.34 above also shows how the Leverage varies by tranche and the Implied Base Correlation that corresponds to these market prices. In particular, we see that the Leverage is higher than the underlying portfolio for the more junior tranches (0%–9%) and lower for supersenior (12%–22%). We also see that the Implied Base Correlation is not constant and is higher for higher attachment points.

5 Other credit derivatives

5.1 As with other derivative products the realm of credit derivatives is constantly changing and developing. At this time we believe that it is convenient to classify credit derivatives into three groups:

1. Default Products – credit derivatives that are linked exclusively to a default event. This means that the payoff is determined by the default event, as opposed to changes in credit quality of the underlying instrument. CDSs (as defined in Section 3), CDOs (as defined in Section 4) and First-to-Default Swaps (see Exotic Default Swaps below) are examples of such products.

2. Spread Products – credit derivatives where the payoff is primarily related to changes in the credit quality of the underlying instrument. Credit Spread Swaps, Credit Spread Options and Credit Linked Notes are examples.

3. Risk-transfer Products – credit derivatives that transfer the total risk of an asset between two parties. Synthetic securitisations and total return swaps are the main examples.

Some example products are outlined below.

Credit Default Options

5.2 Credit default options are very similar to credit default swaps except that the Protection Buyer pays for the default protection through an upfront fee (the option premium) instead of with regular premiums (swap payments). The default payoff will again be some pre-specified payment which will be contingent on a pre-specified credit event (as is the case for a CDS).

5.3 The return from a credit default option at default time τ of the reference entity is a cash flow of the form:

Return = $(L - D(\tau, U))^{+}_{\tau \le T}$

where:

L	is the face value of the debt;
T	is the term of the option;
$U \ge T$	is the maturity date of the debt; and
$D(\tau, U)$	represents the value of the debt immediately after the default event.

5.4 It should not be surprising that such a contract is also commonly known as the *default put option*. Such default put options are clearly very well suited towards matching the credit-related economic exposure of the embedded option of an investment guarantee in an insurance portfolio, where the underlying assets (typically asset share or unit linked assets) are invested in the relevant defaultable bond(s).

5.5 Note that alternative covenants are possible; for example, if $LB(\tau,U)$ represents the value of a risk-free (Treasury) bond with maturity U at time τ, one could receive:

Return = $(LB(\tau,U) - D(\tau,U))^{+}_{\tau \le T}$

This compensates for the loss in value of the defaultable bond relative to the value of the Treasury bond.

5.6 Another possible payoff is:

Return = $(D(\tau-,U) - D(\tau,U))^{+}_{\tau \le T}$

which compensates for the loss in value of the defaultable bond relative to its value ("$D(\tau-,U)$") "immediately before" (or similarly defined) default.

Exotic Default Swaps

5.7 There are numerous variations to standard default swaps and default option derivatives. The variations may relate to the covenants that trigger credit events or determine the settlement amount. Examples:

- *Digital default swap / option:* The payment to the long party at default is a fixed amount not related to the actual value of any Reference Obligation at that time. This economic effect may also be achieved with a standard CDS by specifying an amount to be used for the value of the Reference Obligation immediately after the default event, known as the "recovery amount".

- *Basket default swap / option:* A pay-off occurs in the event of the first default of one in a group of specified reference entities defaults. This is a form of first-to-default contract and naturally extends to other contracts where the return is triggered by the M^{th} default from a basket of N reference entities.

- *Contingent default swap / option*: For the Protection Buyer to receive a return requires the underlying credit event to occur together with an additional trigger. The additional trigger may be a credit event with respect to some other reference entity or something unrelated to credit such as an event linked to equity prices.

- *Dynamic default swap / options:* This is similar to a standard default swap or default option except that the notional amount which determines the return to the Protection Buyer is the mark-to-market value of a designated portfolio of default swaps / options.

Total Return Swaps

5.8 A total return swap is an agreement in which the total return on some reference asset (which could be a single asset, a basket of assets or an index of asset returns) is exchanged for some other cash flows. Typically the exchange is into a floating cash return of LIBOR ± spread.

5.9 Under a total return swap one party, referred to as the payer, agrees to pay the total return of a fixed notional principal amount of the reference asset (coupons, dividends or income ± any changes in the capital value over the life of the swap), to another party, referred to as the receiver. In return, it is usual that the receiver will make periodic payments according to an agreed (fixed or floating) interest rate on the same notional principal amount. From the receiver's perspective, a total return swap is similar to a synthetic purchase of the underlying entity. Note, however, that the swap term need not be as long as the term of the underlying reference asset.

Example: Swap the total return for a period of 5 years on a 9% coupon bond maturing *after* 15 years for LIBOR + 0.25%.

5.10 Total return swaps can be arranged so that, if default occurs during the lifetime of the contract, then the contract will terminate immediately with no further coupon or interest payments. The receiver must normally cover the change in value of the underlying asset by paying the difference since the start of the swap, essentially replicating the recovery amount for the defaulted asset. Thus the receiver accepts the price risk, including the credit risk, of the reference entity and the payer (who may or may not actually hold the underlying reference asset) is effectively a Protection Buyer.

5.11 Note that, if the payer actually owns the underlying asset, then the payer would pass on the asset risk to the receiver. Note also that, if the payer does not own the underlying asset, then the total return swap effectively enables the payer to take a short position in that underlying asset.

5.12 Hull (2004) explains that total return swaps can be convenient financing tools. For example, if the receiver requires financing to invest in a bond, then it can approach the payer counterparty who would probably invest in the bond and enter into the swap. In the example in 5.9 above, the receiver would be in the same economic position as it would have been had it borrowed money at LIBOR + 0.25% in order to purchase the bond. As the payer invests in and retains ownership of the underlying bond, it has much lower exposure to the credit worthiness of the receiver than would have been the case had it lent the bond purchase price directly to the receiver! Thus total return swaps can minimise credit risk when money is borrowed.

5.13 More complex total return swaps can also incorporate put and call options (to establish caps and floors on the returns of the reference asset), as well as caps and floors on the floating reference rate.

Credit Spread Options

5.14 Here the intention is that the settlement amount should depend on the credit spread of the underlying credit risky bond.

5.15 Thus, if one wants protection against the spread rising above some level K, then one should purchase a credit spread put option with a payoff proportional to $Max\,(S_T - K, 0)$. This spread differential is usually multiplied by the duration of the underlying bond when setting the notional for the trade. Note that this type of put provides protection against the price of the bond falling but only due to a change in credit spreads not due to a change in risk free interest rates. Under a log-normal assumption for the underlying credit spread, the Black-Scholes formula can be used to value credit spread options.

5.16 If a bond defaults, then the yield on a bond may rocket up to very high levels (depending on the market's assessment of the likely recovery amounts to the bond holders). However, the bond may cease trading and the spread would become undefined. For this reason, the credit spread option would either:

- provide a payoff on the last trading day prior to default; or
- terminate without payment if the underlying bond defaults.

