Structured Credit Products

Credit Derivatives and Synthetic Securitisation
Second Edition

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For Lindsay
It was worth the wait . . .

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Foreword

Now, more than ever, credit-market professionals rely on sound guidance through the changing world of structured credit products. Moorad Choudhry once again delivers, with a completely updated treatment of the topic, and the same high level of clarity and comprehensiveness.

The timing is perfect. The market has been put back on its heels with the shocking default losses of the past year. It is time to re-think the design, risk measurement, risk management, rating and pricing of these products. The premise of the market, particularly with respect to collateralised debt obligations (CDOs), is that most of the default risk would be distributed outside of the banking system, leaving banks and other originators holding only slivers of equity risk, just enough to provide them with an incentive to protect senior tranches from significant losses. In concept, the highly rated senior tranches would be almost immune to loss, and would be held by institutional investors outside of the banking system, where losses that did occur would be less likely to cause systemic risk. Instead, the senior tranches were, in several alarming cases, held in massive quantities by systemically important banks or dealers, who suffered immense write-downs on these exposures.

What went wrong? It will be some time before we have a complete picture. Was it just bad luck that mortgage-related CDOs suffered such significant losses through an anomalously widespread and deep decline in home prices? Or, as some initial research indicates, did the availability of structured credit products and perhaps a lack of understanding of them lead to an appetite for senior CDOs that gave an unwarranted boost to the housing boom? Why were banks warehousing so much of the senior tranches? Was it poor risk management, incentive-based compensation schemes gone wrong, undue reliance on incorrect ratings or all of the above? Much work remains to be done to answer these questions.

The spill-over effects for corporate-debt structured credit products have been well noted. For example, consider the pricing of protection offered on the CDX.NA.IG 5-year tranches, covering losses on the CDX index of 125 North American investment-grade firms. From February 2007 to February 2008, the market value of protection against losses above 15% of the total notional underlying amount of debt increased by a factor of roughly 50, a truly amazing increase over a period in which corporate default risk had not really changed that much, and was projected to go up only moderately, according to forecasts by the rating agencies and by Ed Altman. The total market value of protection on all losses on the index names went up by a factor of about 5, perhaps reflecting the tightness of credit generally. The fraction of the total market value of all losses that was allocated to those bearing losses above 15% of notional went up by a factor of 10 according to Morgan-Stanley data, and this is largely unexplained. These super-senior sellers of protection were collecting over 42% of the entire valuation offered to all sellers of protection on this index! Even during the worst five years of losses to investment grade debt ever experienced, during the Great Depression period of 1932–1937, total losses were significantly below 15%, according to Moody's data. It is almost unthinkable that those selling protection on CDX.NA.IG.5yr losses above 15% would ever be called upon to pay anything. I speculate that those potential sellers of protection who had significant amounts of 'real money' (these certainly did not include the major dealers) had been so alarmed by the AAA-mortgage CDO losses that they did not want exposure to other AAA-quality CDO-like exposure of any kind until they understood what had happened. The market was offering similarly 'over-rich' pricing for commercial real estate senior structured credit products.

For now, almost the entire CDO market has been poisoned by the experience of the past year. Issuance is down dramatically, and institutional investors will be on their guard for some time. Securitisation is too valuable a risk-transfer methodology to leave behind. It will need to be done better, and over time it will recover, I suspect.

I have also been concerned about weaknesses in the market infrastructure. Credit derivatives are traded almost entirely in the over-the-counter (OTC) market, where a dealer normally acts as a seller to buyers of default protection, and as a buyer to sellers of default protection. In order to balance their positions, dealers often take positions with other dealers. In addition, hedge funds often expose one dealer to another when they reassign their positions in an existing contract. As a result, dealers find themselves significantly exposed to the event of default by some other dealers, normally a very remote but potentially dangerous possibility.

Had Bear Stearns collapsed before the 2005 initiative of the Fed led to reduced documentation backlogs, and had quick action by the Fed and J.P. Morgan not occurred, the unwinding of Bear Stearns' derivatives portfolio could have been extremely dangerous. In the absence of clear and up-to-date records of current derivatives positions, dealers would have been uncertain of their own and other dealers' exposures, and could have responded by a dramatic withdrawal of financing to each other, which could have indeed caused other dealers to fail, with potentially disastrous economic consequences.

In addition to a lack of good records, the market has suffered from an unnecessary build-up of exposure of dealers to each other. For a simple illustrative example, suppose that Goldman Sachs has exposure to Merrill Lynch through a $1 billion credit derivatives position, while Merrill Lynch has the same $1 billion exposure to J.P. Morgan, and J.P. Morgan has the same exposure to Goldman. If all three dealers in this circle of exposures were to reassign their contractual positions to a central clearing counterparty, then each dealer's positions would net to zero. None of them would be exposed through these positions, nor would the central clearing counterparty. In practice, however, the growth of the credit derivatives market has been accompanied by an exceptional increase in the exposures of dealers to each other that could have been significantly avoided by central clearing.

Through a new electronic confirmation platform known as Deriv/SERV, I believe that the trade documentation problem has now been largely addressed, although even more progress should be made in that direction. Central clearing counterparties such as The Clearing Corporation are likely to come on line in the credit derivatives market within a year, and will reduce dealers' exposures to each other significantly for standardised credit derivatives, which constitute the bulk of dealer exposures.

The market is achieving a more robust infrastructure through these and other procedural improvements, such as improved protocols for auction-based cash settlement of contracts at credit events, and for 'novation', meaning the assignment of a customer's position to a new dealer. Further improvements in the OTC market architecture are planned. These infrastructure improvements have come to the OTC derivatives market rather late. Many of their benefits have been available all along with exchange-based trading, which is perhaps a better venue for the trading of highly standardised credit derivatives. The OTC market will continue to be the engine of innovation and customisation to client needs for risk transfer.

As professionals improve their security design, valuation models, risk management practices and operational infrastructure, the market for structured credit products will most likely improve over the coming years, and more importantly it will rest on a firmer foundation for future growth.

Darrell Duffie
Dean Witter Distinguished Professor of Finance
Graduate School of Business, Stanford University
July 2008

Preface

Never say never again . . . as James Bond once suggested, and an apt reference to make at the start of this, the Preface to the second edition of my book on credit derivatives, being published six years after the first one. I'd insisted that my book *Bank Asset and Liability Management* was definitely my last ever and that wild horses couldn't drag me to write another. And yet here we are, a mere three years after the publication of that *magnum opus*, with me at my study desk in the middle of the night, penning arcane but hopefully accessible words on finance once more . . .

The 2007 credit and liquidity crunch was still being felt in 2008 and 2009 as the financial crisis helped tip global economies into recession. So there's still much to talk about, not least the impact on credit derivatives and structured credit products, and I do hope that readers find the new material here to be of value.

We start with the premise that credit derivatives are 'a good thing'. If you're looking for someone to agree that they are 'financial weapons of mass destruction', or somehow 'dangerous', then look elsewhere because that person isn't me. I didn't start my career in credit derivatives (indeed, the market didn't exist when I joined the London Stock Exchange in 1989), but I did start in finance and banking. Banks make the world go round. We can't do without them: no one, whether government, corporate or individual, can function efficiently without credit. And, within banking, any tool that makes both investment and risk transfer easier to undertake is 'a good thing'. We've all read about sub-prime fallout, toxic assets, CDOs and the backlog in credit derivatives documentation (as if people wouldn't have lost money in 2007 and 2008 if credit derivatives or CDOs *didn't* exist!). You won't read about how bad structured credit products are in this book, because this is a textbook and not a polemic on finance. You *will* read, among other things, how risk exposure analysis of structured credit products should be undertaken. The first mantra of any investor should always be to know one's risk. And this can be found here. However, we still think credit derivatives are a good thing. Banks have been around for a very long time and will continue to be around for a very long time; not because they are somehow saintly or the ultimate expression of human development, but because without them we couldn't function in a modern productive way.

There is much to analyse and write about the 2007–2008 global financial crisis: its causes, its impact and the lessons to be learned for the future. But not in a textbook on credit derivatives. Specifically of relevance to this book are the calls for a centralised clearing house for the OTC credit derivatives market. But at the time of writing these remain regulators' proposals, so we can't deliver any detail here. Certainly, a centralised clearing house, along the lines of the London Clearing House model, via which CDS could be traded in a similar fashion to that of Tri-Party repo, would eliminate counterparty risk and contribute to a more stable market. Hopefully something along these lines will be closer to reality by the time you read this.

So there, polemic over! Let's get on with the technical analysis . . .

LAYOUT OF THE BOOK

This book is organised into three parts. These comprise:

- Part I: credit risk and credit derivative instruments;
- Part II: structured credit products and synthetic securitisation;
- Part III: description of the files on the accompanying CD-ROM.

The Prologue discusses the events of 2007–2008 and their impact on the structured finance market. To preserve the technical aspect of this textbook intact, we place this discussion before Part I. In Part I we discuss credit derivative instruments, their structure, application and pricing. In terms of organisation, we look first at unfunded credit derivatives in Chapter 2 and then later at funded credit derivatives. Following our discussion of pricing, we look in detail at the interplay between the cash (bond) and synthetic (credit derivative) markets in corporate credit, exemplified by the basis, in three chapters. Our look at CDS applications also includes a review of credit rating approaches and relative value analysis, as this is relevant to basis trading.