The former case implies an American style option on the credit spread, as it could be exercised at any time prior to contract maturity (contingent on default). The latter case is more common and leads to European style options. This means, however, that the holder of the credit spread option is protected against falls in market value due to credit downgrades but is not protected from the risk of default during the term of the contract. To obtain total protection the holder could purchase both a credit spread option and a CDS.

5.17 A number of other variations exist, such as a put or call option on a floating rate note ("FRN") or a put or call option on the price of the underlying bond (which may or may not payoff contingent on risk free yield changes). Rights to enter into or terminate asset or credit default swaps on pre-defined terms give rise to embedded credit spread options in those products.

5.18 An insurance company could be interested in a credit spread option to protect its valuation interest rates and, in particular, to protect against credit spread shocks for the purposes of the credit RCM or its Individual Capital Assessment ("ICA").

6 Applications of credit derivatives in the life insurance industry and potential barriers to their use

6.1 Credit derivatives allow a more sophisticated management of credit risk exposures than is possible using conventional assets and therefore have a natural attraction both in terms of risk mitigation and return-seeking investment strategies.

6.2 Clearly, however, responsible investors will wish to understand the nature of, and risks associated with, these instruments fully and a lack of familiarity can act as an impediment to using credit derivatives. Furthermore, the pricing of some instruments is opaque and liquidity varies, both of which may cause concerns and can impact on the regulatory treatment (see Section 7). There is currently a lack of clarity regarding the interpretation of FSA rules which also creates some confusion.

6.3 In the remainder of the section we comment on potential application of the CDSs and CDOs described in Sections 3 and 4 respectively.

CDS

6.4 Insurance companies have long been familiar with the advantages and risks involved in taking credit risk with the aim of enhancing investment returns.

6.5 Some potential reasons why purchasing protection under a CDS might be preferred to selling a bond (or other instrument) for reducing credit exposure to certain entities are:

- the firm has a generally favourable view of the credit risk but is concerned that there are some short term factors that have the potential to cause a material adverse change (short term protection for a longer term exposure);
- the anticipated proceeds from the relevant asset are particularly useful for matching of liabilities and the firm would like a holding in excess of its internal limit for that entity (for example long-dated fixed rate or inflation linked securities); or
- at the time of execution, the CDS has superior liquidity to the relevant asset (in particular if there is no market for the asset).

6.6 Some potential reasons why selling protection under a CDS might be preferred for taking credit exposure to certain entities are:

- there is no availability of suitable securities issued by the entity (hence, using CDS enables the firm to diversify credit risk more widely);
- in order to match liabilities the firm wishes to optimise credit exposure and duration separately - a dual optimisation that is difficult using only physical bonds since bonds of suitable duration may not be issued by the entities that would ideally be chosen;

- the firm believes that, at the time of execution, the CDS has superior liquidity to any suitable securities issued by the relevant reference entity (the firm can execute more effectively);

- the spread over risk free that can be obtained through securities issued by the entity is lower than that available by entering into the CDS (pricing efficiency); or

- the firm reasonably believes that, in most future circumstances, the CDS will have superior liquidity than the securities issued by the entity (liquidity when closing the position).

CDO

6.7 There are a number of reasons why life companies may find that CDOs aid efficient portfolio management or credit risk management.

Diversification

6.8 A CDO effectively comes with built-in diversification, since the investment is based on a much larger underlying portfolio. CDOs allow life companies convenient access to a wider range of underlying investments than the cash bond markets.

6.9 For example, a Sterling denominated CDO would typically be based on a wider range of issuers than are readily available in the Sterling corporate bond market, including natural US$ and € issuers.

6.10 A CDO might also include a variety of additional assets such as those listed in 4.6; for example emerging markets, asset-backed securities or loans. The firm might not be able to access these assets efficiently in the cash markets, particularly without a large minimum investment. Via a CDO a firm can obtain exposure to a large and hence economically efficient underlying portfolio for a limited investment. The CDO will also enable a firm to control its risk exposure to these new markets by selecting the appropriate tranche.

6.11 The use of CDO technology enables a firm to optimise separately the credit rating of its investment and the credit rating of the underlying investments. So, for example, a firm seeking a AA investment is no longer restricted to the AA corporate bond universe, which is dominated by financials and so offers very little sector diversification, but can buy a AA tranche based on a portfolio of A and BBB or even speculative grade underlying bonds. Clearly each firm will look beyond ratings when assessing the true level of credit risk inherent in its investments but, by transforming the risk profile, CDO technology enables the firm to optimise credit risk with far fewer constraints than exist when using just corporate bonds.

6.12 The nature of the return from a CDO also provides additional diversification benefits from cash assets. For example, equity CDO tranches can add to the efficiency of a portfolio of cash equities.

Risk management

6.13 A CDO enables the life company to control its exposure to credit risk to fit its credit views and risk appetite, as demonstrated in some of the diversification examples above.

6.14 For example, a life company that generally believes that the credit environment will remain benign but is concerned about rogue defaults from one-off events (eg fraud) could purchase a junior mezzanine tranche. This will simultaneously provide protection against a small number of defaults but a leveraged play on credit generally.

6.15 Alternatively, a life company that is very cautious on credit but wishes to obtain higher returns than are available from government bonds, might consider supersenior tranches, which benefit from substantial subordinated cover and provide strong AAA ratings from a portfolio of underlying sub AAA credits.

6.16 Life companies could also use CDO technology to obtain default protection on their existing bond portfolios by buying protection either synthetically or via an actual securitisation of their portfolio. Banks have been extensive users of CDO technology in this way to maximise their capital efficiency under the Basel rules.

Returns

6.17 Appendix B of this paper describes the so-called credit-spread puzzle, whereby credit spreads appear to offer more than adequate compensation for expected losses on default, particularly for hold-to-maturity investors. Life companies have historically been significant investors in long-dated credit, taking advantage of this effect (Dyer et al (2004)).

6.18 Mezzanine tranches of CDOs, in particular, exploit this effect. The attachment point of the CDO can be set high enough to cover a very prudent level of losses compared to historic experience, while still offering more attractive returns than cash bonds. In the regulatory peak, this may allow firms to capture very attractive risk-adjusted yields.

6.19 While CDOs can offer attractive yields compared to cash bonds, life companies will be aware that ratings are not equivalent to risk and, for example, CDO tranches may exhibit higher volatility than corporate bonds with a similar duration and rating. The enhanced yield may prove more attractive for hold-to-maturity investors than when a sale prior to maturity is likely and, therefore, the firm has greater exposure to price volatility during the life of the tranche.

7 Regulatory analysis

7.1 Firms will naturally wish to analyse the treatment of any derivative transactions they are considering under the FSA's rules but it is worth noting that the FSA has stated that it aims to be a principles-based regulator. It expects firms to meet the high level Principles set out in the Handbook. Compliance with the Rules in the Handbook would normally be taken as evidence of compliance with the relevant Principles. These Rules, however, can only reflect the most frequently occurring or simple cases and the FSA is also likely to be interested in how firms using, or proposing to use, these instruments have complied with its Principles. As well as considering the Rules, therefore, a firm should satisfy itself that it is entering into transactions that meet the Principles; that is they are consistent with, inter alia, the firm's risk appetite, risk management framework, investment policy, systems and controls capabilities, level of expertise and any relevant policyholder disclosures.