We introduce Part II with a primer on securitisation. Following that we discuss in detail the synthetic CDO and also synthetic (that is, credit derivative-based) structured funding vehicles. We illustrate each stage in product development with case studies of real-world deals. We also provide an analysis of CDO note pricing. At relevant points there is further review of the impact on the markets of the credit crunch. At certain stages we have some great input from other contributors, and I would like to take the opportunity now to thank my co-authors for their value added to this project: my appreciation to Abukar Ali, Suleman Baig, James Croke, Jaffar Hussain, Zhuoshi Liu, Richard Pereira, Sharad Samy, Daniel Sempere-Roldan, Timo Schläfer and Marliese Uhrig-Homburg.

All original material has been updated and in some cases removed if no longer relevant. Brand new material in this second edition includes:

- a look at credit analysis and credit relative value measurement;
- a stand-alone chapter on negative basis arbitrage trading, for which there was renewed opportunity for investors after the financial crash;
- an update on the CDS basis, including a look at the adjusted basis and pricing the basis;
- a description and examination of the basis of default probabilities;
- further details on index CDS including the iTraxx contract;
- a new chapter on, and very detailed look at, loan-only CDS;
- descriptions of the latest funding techniques following the liquidity crisis, and a discussion of the in-house securitisations that banks are undertaking for use in central bank funding facilities;
- a single-name CDS pricing model and a CDO tranche pricing model, with Microsoft Excel front end, included on the CD-R.

We hope that readers find the contents to be of value. As ever, comments are welcomed, please contact me via the publishers.

THE CD-ROM

Files on the accompanying CD-ROM are described in detail in Chapter 16, and as well as the pricing models mentioned above there are files of diversity score models, sample Fitch ratings reports for synthetic CDO deals (reproduced with permission), a CDO waterfall model, and teaching aids in the form of a set of PowerPoint slides. The slides cover the bulk of any intermediate- to advanced-level course on credit derivatives and structured credit, and may be of value to course trainers and lecturers.

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Special thanks to Professor Darrell Duffie for the excellent foreword, following his foreword in the first edition. It is a great honour to have his input and observations.

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To the *Raynes Park Footy Boys*, thanks again for your help, support and friendship.

Moorad Choudhry
Surrey, England
30 July 2009

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Moorad Choudhry is Head of Treasury at Europe Arab Bank plc in London. He previously worked at KBC Financial Products, JPMorgan Chase Bank, Hambros Bank Limited, ABN Amro Hoare Govett Limited and the London Stock Exchange.

Moorad was born in Bangladesh and educated at Kingston Grammar School and Claremont Fan Court School in Surrey, England, then at University of Westminster and University of Reading. He obtained his MBA from Henley Management College and his PhD from Birkbeck, University of London. He is Visiting Professor at the Department of Economics, London Metropolitan University; Senior Research Fellow at the ICMA Centre, University of Reading; a Fellow of the Global Association of Risk Professionals; a Fellow of the **ifs**-School of Finance; and a Fellow of the Securities and Investment Institute. He is on the Editorial Board of the *Journal of Structured Finance*, the *Securities and Investment Review* and *Qualitative Research in Financial Markets*, and on the Editorial Advisory Board of the American Securitization Forum.

Structured Credit Products: Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

PROLOGUE

The 2007–2008 Credit and Liquidity Crunch: Impact on Structured Credit Markets

We shall begin the second edition of this book with an assessment, and observations, on the 2007–2008 financial crisis and its impact on structured credit markets. This is in two parts: first, we discuss the origins and impact of the crisis, and then we look at specific market events. Before we do this, though, we outline the rationale for credit derivatives and bank credit risk transfer.

BANKS AND CREDIT RISK TRANSFER

Banking institutions have always sought ways of transferring the credit (default) loss risk of their loan portfolios, for two reasons: (i) to remove the risk of expected losses from their balance sheet, due to an expected increase in incidence of loan default; and (ii) to free up capital, which can then be used to support further asset growth (increased lending). The first method of reducing credit risk is selling loans outright. This simply removes the asset from the balance sheet, and is in effect a termination of the transaction. Alternatives to this approach include the following:

- spreading the risk via a syndicated loan, in partnership with other banks;
- securitising the loan, thus removing the asset off the balance sheet and, depending on how the transaction is structured and sold, transferring the credit risk associated with the loan;
- covering the risk of default loss with a credit default swap (CDS) or an index credit default swap;
- transferring the risk of the asset to a speciality finance company.

In principle, the ability to transfer credit risk is an advantage to the financial market as a whole, as it means risks can be held more or less evenly across the system. In practice this may not happen, and risk can end up being concentrated in particular sectors or among particular groups of investors. But such a result is not to detract from the inherent positive impact of credit risk transfer. In other words, an ability to transfer credit risk in straightforward fashion is in principle a worthwhile and valuable thing.

Credit risk transfer enables banks to manage bank capital more efficiently, and also to diversify their risk exposures. In theory this means they can reduce their overall credit risk exposure.[1] The risk is transferred—not eliminated—to other banks and other sectors such as institutional investors, hedge funds, corporations and local authorities. More efficient allocation of capital should, in theory, lead to a lower cost of credit, which is a positive development for the economy as a whole. Put against this is the negative notion that securitisation and the use of CDS results in the poorest quality assets always being retained on bank balance sheets, because such assets are illiquid and not attractive to other investors; this concentrates risk. In addition, loan risk may be transferred to investors who are less familiar with the end-obligor, and so less able to monitor the borrower's performance and notice any deterioration in credit quality. Where banks originate debt that they then instantly transfer, they may be pay less attention to borrower quality and repayment ability: this reduction in lending standards was one of the contributing factors to the US sub-prime mortgage market default.

In essence, though these are 'micro-level' arguments against risk transfer, we will proceed with the premise that credit risk transfer is on balance a beneficial activity.

Risk transfer is a logical element in bank risk management. The benefits of credit risk transfer are (i) reduction of capital costs that were associated with the full risk-exposure loan asset and (ii) diversification of risk. Risk transfer via securitisation produces other potential benefits, in the form of new investment product for bank and non-bank investors that is a liquid financial instrument, which may not have been the case for the securitised asset.

Risk transfer via credit default swap (CDS) enables the bank to maintain the loan and thus the client relationship, while benefiting from a capital cost reduction. That the CDS can be executed with an identical maturity to the loan is one of the prime advantages of the CDS instrument.

[1] But see Choudhry and Landuyt (2009), who argue that diversification across asset classes is essentially a myth in a bear market environment. But in a bull market, it does result in lower risk exposure.

Given that there are various drivers behind why a bank may select to transfer the credit risk of an asset on its balance sheet using a credit derivative, by extension one can see that the same advantages apply if a bank wishes to transfer entire books of risk via a basket credit derivative, which can be either a cash collateralised debt obligation (CDO) or synthetic CDO. From the other side, investor demand for the product that arises from a CDO deal is also a driver of the transaction.[2] Therefore a bank can tailor the construction of a CDO it wishes to originate to meet the risk-reward profile of the investor. This gives rise to a certain element of moral hazard, because the bank may wish to place its poorest quality assets in the CDO. At the same time, to help sell the CDO notes the bank may still retain the 'first-loss' piece of the CDO itself, which provides investor comfort and ensures that the bank still has an interest in the credit performance of the underlying collateral in the CDO. In the wake of the credit crunch in 2007–2008 and ongoing 2009 recession, banks that originated CDOs and sold the entire issue of notes to clients have been accused of less than good ethical practice.

MARKET DEVELOPMENTS: THE 2007–2008 CREDIT CRUNCH AND NEW DEVELOPMENTS IN CONDUIT TRANSACTIONS[3]

During the course of 2007, the international debt capital markets witnessed an unprecedented drop in investor appetite for structured credit products. Although the circumstances giving rise to the sudden change in economic climate are numerous, the situation remained uncertain well into 2009. One thing is definite, however—when market uncertainty finally clears up in respect of structured products, new structures are likely to arise to continue to support the efficiency of the international debt capital markets.

This chapter (i) examines how the credit and liquidity crunch of 2007 affected structured credit products and identifies some of the factors that helped give rise to and exacerbated the effect of the crunch, and (ii) analyses some of the new structures that are likely to develop as the debt capital markets recover.

[2] CDO products are discussed in detail in Part II.
[3] This section was written by James Croke and Sharad Samy.

The Credit and Liquidity Crunch of 2007: Backdrop

At the beginning of 2007, investors could not get enough of structured finance products. Issuances of CDOs, collateralised bond obligations (CBOs) and collateralised loan obligations (CLOs) (referred to herein collectively as CDOs),[4] residential and commercial mortgage-backed securities, municipal bonds and asset-backed commercial paper (ABCP) were at record highs at the start of the new year.

However, in early 2007, market participants expressed concern with the performance of the US sub-prime mortgage market, and, over the course of the following months, the contagion of fear quickly spread to any structured product that might have exposure to US sub-prime mortgage risk, including likely candidates (such as CDOs repackaging sub-prime risk) and unlikely candidates (such as ABCP conduits fully supported by sufficiently rated bank credit).

Figure P.1 highlights the problem in the context of the ABCP market: it shows the bid-price for ABCP issued at an A–1/P–1 credit level (that is, not attributed to a single ABCP issuer but reflective of a Bloomberg blending of rates of similarly rated issuers) for the period from January 2007 to October 2007, and super-imposed on these values are the titles of some of the relevant *FT* articles covering the changes in market climate. Clearly, by August 2007, ABCP fell prey to the market turmoil.

Prior to this, the ABCP market had thrived. ABCP, a mainstay structured product developed in the mid-1980s, had traditionally been considered one of the safest structured products, with investors relying on the consistency of supply of ABCP and the overall stability of the ratings associated with ABCP conduit platforms. Many investors, including a number of the large money market funds located in the US, identified ABCP as a core financial product to achieve safe, short-term investment returns. By early August 2007, the total value of outstanding ABCP approached $1.2 trillion.

ABCP conduits were traditionally arranged by bank sponsors, with either full or partial credit support. These vehicles enabled bank sponsors to

[4] CDOs experienced a phenomenal growth starting in the early 1990s. The success of the product attracted a large number of market participants, including, for example, hedge funds and mortgage lenders looking to take advantage of the cost of funding available through the CDO space. The CDO product also attracted arrangers interested in taking advantage of leveraged positions: with a certain amount of capital, sponsors could leverage their initial investments to purchase high-yielding securities with a relatively lower cost of funding through a CDO debt issuance. Given the economic demand for CDO products, most structured CDO securities could be placed in the initial or secondary markets.

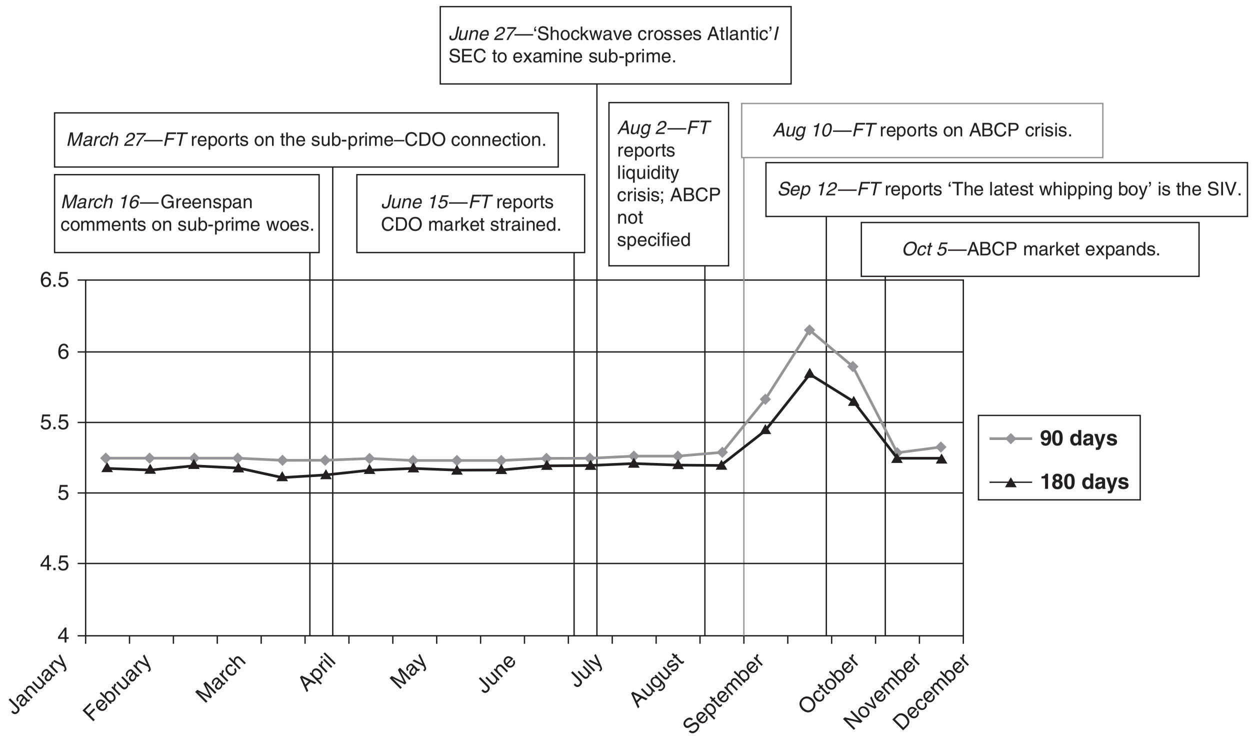

FIGURE P.1 Timeline of events during US sub-prime mortgage crisis, 2007.

manage their institutional liquidity and to obtain regulatory capital benefits through the use of the ABCP vehicle as a financing platform. Following implementation of the Basel Capital Accord in the late 1980s and early 1990s, banks were incentivised to establish ABCP vehicles that enabled them to reduce bank exposure to assets from a credit perspective and incur lower regulatory capital charges associated with related liquidity exposures to such vehicles. With the advent of the new bank regulatory capital rules, ABCP programs with partial credit support and full liquidity support quickly became the norm.

Along with the growth of the ABCP market, the structures of ABCP conduits evolved, giving rise to a host of different types of ABCP conduits by August 2007. As demand for ABCP soared, banks, other financial institutions and even hedge funds realised they could tap into the cheap cost of funding available in the ABCP markets and use such funding to finance higher yielding, longer term financial products. Looking back, many of the vehicles issuing ABCP in August 2007 bore little or no similarity to the original ABCP vehicles of the mid-1980s, especially from a credit and liquidity perspective.

Some non-bank sponsors created 'rent-a-conduit' ABCP platforms that enabled financial institutions and corporates to access the debt capital markets without having to establish an ABCP platform of their own. Arrangers of these vehicles often obtained the requisite credit and liquidity support needed for their vehicles through credit and liquidity lines obtained from appropriately rated financial institutions (typically the same institutions utilising their platforms for financing purposes).

Other vehicles also increasingly tapped into the ABCP sector. Structured investment vehicles, known as 'SIVs', grew alongside the earliest of the ABCP conduits, utilising short-term financing through ABCP issuance and longer term financing through medium-term note and capital note issuances to maintain sufficient liquidity and credit support. As of the start of 2007, SIVs occupied a market segment of approximately $400 billion.

In the early 2000s, arrangers of CDOs realised they could structure CDOs to capture for themselves the arbitrage opportunity that existed between long- and short-term financing options, previously captured by ABCP conduits and SIVs. Arrangers of CDOs integrated ABCP technology into their vehicles, enabling the CDO to directly issue ABCP into the short-term markets. Requisite liquidity support for these CDOs was achieved through the provision of direct liquidity from appropriately rated entities or through structuring innovative 'liquidity puts' wherein appropriately rated entities were required to purchase ABCP or senior tranches of debt that would effectively take out outstanding ABCP if the CDO was unable to roll ABCP.

The most innovative ABCP-issuing vehicle was, perhaps, the SIV-Lite (sometimes referred to as a 'market value' CDO), and it took centre stage in early 2007. In this construct, the vehicle raised proceeds from the debt capital markets through the issuance of long- and/or short-term debt securities. The vehicle used the proceeds to invest in a pool of assets that could reliably be marked-to-market on a regular basis. The administrator of the vehicle selected between different types of note issuances to manage its financing method, selecting among and between the types to determine the lowest cost of funding then available for the required tenor of financing. The administrator also monitored the marked-to-market value of the assets owned by the vehicle to ensure that the vehicle had (or would have) cash on hand, through sales of assets if needed, to repay debt in a timely manner. Given the active, dynamic market value investment strategy of the SIV-Lite, purchasers of SIV-Lite paper relied on the ability of the SIV-Lite to purchase assets at favourable prices and to sell assets quickly if the assets' credit quality or market value deteriorated.

Both SIVs and SIV-Lites thrived in the positive economic climate that existed in 2006 and early 2007, largely because they both relied to some degree on the market-value support of their assets. Market participants showed significant interest in these vehicles because, like traditional, supported ABCP conduits, these vehicles enabled a sponsor to arbitrage the cost of funding in the short-term debt markets against higher return, long-term investments (such as CDO debt). But, unlike traditionally supported ABCP conduits, these vehicles did not have access to full liquidity support from a highly rated financial institution. Instead, their liquidity was totally dependent on their continued ability to issue new ABCP and on the market value of their assets.

Structurally, both SIVs and SIV-Lites were hard-wired to deal with the possibility of a deterioration in the market-value of their assets. An administrator of each of these types of vehicles was required to mark-to-market the value of the assets to ensure that the vehicle had ample liquidity to repay its senior debt, and if the vehicle failed to satisfy any 'net cash outflow' test (referred to as 'NCO tests') over specified periods of time, the vehicle was required to sell assets to obtain cash. Alternatively, the vehicle would be required to issue particular types of debt to enable it to better manage its cash flows during the period in which market values deteriorated (for example, by extending note maturities if possible).

To further bolster the liquidity support, these structures relied on a cushion being available to support the vehicle in the event market values deteriorated quickly or sales of assets were not possible. Some vehicles established this cushion through the issuance of subordinated debt or equity, wherein a cash buffer was provided to account for market value risk

TABLE P.1 Key characteristics of traditional ABCP conduits, SIVs, SIV-Lites and CDOs.

ABCP conduit	SIVs	SIV-Lites	Cash flow CDOs
Perpetual life	Perpetual life	Fixed maturity	Fixed maturity
No market value model	Dynamic market value model	Simpler market value model	No market value model
Diverse asset composition	Diverse asset composition	Moderate asset diversity	Less diversity
Short-term funding	Short- and long-term funding	Short- and long-term funding	Long-term funding
Greatest administrator flexibility	Greater administrator flexibility	Moderate administrator flexibility	Less administrator flexibility
Full third-party liquidity support	Partial (e.g., 15–20%) third-party liquidity support	Minimal third-party liquidity support	Minimal third-party liquidity requirements

by having subordinated debt or equity holders take such risk. Other structures enabled the issuer to exercise a margin call against an appropriately rated entity if the market value of the assets deteriorated below a specified level. Still other structures applied rating-agency assigned haircuts to the values of assets when purchased to ensure that a rating-agency approved level of over-collateralisation was achieved. Some vehicles used a combination of the foregoing to establish the cushion.

Clearly, by August 2007, a myriad of types of vehicles occupied the ABCP space. Table P.1 highlights how different some of these vehicles really were, setting forth some of the key characteristics of the traditional ABCP conduit, the SIV, the SIV-Lite and the traditional 'cash flow' CDO.