7.2 If a life company is satisfied (and can demonstrate) that the relevant Principles are met but a proposed structure does not comply with the letter of the Rules then the firm should consider applying for a waiver prior to proceeding with the transaction. By the same token, if a firm cannot demonstrate that a transaction is in accordance with one or more of the Principles, then the firm runs a risk of regulatory action, even if the structure does not breach any specific Rules.

Pillar one analysis – admissibility rules (peak one)

7.3 For a derivative or quasi-derivative to be admissible it must qualify as approved according to the requirements of PRU 4.3.5R. This states that a derivative or quasi-derivative is approved if:

(1) it is held for the purpose of efficient portfolio management (PRU 4.3.6R to PRU 4.3.7R) or reduction of investment risk (PRU 4.3.8R to PRU 4.3.13G);

(2) it is covered (PRU 4.3.14R to PRU 4.3.33G); and

(3) it is effected or issued:

(a) on or under the rules of a regulated market; or

(b) off-market with an approved counterparty and, except for a forward transaction, on approved terms and is capable of valuation (PRU 4.3.34R to 4.3.35G).

7.4 The conditions for efficient portfolio management are set out in PRU 4.3.6R and PRU 4.3.7R as follows:

PRU 4.3.6R A derivative or quasi-derivative is held for the purpose of efficient portfolio management if the firm reasonably believes the derivative or quasi-derivative

(either alone or together with any other covered transactions) enables the firm to achieve its investment objectives by one of the following:

(1) generating additional capital or income in one of the ways discussed in PRU 4.3.7R; or

(2) reducing tax or investment costs in relation to admissible assets; or

(3) acquiring or disposing of rights in relation to admissible assets, or their equivalent, more efficiently or more effectively.

PRU 4.3.7R The generation of additional capital or income falls within PRU 4.3.6 R(1) where it arises from:

(1) taking advantage of pricing imperfections in relation to the acquisition and disposal (or disposal and acquisition) of rights in relation to assets the same as, or equivalent to, admissible assets, or

(2) receiving a premium for selling a covered call option or its equivalent, the underlying of which is an admissible asset, even if that additional capital or income is obtained at the expense of surrendering the chance of greater capital or income.

7.5 Rules and Guidance regarding cover are given in PRU 4.3.14R to PRU 4.3.33G. In particular PRU 4.3.14R, PRU 4.3.16R and PRU4.3.17R state:

A firm must cover an obligation to transfer assets or pay monetary amounts that arise from:

(1) a derivative or quasi-derivative; or

(2) a contract (other than a contract of insurance) for the purchase, sale or exchange of assets.

An obligation to transfer assets (other than money) or to pay monetary amounts based on the value of, or income from, assets is covered if the firm holds:

(1) those assets; or

(2) in the case of an index or basket of assets, a reasonable approximation to those assets.

An obligation to pay a monetary amount (whether or not falling in PRU 4.3.16R) is covered if:

(1) the firm holds admissible assets that are sufficient in value so that the firm reasonably believes that following reasonably foreseeable adverse variations (relying solely on cashflows from, or from realising, those assets) it could pay the monetary amount in the right currency when it falls due; or

(2) the obligation to pay the monetary amount is offset by a liability. An obligation is offset by a liability where an increase in the amount of that obligation would be offset by a decrease in the amount of that liability; or

(3) a provision at least equal to the value of the assets in (1) is implicitly or explicitly set up. A provision is implicitly set up to the extent that the obligation to pay the monetary amount is recognised under PRU 1.3 (Valuation) either by offset against an asset or as a separate liability. A provision is explicitly set up if it is in addition to an implicit provision.

7.6 A derivative that is effected or issued off-market is approved if it is with an approved counterparty and, except for forward transactions, on approved terms (PRU 4.3.34R)and capable of valuation (PRU 4.3.35). A transaction is on approved terms under PRU 4.3.34R and PRU 4.3.35R only if the counterparty has agreed to enter into a further transaction to close out the first transaction at a price based on current market conditions. A transaction is capable of valuation only if the firm, throughout the life of the transaction, will be able to value it with reasonable accuracy on a reliable basis reflecting an up-to-date mark-to-market value.

7.7 In the consultation process relating to these rules there was feedback to FSA that the approval and valuation conditions in PRU 4.3.34R and PRU 4.3.35R were unclear and could impede the efficient operation of the derivatives market. To allow more time for further consultation these rules were not brought into force at 31/12/2004 but suspended to 31/12/2005 under a transitional provision TP23.

7.8 Further consultation was included in CP05/9, the quarterly consultation paper issued by the FSA in July 2005. The FSA considered that the approach for admissible derivatives should be consistent, where possible, with that set out for collective investment schemes in the Collective Investment Schemes sourcebook. Revisions were proposed to the wording of PRU 4.3.34R and PRU 4.3.35R, essentially requiring an pricing discovery mechanism to be agreed before the transaction is entered into and a commitment from the counterparty to enter into a further transaction to close out that transaction at any time at a price to be determined using the agreed price discovery mechanism. To be capable of valuation the nature of the agreed price discovery mechanism must be such as will enable the firm to estimate with reasonable accuracy the price that would result from the agreed price discovery mechanism and to reasonably believe that it will be able to continue to estimate this price throughout the life of the transaction.

7.9 Once again the feedback to this consultation expressed concerns about these proposals, and the potential impact on the operation of the derivatives market; and again the FSA has responded by deferring the introduction of these rules by extending the period for which TP23 applies to 31/12/2006. Clearly there are regulatory concerns about the (lack of) pricing transparency and liquidity perceived for some off-market derivative transactions and the industry and their counterparties will need to consider how far the regulatory wish for greater pricing transparency and liquidity can reasonably be met in practice and put forward suggestions for the scope of rules that might be appropriate.

7.10 If a derivative is not approved, then PRU 4.3.18R requires that "A firm must implicitly or explicitly set up a provision equal to the value of the assets or offsetting transactions held to cover a non-approved derivative or quasi-derivative transaction." This is a very onerous requirement in some cases.

CDS Protection Buyer

7.11 As stated in PRU 4.3.5R(1), to be approved, a derivative must be held for the purpose of efficient portfolio management or reduction of investment risk. In the case of credit default swaps one would usually expect that the rationale for entering into the contract as a buyer of protection would be for risk mitigation purposes, in which case the reduction in investment risk criteria would be expected to be met provided that the derivative is covered. However, it exposes the firm to credit risk on the counterparty to the extent the exposure is not managed using collateral assets. This increase in risk would need to satisfy PRU 4.3.9R in order for the CDS to qualify as reducing investment risks.

7.12 In terms of the cover requirements, for a Protection Buyer of a single name CDS the derivative would be covered if the buyer holds bonds, loans or other suitable obligations of the Reference Entity of an amount required to settle the CDS.

7.13 Credit default swaps could also be used to protect against credit exposures that do not relate to holdings of investment assets, for example a reinsurance exposure. Indeed PRU 3.2.36R(2) specifically recognises that a credit derivative may mitigate a counterparty exposure which would otherwise breach the large exposure limits. To demonstrate both cover and reduction in investment risk in these circumstances will require the firm to assess how the definition of default and the settlement process under the CDS correspond to the credit exposure it is seeking to mitigate.

CDS Protection Seller

7.14 One would usually expect efficient portfolio management to be the prime motive for increasing credit exposure through one or more CDS. Under PRU 4.3.8R a derivative is deemed to be held for the purpose of efficient portfolio management if the firm reasonably believes that this enables the firm to achieve its investment objectives by *"acquiring or disposing of rights in relation to admissible assets, or their equivalent, more efficiently or effectively."*

7.15 In the event of a default the Protection Buyer under a CDS would deliver the impaired assets to the Protection Seller. Hence, the Protection Seller is acquiring rights in relation to the potential obligations that could be delivered by the Protection Buyer under the terms of the CDS. The insurer will need to check that these potential obligations are loans, debt securities, bonds and other money and capital market instruments and, therefore, admissible assets under PRU 2 Annex 1R Part (1).

7.16 To satisfy PRU 4.3.5R(1) the firm must reasonably believe that the CDS enables it to achieve its investment objectives more efficiently or effectively than other approaches, in particular by investing directly in admissible debt securities, bonds and other capital market instruments rather than acquiring this interest to the CDS. As a simple example a sold CDS combined with a suitable gilt has a very similar economic effect to holding a corporate bond issued by the Reference Entity. Therefore, provided such a bond would be an admissible asset, a sold CDS may be able to qualify as efficient portfolio management by allowing a firm to acquire rights in relation to the equivalent of an admissible asset more efficiently or effectively. Some reasons why CDSs might be preferred for taking credit exposure to certain entities are listed in Section 6.

7.17 The cover requirement, could be met by a holding of suitable liquid assets to comply with PRU 4.3.14R (see above).

7.18 Alternatively, the firm might need to set up a provision equal to the assets that would be delivered if the CDS were exercised, which for a physically settled CDS would be the face value of the Reference Entity.

Index Credit Default Swaps

7.19 The issues for a life company taking credit risk through a CDS on an index are similar to those for taking credit risk through a single name CDS. In fact the arguments for efficient portfolio management might well be more powerful given the inherent diversification of risk within the index product.

7.20 If a life company is the Protection Buyer under an index CDS, then demonstrating both cover and reduction in investment risk will require the firm to satisfy itself as to the congruence of the index to its existing credit exposures. As set out in PRU 4.3.16R(2), in the case of an index or basket of assets, an obligation to transfer assets is covered if the firm holds "a reasonable approximation to those assets".

Collateralised Debt Obligations

7.21 A CDO could be seen as a bond (mezzanine tranche), equity (equity tranche) or as a quasi-derivative. Under IPRU(INS) rules, classification as a quasi-derivative would have implied that to be admissible the CDO would have had to satisfy all the admissibility criteria for derivatives. However, the definition of an admissible asset in the FSA Handbook is "an asset that falls into **one or more categories** in PRU 2 Annex 1". Therefore a CDO that is admissible as a bond now appears to be admissible

whether or not it met the criteria for being admissible as a quasi-derivative. This seems to be a significant change in the FSA's approach to the admissibility test.

7.22 However, even if the CDO is admissible there are still asset and counterparty exposure limits in PRU 3.2 which may severely curtail investments. The FSA is also likely to react unfavourably to structures which appear to be designed specifically to circumvent the admissibility rules without meeting its high level Principles. It may therefore be useful to consider the extent to which a CDO may satisfy the requirements of PRU 4.3.5R, as set out above. We discuss these further below.

7.23 A bought tranche of a CDO is unlikely to qualify as a reduction in investment risks. There may be problems in satisfying the efficient portfolio management test as a CDO might provide an economic exposure that could not be replicated by investing in the underlying bonds. PRU 4.3.22G suggests that the FSA is not comfortable with excessive gearing in the investment portfolio which a CDO holding (especially of more junior tranches) could be seen to represent. As a minimum, therefore, a firm should be prepared to demonstrate that it understood that a CDO with an 'A' rating was not necessarily consistent with an investment mandate to invest in 'A' rated corporate bonds and that any gearing involved was in accordance with its investment objectives (and, where appropriate, representations made to policyholders).

7.24 If the CDO is quoted then it may satisfy the requirement in PRU 4.3.5R(3) to be effected or issued on or under the rules of a regulated market. However, if it is issued off-market then the requirement for approved status is to be effected or issued by an approved counterparty, which is unlikely to be satisfied when the CDO is issued by an SPV. Again a waiver may be required here before investments in such derivatives are made.

Pillar one analysis - the Realistic Balance Sheet (peak two)

7.25 Derivatives held in a with-profits fund that are assets may always be given a realistic value even if they have no admissible value; see PRU 7.4.33R(1)(d). A firm that is a realistic reporter might wish to hold derivatives in its with-profits fund to reduce the impact of the RCM tests even if these derivatives have no admissible value.

7.26 If a firm holds a (bought or sold) CDS then the contract will need to be revalued under the appropriate RCM credit stress test. PRU 7.4 sets out a credit stress test involving instantaneous increases in credit spreads determined according to the rating of the underlying bond and the current credit spread. In the case of a CDS the credit rating would be that of the Reference Entity.

7.27 The classification of a CDO is relevant to its revaluation under the RCM stress tests set out in PRU 7.4. The CDO might be treated as a bond or as equity and subjected to the relevant credit or market risk stress tests. Alternatively it might be treated on a 'look-through' basis, in which case the underlying bonds and credit derivatives would be subjected to the credit risk stress test and the effect on the value of each CDO tranche held would have to be deduced. The two approaches may give very different results in some circumstances but we believe that both are allowed under the rules in PRU 7.4.

Pillar two analysis

7.28 Similar issues to those under peak 2 of pillar 1 arise for CDS and CDO where their value has to be taken into account and stressed under ICA calculations. Normally the capital available for the purposes of the ICA is calculated on a realistic basis, even if the firm is not a realistic reporter. Thus derivatives that are assets would normally be given a realistic value in these calculations whether they are admissible or not.

7.29 If the ICA is calculated over a 1-year period, then the credit stress applied should be that representing a "1 in 200 year event" in severity for the firm. The firm should consider stressing variables that are not stressed under the RCM but that nevertheless might have a material impact. An obvious example is to consider the impacts of changes in implied correlation on the value placed on an investment in a particular CDO tranche. If a CDO holding is material then it would appear more appropriate to use the look-through basis described in 7.23, as this is more consistent with the actual economic impact.

8 Conclusions

8.1 The Working Party believes that credit derivatives can play a useful part in insurers' credit risk management and that there is increasing interest in this area.

8.2 Credit derivatives are becoming better understood but this is a rapidly developing market and many actuaries are wary in the light of a lack of pricing transparency, low liquidity and regulatory uncertainty for some instruments.