In August 2007, the liquidity crisis hit the ABCP market in full force, calling into question the viability of some ABCP-issuing structures. The spike in the cost of funding of ABCP during this period reflected significant investor concerns regarding whether ABCP vehicles (or, in some cases, the banks that sponsored and supported such vehicles) had direct or indirect material exposure to the US sub-prime market.

Perhaps in fear of the answer, many ABCP investors shied away entirely from ABCP during this time, causing third-party liquidity in the ABCP markets to vanish. Unable to roll commercial paper as bid–ask spreads continued to widen, vehicles were required to make draws on available liquidity. Banks providing full or partial liquidity support to ABCP conduits were forced to fund under liquidity lines or to find other ways to provide liquidity support to their sponsored vehicles (for example, through entering repurchase agreements with the vehicles in respect of assets, etc.).

While ABCP conduits were certainly impacted by the liquidity and credit crunch of 2007, SIVs and SIV-Lites would ultimately succumb to the market turmoil because of the lack of external liquidity support provided to them. They were in a much more precarious position at this time: while a traditional ABCP conduit might rely on liquidity support from an appropriately rated bank arranger to obtain cash to repay its debts (putting the liquidity strain on the bank sponsor but enabling the vehicle to repay its debts), both SIVs and SIV-Lites, having limited liquidity support, were unable to obtain necessary funding through available liquidity lines and faced severe cash-flow problems.

The grave situation that SIVs and SIV-Lites faced was further exacerbated by the sharp decline in the market values of the financed assets. Without recourse to liquidity lines, SIVs and SIV-Lites were required to sell securities at depressed market prices at a time when market values continued to drop sharply. Indeed, market confidence had eroded so badly that even experts in valuations faced difficulties in determining the fair market value of the assets held by these vehicles—valuation teams from some of the leading investment banks used a blend of both mark-to-model and mark-to-market methodologies in an attempt to calculate the range of discounts on particular asset classes. The valuation problems were further exacerbated by (i) actual and potential further forced liquidations of collateral held by distressed structured vehicles (including other SIVs and SIV-Lites); (ii) sales of downgraded collateral by institutional investors because they were failing to satisfy their own minimum credit quality investment guidelines that required investment in only 'investment-grade' assets; and (iii) public and private companies disposing of investments as a result of margin calls, lender demands or investor pressure.

The Credit Crunch: Contributory Causes

It is only reasonable to ask what factors caused or contributed to the credit and liquidity crunch of 2007. While investor fear of sub-prime risk may have served as a catalyst for the crunch, it was a perfect storm of conditions that joined together to cause the significant market disruption. Here are some of the causes:

Disclosure The variation in the level and quality of disclosure relating to structured credit products contributed significantly to the market turmoil. In a number of instances, the disclosure provided to investors was cumbersome or, alternatively, light. In some cases, the disclosure was comprehensive, but difficult to process, and, in other cases, the disclosure was simple, but wholly inadequate. Some of the blame rests with the investors who bought the products; investors have admitted that they relied heavily on ratings to determine whether to buy a structured product because they did not have adequate staffing to comprehensively review the related disclosure.[5]

Indeed, the variation in the level and quality of disclosure is apparent in the context of the restructurings and insolvencies currently taking place in respect of various structured credit products. As noted above, valuation experts face significant challenges in trying to value the assets underlying failed or failing structured vehicles. The poor quality of disclosure has helped exacerbate the problem—for the effective valuation and risk assessment of any structured product the valuation expert must analyse the structure, collateral and originators of a deal, which can be difficult if the related disclosure is poor. In addition, in a period of a protracted credit or liquidity crisis, the valuation expert must also analyse the underlying assumptions relating to the valuation, attempt to differentiate one security from another, analyse the specific details of each security and, like the peeling of an onion, examine the underlying assets supporting that security. Valuation experts have noted that inadequate disclosure at all levels of the deal (that is, in respect of the failing structured product but also its assets) has made the valuation process in this regard difficult, if not, in some cases, impossible.

Credit Rating Agencies A number of market participants and commentators blame the credit rating agencies (CRA) for the failings that have occurred. The rating agencies have been criticised for relaxing the standards of their review in order to push through more rated transactions to earn more fees. Others argue that the rating agencies may have based their ratings criteria on failed economic assumptions that were proven untrue in the current market climate. Still others contend that the rating agencies' traditional disclaimer of liability for errors in ratings lies at the heart of the market mess.[6] As a result, the rating agencies are now facing intense public—and governmental—scrutiny. The rating agency reaction to the

[5] Rightly or wrongly, some investors argue that they were forced to take this approach because competitive market conditions made the option of retaining sufficient staff to review disclosure cost prohibitive.

[6] Unlike lawyers or accountants, rating agencies are not subject to professional malpractice-type claims. The rating agencies have consistently stated that they merely provide ratings as a service and that they do not provide any investment or other financial advice to any person in respect of the rated products.

situation is interesting: some rating agencies have bolstered their internal organisations to stress application of ratings criteria to structured deals going forward while at least one rating agency has indicated that it will exit the structured finance space entirely.

To be fair, however, the methodologies used by the rating agencies to rate structured finance deals were not a secret. On the contrary, they were published freely and available for inspection on the agency websites. If investors disagreed with the assumptions used to assign a rating, they were always in a position to not accept it (and thereby not buy the asset at the assigned price). Rating a structured finance vehicle is not like rating a government or conventional corporate; there is very little qualitative judgement to be made, so the rating process is essentially a quantitative one. It is this process that led to controversy later.[7] Perhaps the biggest mistake made by the CRAs was their failure to make clear to investors that a AAA rating for a CDO note was not the same as a AAA rating for a US Treasury security.

Government Regulators While criticism of the rating agencies may or may not have merit, it is fair to say the market crisis does not rest on the shoulders of the rating agencies. Government regulators certainly share part of the blame for the crisis because they failed to provide the market with a clear, consistent bank regulatory capital framework that worked across jurisdictional lines.

For over a decade, the regulators worked on refining and adopting the new Basel II rules, in order to increase flexibility in the regulatory capital framework to more accurately reflect the credit risk positions that banks were taking in respect of exposures they were holding. During this time, banks were made aware that the old rules would change, and they waited to see how the new rules would develop. They would have to re-evaluate their capital positions in light of the new framework, and this would likely impact the types of structured transactions they would engage in going forward.

However, even after the new rules were finally adopted and published by the Basel Committee on Banking Supervision (the 'Basel Committee'), getting the rules implemented in each applicable jurisdiction has moved very slowly (having only been adopted at the end of 2007 in the US, and only for the 10 largest banks). The delay in implementation has been compounded by the fact that different regulators have taken different

[7] Although the flaws in the methodology, relying on unobservable assumptions and statistics such as default correlation, had long been debated in academia.

approaches in respect of adopting the framework, leading to different regulatory treatment of banks competing in the same space.[8]

It would appear, based on the latest announcement of the Basel Committee, that they recognise the importance of clarity in respect of the regulatory capital framework. The Basel Committee announced on 16 April 2008 that it would enhance the Basel II framework to strengthen the resilience of the banking system. Dr Nout Wellink, Chairman of the Basel Committee, said: 'A resilient banking system is central to sound financial markets and growth. Supervisors cannot predict the next crisis but they can carry forward lessons from recent events to promote a more resilient banking system that can weather shocks, whatever the source. The key building blocks to core bank resiliency are strong capital cushions, robust liquidity buffers, strong risk management and supervision, and better market discipline through transparency.'

While noting that the current Basel II framework better reflects the types of risks that banks face, the Basel Committee indicated that it would improve the framework by introducing additional measures to (i) ensure sufficient capital adequacy, (ii) more effectively capture off-balance sheet exposures and (iii) improve regulatory capital incentives. More specifically, it intends to establish higher capital requirements for complex structured credit products (including 'resecuritisations' like CDOs of asset-backed securities) and strengthen the capital treatment of liquidity facilities extended to support off-balance sheet vehicles like ABCP conduits.

The Basel Committee also stated that it would focus on capital adequacy concerns relating to a bank's exposure to assets held in its trading book. Recognising that an increasing number of banks hold assets through their respective trading books and many of these assets are complex, less liquid financial products, the Basel Committee stated that it intends to extend the scope of its guidelines for 'incremental default risk' to include various trading book risk events.

The Basel Committee on Banking Supervision released proposals relating to the above refinements in 2009. These can be reviewed at the BIS website. In addition, the Basel Committee stated that it would continue to monitor the credit markets and re-examine Basel II's minimum capital requirements if it found shortcomings in the existing capital cushions.

While these comments are helpful, banks across the world are still waiting to see how the conceptual statements will actually be implemented.

[8] Local banks following the new rules have protested as well, complaining that some of the rules (for example, the internal-ratings based rules) would effectively create a non-competitive playing field between the multi-national banks and the local banks by providing greater regulatory capital relief to multi-national banks.

The uncertainty regarding the risk capital treatment of structured products (and the prospect of exponentially higher risk capital requirements being applied to any structured products that suffer credit rating downgrades) has been a significant factor in the lack of market liquidity for these products.

In a move that possibly increases uncertainty in the financial markets, the US government, reacting to the market turmoil, announced that it would overhaul the US regulatory regime to help streamline market regulation in the US to make it more robust and effective. In March 2008, the US Department of the Treasury ('Treasury') published a comprehensive proposal for a restructuring of the US financial regulatory system, the so-called 'Blueprint for a Modernised Financial Regulatory Structure' (the 'Blueprint'). If fully implemented, the Blueprint would fundamentally change both the methodologies and the entities that the US uses to regulate financial institutions.