8.3 However, the liquidity of markets is improving and banks are making efforts to provide price discovery mechanisms. We also hope there will be more evidence of principle-based regulation and greater clarity on the interpretation of FSA Rules and views on the appropriateness of various types of instruments to provide efficient financial management which will provide insurers with confidence to use credit derivatives where appropriate.

A Working Party terms of reference and members

1 The Derivatives Working Party is a permanent working party set up by the Life Research Committee of the Faculty and Institute of Actuaries. The current terms of reference are as follows:

"The aim of the working party is to consider examples where life assurance companies are currently utilising derivatives and to establish if companies believe their use of derivatives is constrained."

2 The current members of the working party are:

Martin Muir (chairman)

Andrew Chase

Paul Coleman

Paul Cooper

Gary Finkelstein

Paul Fulcher

Chris Harvey

Richard Pereira

Albert Shamash

Tim Wilkins

B The credit spread "puzzle"

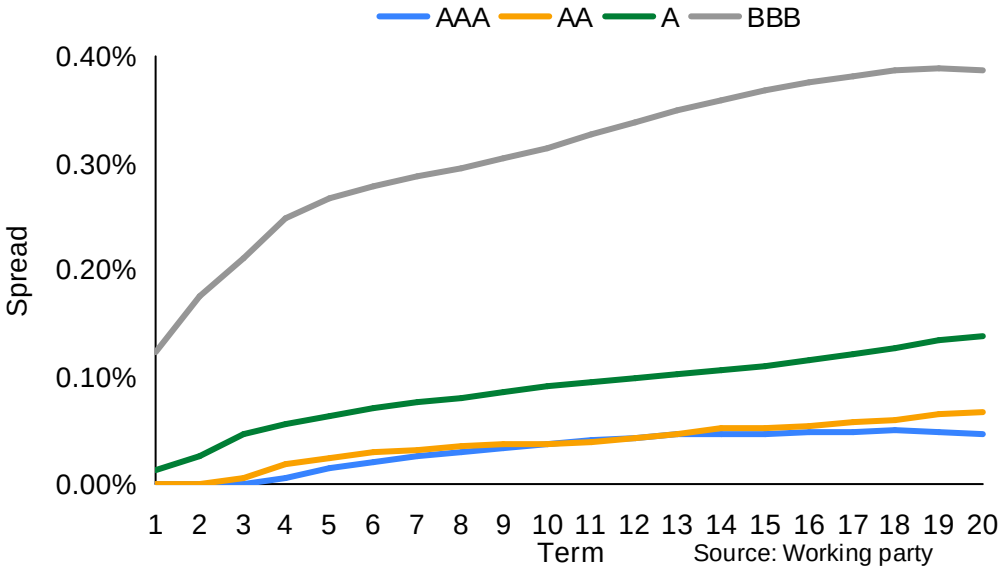
1 The market level of spread payable on corporate bonds, relative to government bonds, is consistently much wider than would be implied by an analysis, from historic data, of expected default losses. This phenomenon is particularly marked for shorter-duration, investment grade bonds and is often referred to as the "credit spread puzzle".

2 One early study to highlight this effect was Altman (1989) who showed that, from historic data, an investor would have earned significantly higher returns from investing in corporate bonds, rather than risk-free bonds, even allowing for defaults.

3 To illustrate the credit risk puzzle we have used the data from Moody's 18th annual survey of global corporate bond defaults and recovery rates (Moody's (2005)). Using the data given on historic default and recovery rates for the 35 year period 1970 to 2004 we can compute the theoretical spread required on a corporate bond to compensate precisely for expected default losses, based on this historic experience, as explained below.

The results are shown in Figure 1.

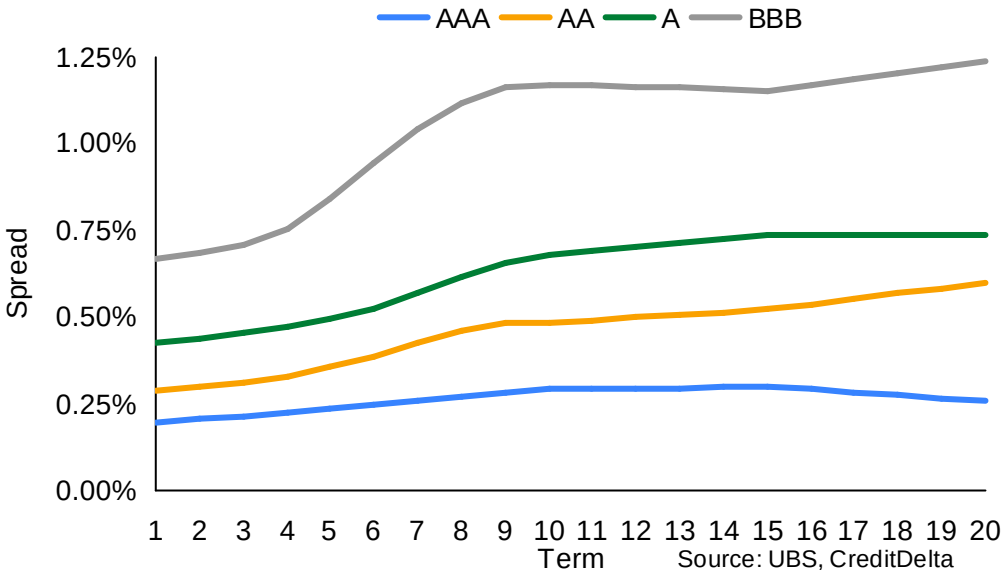
Figure 1: Spread to compensate for expected defaults



4 Figure 2 shows, by comparison, the market spread, relative to gilts, on the iboxx index of corporate bonds, as at 7 July 2005.

5 As can be seen, the spread payable is significantly in excess of that in Figure 1.

Figure 2: Market spreads 5th September 2005



Resolving the credit spread puzzle

6 The "credit spread puzzle" is a currently active area of academic research. There is a detailed review of some key papers published from 2001 below.

7 A variety of factors have been investigated to explain the spread on corporate bonds. Researchers are yet to reach a definitive view on the magnitude of the different factors. However, a consensus is emerging as to the main sources of credit spread and, in particular, that it does not represent a free lunch, even for buy-and-hold investors.

8 The factors most typically cited as contributing to the credit spread in excess of expected defaults, from historic data, are:

- *Risk premium*

  If the credit spread only compensated for expected defaults, then it would be more attractive to hold gilts than corporate bonds, since gilts would offer the same expected return for less risk.

  Credit risk is also positively correlated with equity risk and, more generally, with the overall drivers of market risk. Hence, this cannot be diversified away and should command a risk premium.

- *Small sample bias*

  An analysis based on historic data for the period 1970 to 2004 may not be a good guide to extreme events. Moody's (2005) includes data back to the 1920s, which embraces the Great Depression, but analysis using these data, even based on the worst periods, does not explain the credit spread puzzle. It is likely that the market is pricing more extreme events than observed in the historic data, particularly given the skewed nature of the payoff of credit.