The Blueprint divides its proposals into three categories: short-term recommendations, intermediate-term recommendations and a conceptual model for a longer term restructuring of the regulatory system.

The Treasury's principal short-term recommendations include a proposal to establish a new federal commission to establish minimum licensing criteria that the states would be required to apply in licensing mortgage brokers. The Treasury's principal intermediate-term recommendations include proposals to (i) merge the Office of Thrift Supervision into the Office of the Comptroller of the Currency, (ii) merge the Securities and Exchange Commission and the Commodities and Futures Trading Commission, and (iii) create a new federal regulatory structure that would permit insurers, re-insurers and insurance brokers the choice of being regulated at the federal level or of continuing to be regulated by the states. Finally, the Blueprint sets forth a conceptual model for a long-term restructuring of the US financial regulatory system under which the federal government would establish a 'market stability regulator', a 'prudential financial regulator' and a 'business conduct regulator' to apply objectives-based regulation on a system-wide basis.

Accountants Another significant factor in the market crisis has been the adoption and broad application of mark-to-market accounting principles. First, current accounting rules have not been able to adequately address the discrepancy between the actual, intrinsic value of an asset and its current market value, which can be affected by a number of factors, including irrational market fear. Financial institutions applying GAAP or IAS rules are required to mark-to-market assets for purposes of determining the fair market value thereof, which is used as a basis for determining the balance sheet 'health' of the financial institution in question. Some commentators have suggested that this approach is inappropriate during times of severe market stress, as market values will not reflect the true intrinsic value of the asset. Indeed, many of the bank write-downs reported in the press to date result from the mark-to-market treatment of the subject assets—these assets have not been defaulting to the level of the reported losses.

In addition, uncertainty surrounding proposed changes to the US accounting treatment of off-balance sheet vehicles has exacerbated the problem. On 9 April 2008, the Financial Accounting Standards Board (FASB) met and considered amendments relating to FASB Interpretation No. 46, Consolidation of Variable Interest Entities, largely against the backdrop of (i) the current credit and liquidity crisis and (ii) the proposed elimination of the 'qualifying special-purpose entity' concept in FASB Statement No. 140, Accounting for Transfers and Servicing of Financial Assets and Extinguishments of Liabilities.

At this meeting, FASB announced that it would develop a qualitative analysis, easily understood and applied by all constituents, to determine whether an enterprise is required to consolidate a variable interest entity (a 'VIE') on its books. Moving philosophically in a direction similar to that embraced by the International Accounting Standards Board (IASB), FASB voted in favour of using a qualitative analysis to determine whether an enterprise is the 'primary beneficiary' of the VIE. FASB did not, however, discard the current quantitative analysis described in FASB Interpretation No. 46(R), and indicated that the quantitative analysis would continue to be used when, under the qualitative analysis, a primary beneficiary does not exist or cannot be determined.

FASB stated that an enterprise holding only a passive interest in a VIE should not be considered its primary beneficiary and that the following questions should be considered in determining whether an interest in a VIE is a 'passive interest':

- Is the maximum exposure of the enterprise to the VIE capped and is such exposure an amount determinable on the date of the enterprise's involvement with the VIE?
- Does the enterprise (including related parties) or its de facto agents have involvement with the design of the VIE?
- Does the enterprise have additional involvement or interests in or with the VIE?
- Do the enterprise's interests in the VIE give it any significant control rights over the VIE?
- Is the enterprise's interest in the VIE significant?

This obviously puts transaction arrangers in the US in an awkward and difficult position at a time of significant market stress—they can either proceed with structuring new deals under the old rules, recognising that those rules will change at some point in the future, or they can wait to structure deals when the new accounting rules are implemented, which may not be for some time.

New Structures

Based on the lessons learned from the 2007–2008 crisis, investors desire structured products that have rock-solid credit and liquidity support as opposed to products that pay higher yields with greater liquidity or credit risk. This new direction will undoubtedly shape the structured finance landscape going forward.

Fully Supported Vehicles Many arrangers of ABCP conduits are now looking to revise their ABCP program documentation to make their ABCP conduits fully supported vehicles able to rely on the credit of the sponsoring institution to support the repayment of the related ABCP obligations. This heralds a return to the past to some degree, as the earliest ABCP programs were, in fact, fully supported.

The economic climate has encouraged this new development. The Basel II rules make the partially supported ABCP conduit less beneficial from a regulatory capital perspective. In addition, investors in ABCP, fearful of risks relating to some ABCP vehicles, realise that in a fully supported vehicle, the credit risk of the bank sponsor is paramount. Fully supported ABCP vehicles backed by sponsors with good credit ratings and market reputations will likely be able to access the ABCP markets at much better rates than partially supported vehicles that purportedly represent more risk to investors. As such, it appears likely that many partially supported ABCP vehicles will likely be converted into fully supported vehicles over the next few years.

Statutory Covered Bonds One structured product that is currently of great interest to investors is the so-called 'covered bond'. Covered bonds have occupied a space in the capital markets for centuries; the German covered bond equivalent—the *Pfandbrief*—has been around since the 1700s. Other jurisdictions, including France and the UK, have adopted covered bond legislation enabling certain financial institutions to issue covered bonds.

Under the statutory covered bond construct, specific legislation enables certain financial institutions to issue financial instruments that are backed by both the credit of the issuing financial institution and ear-marked specific 'ring-fenced' collateral pledged by the financial institution to the holder of the instrument. If the collateral defaults, the holder of the financial instrument has recourse to the general credit of the financial institution for repayment. Alternatively, if the financial institution defaults on its obligation (including as a result of its insolvency), the holder has recourse to the collateral supporting the financial instrument. In a very real sense, the holder of the financial instrument gets the best of both worlds.

Interestingly, a statutory covered bond construct similar to the construct in Europe has not developed to date in the US. However, investor interest in this product has sparked movement on the part of the US government in this regard; on 15 April 2008, the Federal Deposit Insurance Corporation (the FDIC) took a positive—albeit measured—first step in the direction of fostering the development of a US-covered bond market, having released for public comment its long-awaited Covered Bond Policy Statement. Under the proposed rules, insured depositary institutions could issue a limited amount of covered bonds backed by statutorily permitted assets, with holders of such bonds benefiting from specific statutory rules limiting the FDIC's reach to those assets in the event of an insolvency of the insured depositary institution. Clearly, the development of this type of covered bond market in the US is still in its early stages.

Structured Covered Bonds Notwithstanding the existence (or, in the case of the US, the non-existence) of a statutory covered bond framework, it is already possible to create 'structured' covered bonds in the US and Europe through the utilisation of bankruptcy remote financial contracts such as repurchase agreements, derivatives and securities lending agreements. Indeed, given today's volatile capital markets and the near collapse of some significant financial institutions, market participants are more sensitive than ever to counterparty insolvency risk in all types of financings, including those effected through repurchase agreements. An increasing number of market participants are actively modifying terms of repurchase agreements, derivatives and securities lending arrangements so as to achieve bankruptcy-remoteness from counterparty insolvency or receivership risk. These types of modifications may generally be documented and negotiated efficiently, and consistent with current market standard documents and related market practices, and the related benefits (including, for example, the ability to repo assets with full recourse to the counterparty for payment of the repurchase price, without assuming that counterparty's insolvency risk) may be substantial.

Structured covered bonds use repo technology to reap the same benefits as statutory covered bonds—a financial institution for the issuance of a bond allowing the holder thereof to have recourse to the general credit of the financial institution for repayment of the bond as well as access to specified collateral if the financial institution should default in repayment (including in connection with its insolvency). Changes in US bankruptcy law and related bank insolvency rules enacted in 2005 and 2006 allow for the possibility of creating a covered bond construct in the US. The strength of the repo safe harbour has recently been validated in a series of US court decisions, having addressed the rights of repo participants to terminate a repurchase agreement involving mortgage loans and certain related rights. While the decision in this case provided significant direction to warehouse lenders, investors in mortgaged-backed securities and other parties that engage in repurchase agreement financings, at its heart, the court clearly interpreted (and upheld) the repo safe-harbour created through the changes in US bankruptcy law and related bank insolvency rules. The same structure can be used to create structured covered bonds in specified jurisdictions in Europe (including, for example, the UK).

ECB-Eligible Assets Market participants are equally interested in creating structured products that are eligible for trading on the European Central Bank (ECB) discount window. The rationale for this interest is likely based on the fact that ECB-eligible assets probably have enhanced prospects of liquidity.

Under current ECB rules, specified assets can be pledged to the ECB by specific eligible financial institutions in Europe in exchange for short-term financing at favourable rates of interest. The application of these rules has helped alleviate some of the market stress relating to the scarcity of liquidity in the current crisis; financial institutions in Europe have relied on access to the ECB to manage the liquidity of their institutions. (US financial institutions have similarly relied on the US equivalent to the ECB discount window, the Federal Reserve discount window, for liquidity management in the current market crisis.) While access to the ECB discount window and the ability to pledge specified assets to the ECB discount window is not guaranteed by the ECB, it has become a central liquidity source in the current market, which is of interest to arrangers of structured products as well as investors (as ECB eligibility may potentially increase the marketability of assets in the secondary trading market).

However, because a number of structured products were created prior to the current market crisis, a number of program revisions may be required in order to make a product ECB eligible. Minimum ratings thresholds have to be satisfied, so the quantum of structured products that can even become ECB eligible are limited. There are a number of other requirements that must be satisfied before the ECB is willing to finance such products, so the process of making a structured product ECB-eligible can sometimes be cost prohibitive. Finally, as noted above, there is no guarantee that the ECB discount window will remain open for these purposes, so this will likely never become a permanent reliable source of liquidity. But, in the current crisis, investor interest in ECB-eligible products has only increased, and this will likely continue until traditional sources of liquidity available through the market are freed up.