- *Skewed nature of payoff*

  The return from corporate bonds is highly negatively skewed with a capped upside but a very strong downside if the bond defaults. Given investors' risk preferences they may require an additional compensation for this risk profile, which is difficult to diversify away with realistically achievable bond portfolios.

- *Taxation*

  In different jurisdictions and for different investors corporate bonds may be taxed less favourably than government bonds.

- *Correlation effects with interest rates*

  Typically, credit spreads have negative correlation to interest rate risk on bonds, which might actually reduce the required credit spread.

- *Liquidity premium*

  Particularly illiquid bonds will typically offer higher yields than more liquid bonds as a compensation for the liquidity risk. If corporate bond spreads are measured relative to gilts then there would typically be a generic liquidity premium for the overall corporate bond universe.

  There is particular evidence of a "flight-to-liquidity" effect where government bonds command a premium, which is particularly high in times of market stress.

  If bond spreads are measured relative to swaps, as is standard practice in the financial markets, then there is much less evidence of any significant overall liquidity premium.

9 In addition, when comparing corporate and government bonds allowance must be made for differing features such as callable bonds, putable bonds, convertible bonds, sinking-funds and subordinated or hybrid bonds. The various academic studies correct for these features, largely by excluding such bonds from their analysis.

10 Overall the literature suggests that the credit risk premium is explainable. A liquidity premium effect is present but, in most studies, it does not account for a major portion of the total credit spread. A more significant component is due to compensation for the undiversifiable and skewed nature of credit risk.

11 One weakness of the literature is that it typically does not distinguish between credit spread risk and default risk. An investor measuring performance over a short-time horizon will be exposed to short-term noise from spread volatility whereas a long-term hold-to-maturity investor is primarily exposed to default risk and hence might conceivably be able to capture part of the risk premium. In practice, however, many life company portfolios are not held-to-maturity but are rebalanced to maintain a constant or minimum credit quality. In this case the risk is not primarily from defaults but from a gradual loss of return as bonds are sold on downgrade and it would seem less likely that a risk premium can be captured.

Relevance for credit derivatives

12 The CDS market provides a purer analysis of the cost of credit risk since it is less prone to various factors affecting the physical bond market (eg tax effects, limited supply, difficulty of taking short positions, liquidity squeezes). Indeed the CDS premium can be regarded as a measure of the cost of credit risk and the spread on a bond relative to swaps is typically close to the corresponding CDS premium.

13 For CDOs, the strong attraction to investors, in recent years, of mezzanine tranches has been driven, inter alia, by the same phenomena as the credit spread puzzle. The attachment point for the tranche is typically set as a multiple (perhaps 200% or 300%) of observed levels of historic defaults. Hence, even on a prudent analysis of historic data, the expected losses on the tranche are minimal.

14 On the other hand, the market prices for CDOs are determined using risk-neutral pricing based on the cost of the CDS premium. On a risk-neutral basis the expected level of default losses equates to the CDS premium and hence the expected losses on mezzanine tranches can be material. As a consequence, and particularly given the leveraged nature of the exposure to the underlying credits once losses reach the attachment point, a high spread is payable on these tranches.

Pricing example

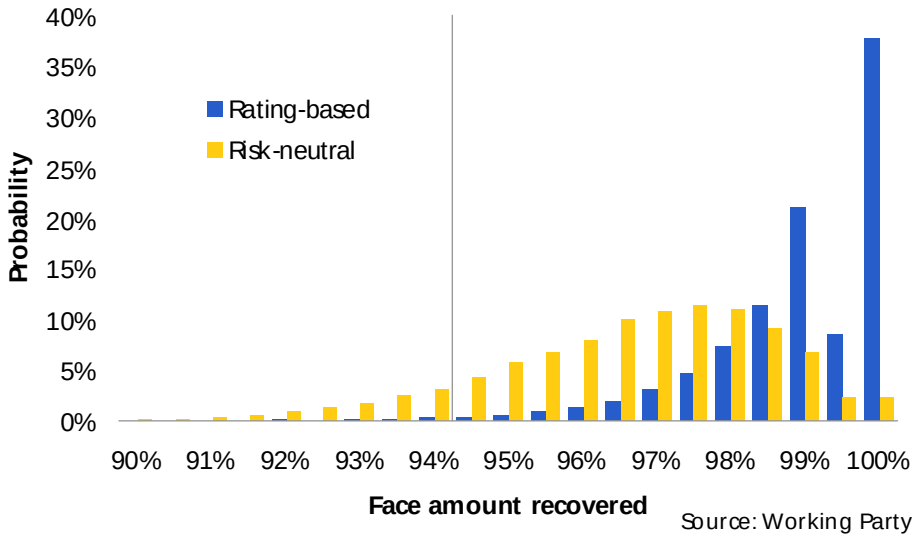
15 The example below shows a typical CDO based on a portfolio of 100 A and BBB 7-year maturity credits, well diversified within the practical constraints of available issuers. We consider a mezzanine tranche exposed to losses between 5.5% and 6.5% on the overall portfolio.

16 Based on historic default levels, per Moody's (2005), there is a 99% chance that the holder of the mezzanine CDO tranche will receive full payment. However, the market

will price the CDO based on expected losses consistent with the spread on the underlying bonds, which implies a much greater risk of losses and, consequently, a higher required spread. The graph below shows the distribution of recoveries on the underlying portfolio relative to the 94.5% point below which the mezzanine CDO tranche suffers losses on both a historic rating-based simulations and a risk-neutral simulation.

17 This mezzanine CDO tranche might, on these results, be expected to receive a credit rating of A from the agencies and yet receive a spread of around 125 basis points over LIBOR, around three times the spread on comparably rated corporate bonds.

Figure 3
Expected portfolio loss distribution



Source: Working Party

18 Therefore mezzanine CDOs offer attractively high spreads relative to losses simulated from historic data. This is effectively a leveraged play on the attractiveness of credit to held-to-maturity investors.

Computing default consistent spreads

19 This section describes how we computed the spread required on a bond in order to compensate an investor for investing in a particular credit class. Our analysis is based on the historic long-term default probability of assets from a particular rating category. Moody's publish such data annually, and we have used data from their 18th annual study covering the period 1970-2004 (Moody's (2005)). In particular this contains cumulative default probabilities over time and, for example, shows that a bond starting in credit class BBB has a 2.08% chance of defaulting over 5 years.