EXAMPLE OF MARKET PRICES

Figures P.2 and P.3 show the impact on CDS prices following the 2007 liquidity crunch and 2008 bankruptcy of Lehmans. The first figure shows CDS prices during 2007–2008 for Morgan Stanley, and the second during 2008–2009 for the UK government. They clearly show the negative sentiment that affected both the higher risk reference names, such as US investment banks, and a more conventional 'safe haven'. The UK sovereign CDS

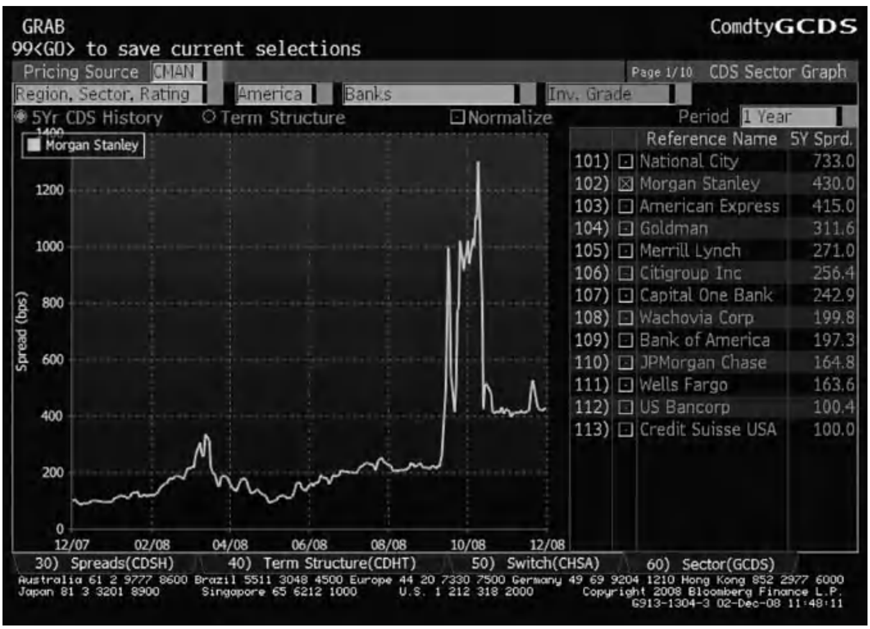

FIGURE P.2 CDS price history, Morgan Stanley 2007–2008.
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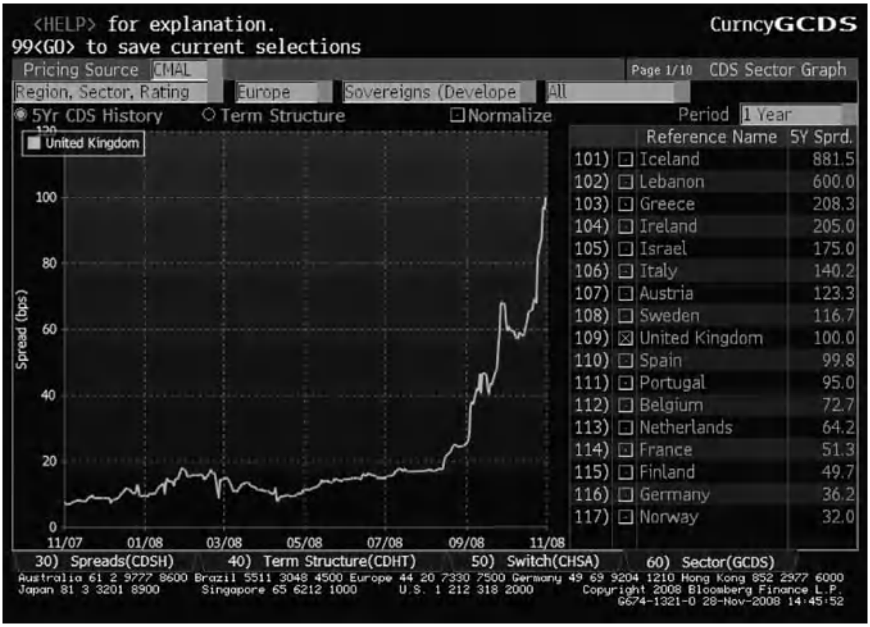

FIGURE P.3 CDS price history, UK sovereign name, 2007–2009.

price climbed following the Lehmans default, and peaked in the new year, before settling down to lower levels.

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Structured Credit Products: Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

PART I

Credit Risk and Credit Derivative Instruments

Credit risk is the risk of loss arising from the inability of a borrower to make interest and/or principal repayments on a loan. Anyone who has lent funds to a borrower that is not considered as default risk-free is exposed to a certain level of credit risk. While credit risk has been a factor for investor concern ever since the development of capital markets, it has received considerable attention among market participants since the 1990s. This attention has taken the form of ever more sophisticated methods of measuring credit risk and managing credit risk. It is the latter that is the backdrop to the instruments discussed in this book. An understanding of the former is necessary, therefore we will begin with a look at credit risk and credit risk measurement.

Credit derivatives are important tools that are used in the managing and hedging of credit risk, and also for trading and investing in credit, as we shall see. All credit derivatives are instruments, financial contracts in fact, that enable credit risk on a particular named asset or borrowing entity, the *reference entity*, to be transferred from one party to another. In essence, one party is buying protection on the reference entity from the counterparty, who is selling credit protection. The buyer pays a premium to the seller during the life of the credit derivative contract in return for receiving credit protection. The seller agrees to pay the buyer a pre-specified amount under certain conditions of default, or upon a restructuring event.

We begin with a look at credit risk and risk measurement. After our introduction to the concept of credit risk, we look in detail at all the important credit derivative instruments, their description, application and pricing.

The main instruments are *credit default swaps*, *total return swaps* and *credit-linked notes*. Although all these instruments achieve the same end-goal of transferring credit risk exposure from a protection buyer to a protection seller, there are subtle differences between them. Credit-linked notes are fundamentally different to the other two types, as they are funded credit derivatives as opposed to *unfunded* ones. We explain this shortly. An instrument developed much earlier, the asset swap, is nowadays considered to be a credit derivative as well, so we also look at this product.

THE CONCEPT OF SYNTHETIC INVESTMENT

If one stops to consider it, banks have been 'selling protection' on their customers ever since they began formally borrowing and lending in the Italian city-states during the Middle Ages. Let's think about it.

Cash Investment

A Bank lends 100 florins to Mr Borrower for a period of five years, who agrees to pay interest of C% per year each year until loan expiry, at which point he will return the original 100 florins. This is shown at Figure 1. We assume that Mr Borrower does not default on payment of both interest and principal. The net gain to Bank after the five years is the interest of C each year, which after five years will be 5C. (We have ignored funding costs here.)

Synthetic Investment

A Bank sells protection on Mr Borrower to Mr Practitioner for a period of five years, who agrees to pay C basis points premium per year each year until trade expiry. This is also shown at Figure 1. We assume that Mr Borrower does not go into bankruptcy, liquidation or administration during the five years, and that Mr Practitioner keeps up the premium payments until expiry.

The net gain to Bank after the five years is the CDS premium of C each year, which after five years will be 5C. Note that Mr Borrower is not involved in this transaction at all, as we see in Figure 1. It is between Bank and Mr Practitioner.

This illustration is a bit cheeky but it makes the point. The return for Bank of 5C is identical in each case. So Bank can decide between cash and synthetic investment; in theory the return will be identical. In terms of net cash flow, the end-result actually is identical if the price associated with Mr Borrower's credit risk is C. The only difference is that the cash trade is

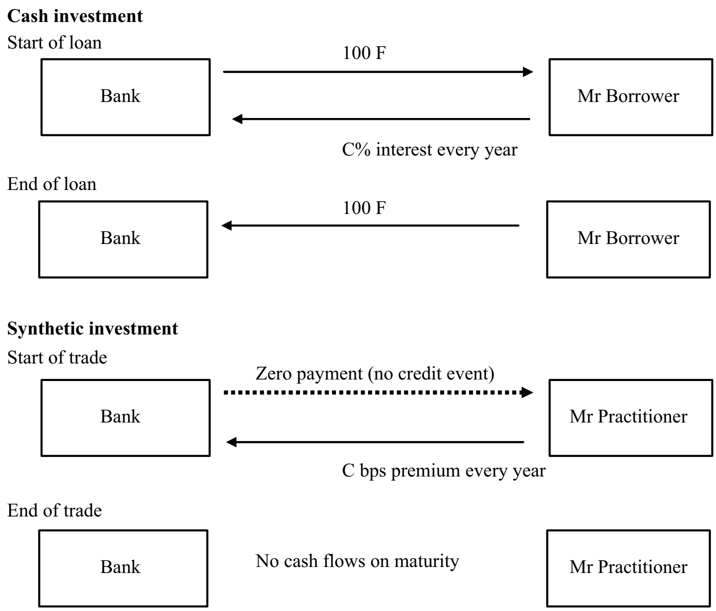


FIGURE 1 Cash and synthetic investment: no default.

funded while the CDS trade is unfunded. Bank has to find 100 florins to lend to Mr Borrower, but doesn't need to find any cash to invest in Mr Borrower via Mr Practitioner.

Of course, if there is a credit event, then Bank will have to find 100 florins. So we need to consider the event of default. Before we do, let's make it a bit more real . . .

Real-world Application

If we convert the bond investment to an asset swap that pays LIBOR + X basis points (bps), the interest basis of the bond has changed from fixed coupon to floating coupon. It is now conceptually identical to the synthetic (credit default swap) premium of X bps.

In the cash market, we assume that the investor has funding cost of LIBOR-flat, so that the 100 it borrows to buy the bond with costs it LIBOR-flat in funding. The net return to the investor is X. For the synthetic investor, who has no funding cost (it does not borrow any cash as it is not buying a bond), the net return is X bps.

Let us now allow for a default or 'credit event'.

Cash Investment

At the beginning of year 3, Mr Borrower is declared bankrupt and defaults on his debt to Bank. The Bank falls in line with the other creditors, and after three years receives a payout from the administrators of 39 cents on the florin.

After five years, Bank has therefore received 2C in interest, but lost 61 florins of capital, a substantial loss.

Synthetic Investment

At the beginning of year 3, Mr Borrower is declared bankrupt and immediately Bank pays 100 florins to Mr Practitioner. In return, Mr Practitioner delivers to Bank 100 florins nominal of a loan that Mr Borrower took out from A N Other Bank. This loan has some residual value to Bank, at the time it is valued at 30 cents on the florin so Bank records a capital loss of 70 florins, a substantial loss.

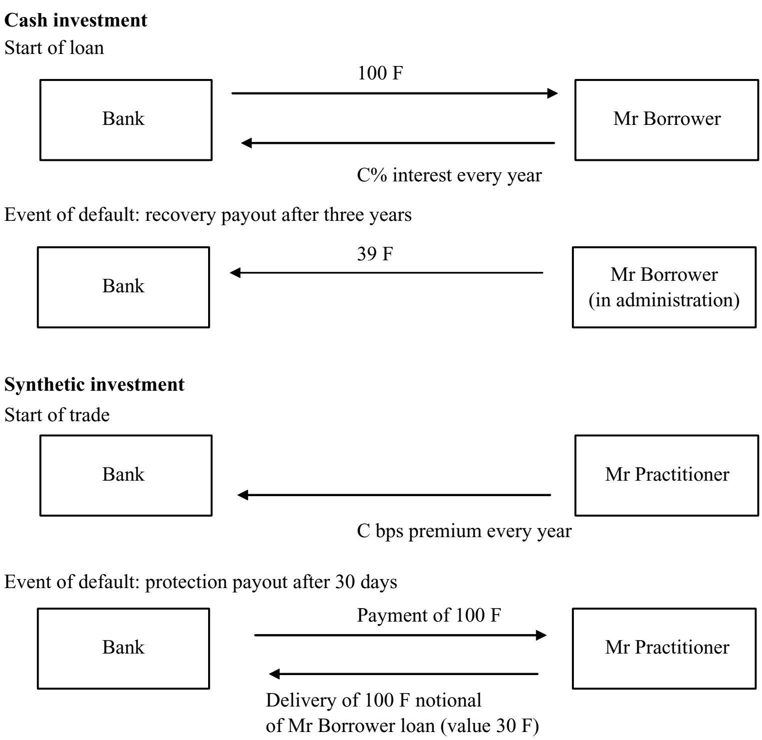


FIGURE 2 Cash and synthetic investment: default.

After three years the Mr Borrower loan that Bank is holding is valued at 39 cents on the florin, so Bank recovers 9 florins of the loss it booked three years ago. Hence, after five years Bank has received 2C in interest, but lost 61 florins of capital, a substantial loss. The illustrations are shown in Figure 2 above.

The point we are making is that funded and unfunded investments are identical on a net-net basis, in theory anyway, and involve taking credit risk exposure in Mr Borrower's name. The price of this risk is C%, and reflects what the market thinks of the credit quality of Mr Borrower. Of course there are some technical differences, not least the introduction of another counterparty, Mr Practitioner. But from the point of view of Bank, both trades are in essence identical; or at least have identical objectives. And the synthetic trade actually has some advantages for the investor, principally with regard to the fact that no funding is required. The counterparty risk to Mr Practitioner (principally his ability to keep up premium payments) can be viewed as a disadvantage, although there are ways to mitigate this.

CHAPTER 1

Credit Risk

Credit risk emerged as a significant risk management issue during the 1990s. In increasingly competitive markets, banks and securities houses began taking on greater credit risk from this period onwards. While the concept of 'credit risk' is as old as banking itself, it seems that only recently the nature and extent of it has increased dramatically. For example, consider the following developments:

- credit spreads tightened during the late 1990s and again during 2002–2007, to the point where blue-chip companies such as General Electric, British Telecom and Shell were being offered syndicated loans for as little as 10–12 basis points (bps) over LIBOR. To maintain margin, or the increased return on capital, banks increased lending to lower rated corporates, thereby increasing their credit risk both overall and as a share of overall risk;
- investors were finding fewer opportunities in interest rate and currency markets, and therefore moved towards yield enhancement through extending and trading credit across lower rated and emerging market assets;
- the rapid expansion of high yield and emerging market sectors, again lower rated assets, increased the magnitude of credit risk for investors and the banks that held and traded such assets.

The growth in credit risk exposure would naturally be expected to lead to more sophisticated risk management techniques than those employed hitherto. It was accompanied, however, by a rise in the level of corporate defaults and consequently higher losses due to credit deterioration, which led to a rigorous test of banks' risk management systems and procedures. It also led to a demand for the type of product that resulted in the credit derivative market.

The development of the credit derivatives market, and hence the subsequent introduction of structured credit products, was a response to the rising importance attached to credit risk management. For this reason, it is worthwhile beginning this book with a look at credit risk, credit ratings, default and credit risk measurement. In this chapter we will look at the concept of credit risk, before considering the main way that it is measured in banks and financial institutions, using the technique known as credit *value-at-risk*. We also introduce credit risk measurement methodology. First, though, we look at the incidence of corporate defaults during the 1990s and during 2007–2008.

CORPORATE DEFAULT

During the second half of the 1990s and into the new century, credit risk and credit risk management have been topical issues in the financial markets industry. Viewed statistically, 1999 onwards appear to be years of excessive corporate default, when compared with the market experience in the previous two decades. This is vividly illustrated in Figure 1.1, which shows the monetary value of corporate defaults for the period 1980–2002. The average size of corporate bond defaults also rose significantly, as we show in Figure 1.2. Adjusted for inflation, the average size of default in 2002 was over five times that for the entire period 1980–2002.

The excessive levels of corporate defaults provided confirmation that banks and bond investors needed to focus closely on credit risk management. They did this using a two-pronged approach, by concentrating on risk measurement and risk hedging. The former used so-called value-at-risk

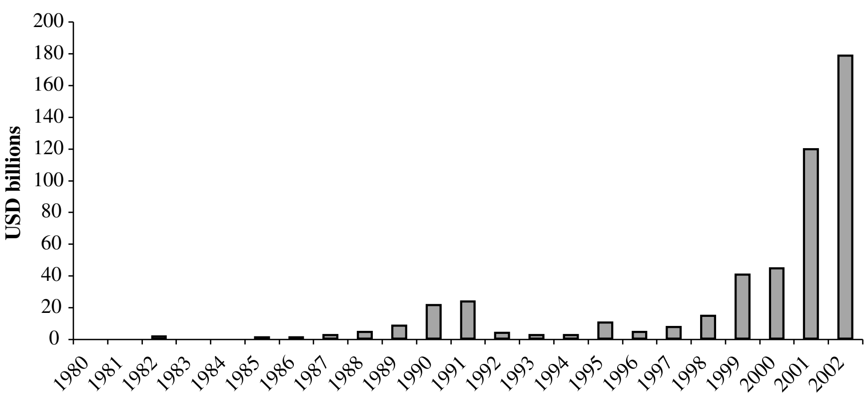


FIGURE 1.1 Global corporate defaults, 1980–2002.
Sources: S&P, CFSB. Used with permission.

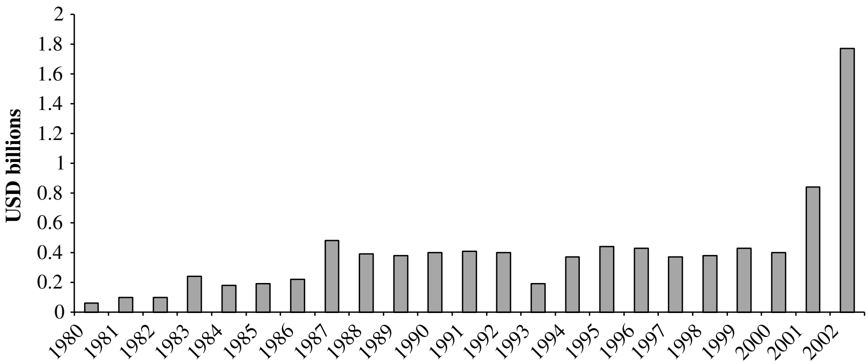


FIGURE 1.2 Average size of corporate bond defaults.
Sources: Moody's, CFSB. Used with permission.

techniques, introduced earlier in the 1990s for market risk measurement, while the latter was accomplished with credit derivatives.

CREDIT RISK

There are two main types of credit risk that a portfolio of assets, or a position in a single asset, is exposed to. These are credit default risk and credit spread risk.