	1	2	3	4	5
AAA	0.00%	0.00%	0.00%	0.04%	0.12%
AA	0.00%	0.00%	0.03%	0.12%	0.20%
A	0.02%	0.08%	0.22%	0.36%	0.50%
BBB	0.19%	0.54%	0.98%	1.55%	2.08%
BB	1.22%	3.34%	5.79%	8.27%	10.72%
B	5.81%	12.93%	19.51%	25.33%	30.48%
CCC	22.43%	35.96%	46.71%	54.19%	59.72%

20 Let c_t represent the cumulative default probability up to time t as per the above table. From this we can compute the marginal default probabilities m_t that the bond defaults in a particular time period using the relationship (with $c_0 = 0$):

$$c_t = c_{t-1} + (1 - c_{t-1})\, m_t$$

21 The above data produces the following marginal probabilities:

	1	2	3	4	5
AAA	0.00%	0.00%	0.00%	0.04%	0.08%
AA	0.00%	0.00%	0.03%	0.09%	0.08%
A	0.02%	0.06%	0.14%	0.14%	0.14%
BBB	0.19%	0.35%	0.44%	0.58%	0.54%
BB	1.22%	2.15%	2.53%	2.63%	2.67%
B	5.81%	7.56%	7.56%	7.23%	6.90%
CCC	22.43%	17.44%	16.79%	14.04%	12.07%

22 The following notation is used:

- p_t is the t-year par rate, i.e. the market coupon to pay on a risk-free bond maturing in t years;
- d_t is the t-year discount factor, derived from the risk-free curve;
- r is the assumed recovery rate given default; and
- s_t is the spread to pay on a t-year bond to compensate the investor for credit risk.

23 If default occurs, then the investor will get back a percentage of the face of the bond (the recovery rate). We have assumed that r = 40% for all periods and classes of bond. This compares to historic recovery rates, per Moody's (2005) of 45% for senior unsecured bonds.

24 We assume, for simplicity, that the risk-free rate is 5% per annum, so p_t = 5%, and $d_t = (1+5\%)^{-t}$.

25 To compute the spread applicable, s_t, we simply have to examine the cashflows that can occur, and with what probability, and solve for the appropriate spread such that the bond is valued at par.

26 For example, consider a 4-year bond. In the first year there is a probability m_1 that the bond defaults (in which case we get cashflow r), and a probability $1 - m_1$ that the bond does not default (when we get cashflow $p_4 + s_4$). The discounted probability weighted values of these cashflows is therefore:

$$d_1\left[(p_4 + s_4)(1 - m_1) + m_1 r\right]$$

27 In the second year, there is only a probability $1-c_1$ that the bond is still alive. Therefore the discounted probability weighted values of the second year cashflows are:

$$(1-c_1)\,d_2[(p_4+s_4)(1-m_2)+m_2 r]$$

28 Continuing in this manner we can derive all of the probability weighted cashflows. The sum of all these cash flows must sum to 100% to compensate the investor for the risk taken. Therefore we can solve the following equation for the correct spread s_4.

$$\begin{aligned} 1 \;=\; & d_1[(p_4+s_4)(1-m_1)+m_1 r] \\ & +(1-c_1)\,d_2[(p_4+s_4)(1-m_2)+m_2 r] \\ & +(1-c_2)\,d_3[(p_4+s_4)(1-m_3)+m_3 r] \\ & +(1-c_3)\,d_4[(1+p_4+s_4)(1-m_4)+m_4 r] \end{aligned}$$

29 We have repeated this procedure for all credit classes and for durations of up to 20 years.

Review of the literature

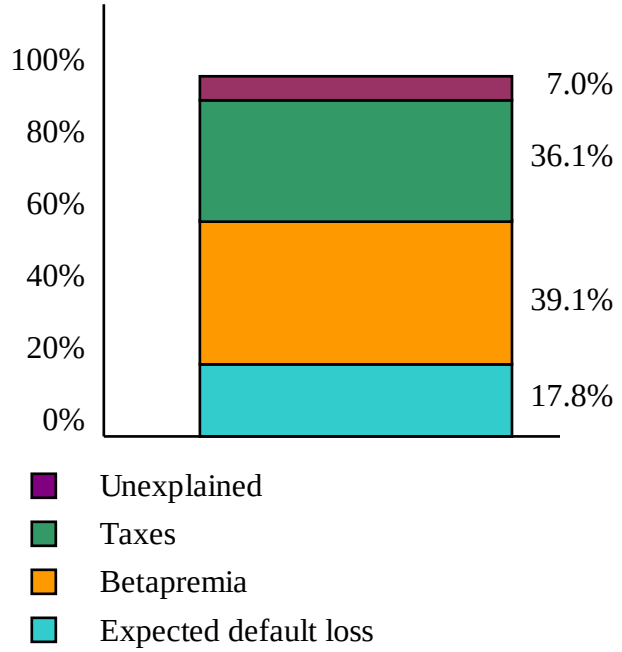
30 Elton, Gruber, Agrawal & Mann (2001) provided an important analytical estimate of US corporate bond spreads based on three factors:

- expected default losses, estimated from historic data;
- beta premium for credit risk, estimated using the Fama-French model (Fama & French (1993)) to measure sensitivity to the risk factors driving the overall market risk premium; and
- differential taxation: in the US, corporate bond coupons are subject to state tax.

31 Elton et al's results suggest that the spread on corporate bonds over government bonds can be almost entirely explained by these three influences, although expected losses from default accounted for only a relatively limited proportion of the spread.

32 For example, Figure 4 below shows their decomposition of the spread on 10-year industrial (i.e. non-financial) A rated bonds versus US treasuries. Although only 17.8% can be explained by expected defaults, an additional 39.1% can be explained as a credit risk premium, giving a total of 56.9% for credit risk. The residual spread they largely explain as a tax effect.

Figure 4



33 Elton et al did not analyse any effect associated with a liquidity premium. Perraudin and Taylor (2003) extend their model to, inter alia, examine liquidity effects. They find spread differences of the order of 10 to 28 basis points due to liquidity effects between liquid and illiquid high quality (A to AAA) corporate bonds. However, this is a relative effect between different corporate bonds and does not explain the credit risk puzzle for liquid corporate bonds.

34 Huang & Huang (2003) produce a much lower estimate than Elton et al of the proportion of the credit premium that can be explained by credit risk. They survey a large class of structural credit models and conclude that only 20% to 30% of the spread can be explained by credit risk for investment grade bonds, although the proportion is much higher for junk bonds. Explaining a higher proportion would require higher risk premia for credit than they regard as empirically reasonable. However, a number of other studies focus on particular features of the bond market that might give rise to a higher required risk premium and hence are able to explain a higher proportion of credit spread.

35 Hull, Preduscu & White (2003) observe that historic default statistics typically cover only the period since 1970. Market participants may allow for the risk of more extreme events than observed in this period. Smith (2004) makes a similar observation relating to small-sample bias. This is also referred to as the "peso effect" after the experience of the Argentian peso, which commanded a significant interest rate premium over US dollars despite being historically pegged.

36 Hull et al also suggest that their may be an agency effect, with portfolio managers not incentivised to seek maximally diversified portfolios, particularly if this reduces expected returns.

37 Dionne, Gauthier, Hammami, Maurice & Simonato (2004) extend Elton et al's model to allow for the small-sample bias in the historic data and find that the expected defaults explain a much higher proportion of the credit spread – for example 37% (vs. 17.8% in Elton et al) for A bonds and 76% (vs. 34%) for BBB bonds.

38 Amato & Remolana (2003) and Smith (2004) observe that the payoff of corporate bonds is highly negatively skewed with limited upside (bond does not default, full spread captured) but strong downside (losses on default are typically 60% or more of nominal value). This negative skew is much more significant than for equities and as a consequence much larger portfolios of bonds are needed to diversify away this effect. Amato & Remolana suggest that even if individual issuers had uncorrelated default risk a portfolio of 300 bonds might be needed to diversify this downside risk, compared to say 30 for equities. In practice such large portfolios of uncorrelated bonds cannot be constructed and hence a higher risk premium is required.

39 Collin-Dufresne, Goldstein & Helvege (2003) focus on '"contagion" risk, whereby the default of one firm affects the market's perception of the risk in other firms. The default of Enron, with the concern raised about the quality of accounting and auditing across the market, is one example. Such risk can not be diversified away and their evidence suggests that this may account for a significant part of the credit spread eg up to 20 basis points per annum.

40 Collin-Dufresne et al suggest that the size of the contagion risk premium suggests it may relate to a "flight to liquidity" effect, as per Longstaff (2001), rather than a true updating of future default risk. Longstaff compares the prices of US Treasury bonds to those issued by Refcorp, a US Government Agency, which are effectively guaranteed by the US Treasury but are less liquid. He finds significant evidence of a "flight to liquidity" effect, whereby US Treasuries command a premium, particularly in times of uncertainty in the financial markets such as the Russian default in 1998. The premium averages around 10 basis points p.a., but has risen as high as 30-50 basis points p.a.

41 Longstaff, Mithal & Neis (2004) focus on evidence from the credit default swap market to quantify the credit risk premium. They find that the credit default related component accounts for 51% of the spread relative to government bonds for AAA/AA rated bonds, 56% for A bonds, 71% for BBB and 83% for BB. If spread is measured relative to swaps then the credit default related component accounts for close to 100% of the spread.

42 Longstaff, Mithal & Neis find lower estimates for the impact of tax than Elton et al, reflecting the fact that some marginal investors may be tax exempt. They find that the residual non-default related component is, overall, related to macroeconomic measures of liquidity, as per Longstaff's "flight to liquidity" effect, with bond-specific illiquidity measures important in accounting for differences between bonds.

43 Li, Shi and Wu (2005) directly estimate the liquidity effect for corporate bonds, using a liquidity risk factor based on data for liquid versus illiquid Treasury bonds. Their results show a significant liquidity premium which explains 25% of the spread for investment grade bonds and 30% to 40% for speculative grade bonds. Li, Shi and Wu have not analysed credit risk premia, in contrast to most of the papers above which started with the credit risk premium and then analysed only the residual spread for any liquidity effects. Li, Shi and Wu's "liquidity premium" may therefore have some overlap with the "risk premium" found by other researchers.

44 Driessen (2005) analyses the spread on corporate bonds into six components, which for a typical BBB bond (with spread of 95bpa) are split as follows:

Systematic risk in credit spreads (covers both expected defaults, and a beta effect)	33%
A default jump premium (reflects the skewed nature of credit risk and inability to diversify this effect)	24%
Firm specific risk factors	4%
Correlation with interest rate risk (negatively correlated, so reduces the risk premium)	-9%
Tax effects	33%
Liquidity premium	13%

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D Glossary

Attachment point	For a mezzanine tranche of a CDO, the percentage of losses on the Collateral Portfolio of a CDO at which the tranche starts to incur losses.
Base Correlation	The Implied Correlation that solves for the price of equity tranches with varying width.
Basis	The difference between the default swap spread and the spread on corresponding bonds and asset swaps.
Bespoke CDO	A CDO where the Reference Portfolio is chosen by the investor who invests in one particular tranche, leaving the bank to risk-manage or sell off the remaining tranches.
Calculation Agent	The entity that is responsible for making calculations and determinations as required by the transaction confirmation. This role should involve minimal judgement.
Cash Settlement	A method of settling a CDS whereby the Protection Seller pays to the Protection Seller a cash amount equal to the difference between the par and market values of the Reference Obligation.
CDO	Collateralised Debt Obligation
CDO^2	A CDO whose Collateral Portfolio consists of tranches in other CDOs.
CDS	Credit Default Swap
CFO	Collateralised Fund Obligation – a CDO whose Reference Portfolio consists of hedge funds.
Cheapest to Deliver option	Under physical settlement of a CDS, the option of the Protection Buyer to choose from a range of Deliverable Obligations, one or which will be cheapest.
Collateral Portfolio	In a CDO, the pool of assets to which investors are exposed.
Credit Event	An event (eg default) triggering a payment under a CDS.
CSO	Credit Spread Option
Default Swap Spread	The price of a CDS expressed as a percentage of the notional amount.
Deliverable Obligation	An asset that may be used as physical settlement of a CDS.

Detachment point	For a mezzanine tranche of a CDO, the percentage of losses on the Collateral Portfolio of a CDO at which the tranche is exhausted.
Equity tranche	The most junior tranche of a CDO, which is exposed to the first losses on the Collateral Portfolio.
Final Price	For Cash Settlement of a CDS, the price of the Reference Obligation used in the determination of the cash payment.
Implied Correlation	A measure of the diversification of the Reference Portfolio of a CDO.
ISDA	International Swap Dealers Association – provides standardised documentation for many types of derivative.
Leverage	The ratio of the change in the spread on a tranche of a CDO to the change in the spread on the Reference Portfolio.
Managed CDO	A CDO where there is an asset manager appointed to adjust the Collateral Portfolio within specified parameters.
Mezzanine tranche	An intermediate tranche of a CDO that starts to absorb losses on the Collateral Portfolio when the equity tranche is exhausted.
Modified Restructuring	In ISDA documentation, a restriction on the maturity of Deliverable Obligations that can be delivered following a restructuring event.
Modified Modified Restructuring	A refinement of Modified Restructuring designed for European markets.
Physical Settlement	A method of settling a CDS whereby the Protection Buyer delivers a Deliverable Obligation to the Protection Seller and receives the par value in return.
Physical Settlement Date	During Physical Settlement of a CDS, the date on which the Protection Buyer is scheduled to deliver a Deliverable Obligation to the Protection Seller.
Protection Buyer	The party paying for protection against credit risk.
Protection Seller	The party taking on credit risk.
Reference Entity	The entity (eg a company) issuing a Reference Obligation.
Reference Obligation	A financial instrument (eg a bond) used to determine whether a Credit Event has occurred.

Reference Portfolio	In a synthetic CDO, the pool of assets used to determine whether a default has occurred.
Senior tranche	A tranche of a CDO that starts to absorb losses on the Collateral Portfolio when the equity and mezzanine tranches are exhausted.
Static CDO	A CDO where no changes are allowed to the Collateral Portfolio.
Supersenior tranche	A tranche of a CDO that starts to absorb losses on the Collateral Portfolio when the equity, mezzanine and senior tranches are exhausted.
Synthetic CDO	A CDO where exposure to the Collateral Portfolio is obtained through a derivative transaction with a bank rather than direct investment.
Waterfall	The process of allocating losses from defaults amongst different tranches of a CDO.
z-spread	The average incremental (in basis points) expected to be earned over the swap yield curve. If one discounts each cash flow at the like-maturity spot rate plus the z-spread then the sum of these discounted cash flows will equal the security price.