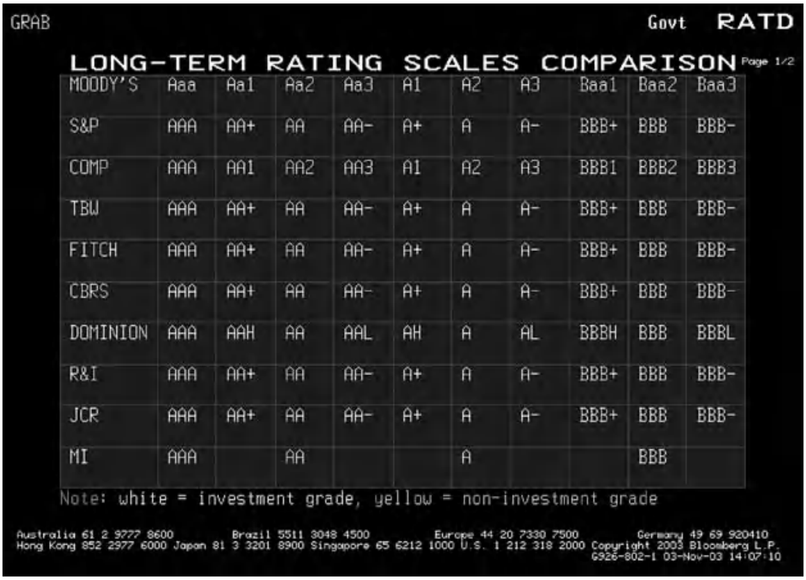
Credit Default Risk

This is the risk that an issuer of debt (obligor) is unable to meet its financial obligations. This is known as *default*. There is also the case of technical default, which is used to describe a company that has not honoured its interest payments on a loan for (typically) three months or more, but has not reached a stage of bankruptcy or administration. Where an obligor defaults, a lender generally incurs a loss equal to the amount owed by the obligor less any recovery amount that the firm recovers as a result of foreclosure, liquidation or restructuring of the defaulted obligor. This recovery amount is usually expressed as a percentage of the total amount and is known as the *recovery rate*. All portfolios with credit exposure exhibit credit default risk.

The measure of a firm's credit default risk is given by its *credit rating*. The three main credit rating agencies are Moody's, Standard & Poor's and Fitch Ratings. These institutions undertake qualitative and quantitative analysis of borrowers and formally rate the borrower after their analysis. The issues considered in the analysis include:

TABLE 1.1 Long-term bond credit ratings.

Fitch	Moody's	S&P	Summary description
Investment grade—High creditworthiness			
AAA	Aaa	AAA	Gilt-edged, prime, maximum safety, lowest risk
AA+	Aa1	AA+	
AA	Aa2	AA	High-grade, high-credit quality
AA−	Aa3	AA−	
A+	A1	A+	
A	A2	A	Upper medium grade
A−	A3	A−	
BBB+	Baa1	BBB+	
BBB	Baa2	BBB	Lower medium grade
BBB−	Baa3	BBB−	
Speculative—Lower creditworthiness			
BB+	Ba1	BB+	
BB	Ba2	BB	Low grade; speculative
BB−	Ba3	BB−	
B+	B1		
B	B2	B	Highly speculative
B−	B3		
Predominantly speculative, substantial risk or in default			
CCC+		CCC+	
CCC	Caa	CCC	Substantial risk, in poor standing
CC	Ca	CC	May be in default, very speculative
C	C	C	Extremely speculative
		CI	Income bonds – no interest being paid
DDD			
DD			Default
D		D	



GRAB Govt RATD

LONG-TERM RATING SCALES COMPARISON Page 1/2

MOODY'S	Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3
S&P	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
COMP	AAA	AA1	AA2	AA3	A1	A2	A3	BBB1	BBB2	BBB3
TBW	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
FITCH	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
CBRS	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
DOMINION	AAA	AAH	AA	AAL	AH	A	AL	BBBH	BBB	BBBL
R&I	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
JCR	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
MI	AAA		AA			A			BBB	

Note: white = investment grade, yellow = non-investment grade

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2003 Bloomberg L.P.
6926-802-1 03-Nov-03 14:07:10

FIGURE 1.3 Bloomberg screen RATD, long-term credit ratings.
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- the financial position of the firm itself, for example, its balance sheet position and anticipated cash flows and revenues;
- other firm-specific issues such as the quality of management and succession planning;
- an assessment of the firm's ability to meet scheduled interest and principal payments, both in its domestic and in foreign currencies;
- the outlook for the industry as a whole, and competition within it, together with general assessments of the domestic economy.

The range of credit ratings awarded by the three rating agencies is shown at Table 1.1. Ratings can also be seen on Bloomberg page RATD, shown at Figure 1.3. We discuss credit ratings again shortly.

Credit Spread Risk

Credit spread is the excess premium, over and above government or risk-free risk, required by the market for taking on a certain assumed credit exposure. For example, Figure 1.4 shows the credit spreads in May 2009 for US dollar corporate bonds with different credit ratings (AAA, A and BBB). The benchmark is the on-the-run or active US Treasury issue for the

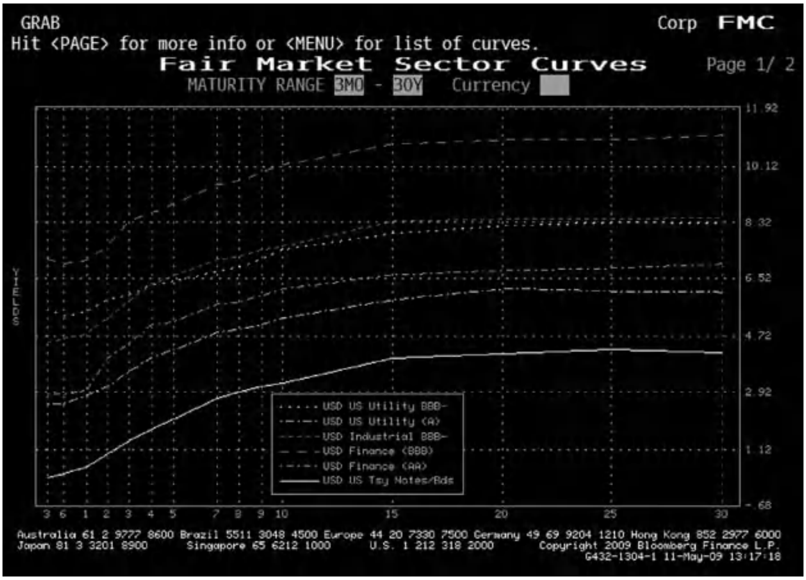

FIGURE 1.4 US dollar bond yield curves, May 2009.
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given maturity. Note that the higher the credit rating, the smaller the credit spread; note also the higher yields on financial names. Credit spread risk is the risk of financial loss resulting from changes in the level of credit spreads used in the marking-to-market of a product. It is exhibited by a portfolio for which the credit spread is traded and marked-to-market. Changes in observed credit spreads affect the value of the portfolio and can lead to losses for investors.

CREDIT RATINGS

The risks associated with holding a fixed interest debt instrument are closely connected with the ability of the issuer to maintain the regular coupon payments as well as redeem the debt on maturity. Essentially, the *credit risk* is the main risk of holding a bond. Only the highest quality government debt and a small amount of supra-national debt are considered to be entirely free of credit risk. Therefore, at any time, the yield on a bond reflects investors' views on the ability of the issuer to meet its liabilities as set out in the bond's terms and conditions. A delay in paying a cash liability as it becomes due is known as technical default and is a cause for extreme concern for investors–failure to pay will result in the matter going to court as investors seek to recover their funds. In order to determine the ability of an issuer to meet its obligations for a particular debt issue, for the entire life of the issue, judgmental analysis of the issuer's financial strength and business prospects is required. There are a number of factors that must be considered, and larger banks, fund managers and corporates carry out their own *credit analysis* of individual borrowers' bond issues. The market also makes considerable use of formal *credit ratings* that are assigned to individual bond issues by a formal credit rating agency.

A credit rating is a formal opinion given by a rating agency, of the *credit risk* for investors holding a particular issue of debt securities. Ratings are given to public issues of debt securities by any type of entity, including governments, banks and corporates. They are also given to short-term debt such as commercial paper as well as medium-term notes and long-term debt such as bonds.

The specific factors that are considered by a ratings agency, and the methodology used in conducting the analysis, differ slightly among the individual ratings agencies. Although in many cases the ratings assigned to a particular issue by different agencies are the same, they occasionally differ and in these instances investors usually seek to determine what aspect of an issuer is given more weight in an analysis by which individual agency. Note that a credit rating is not a recommendation to buy (or equally, sell) a particular bond, nor is it a comment on market expectations. Credit analysis does take into account general market and economic conditions, but the overall point of credit analysis is to consider the financial health of the issuer and its ability to meet the obligations of the specific issue being rated. Credit ratings play a large part in the decision-making of investors, and also have a significant impact on the interest rates payable by borrowers. This become an issue of contention during the 2007–08 crash.

Purpose of Credit Ratings

Investors in securities accept the risk that the issuer may default on coupon payments or fail to repay the principal in full on the maturity date. Generally, credit risk is greater for securities with a long maturity, as there is a longer period for the issuer potentially to default. For example, if company issues 10-year bonds, investors cannot be certain that the company will still exist in ten years' time. It may have failed and gone into liquidation some time before that. That said, there is also risk attached to short-dated debt securities; indeed, there have been instances of default by issuers of commercial paper, which is a very short-term instrument.

The prospectus or offer document for an issue provides investors with some information about the issuer so that some credit analysis can be performed on the issuer before the bonds are placed on the market. The information in the offer document enables investors to perform their own credit analysis by studying this information before deciding whether or not to invest in the bonds. Credit assessments take up time, however, and also require the specialist skills of credit analysts. Large institutional investors employ specialists to carry out credit analysis; however, often it is too costly and time-consuming to assess every issuer in every debt market. Therefore investors commonly employ two other methods when making a decision on the credit risk of debt securities:

- name recognition;
- formal credit ratings.

Name recognition is when the investor relies on the good name and reputation of the issuer and accepts that the issuer is of such good financial standing, or sufficient financial standing, that a default on interest and principal payments is unlikely. An investor may feel this way about companies such as Microsoft or British Petroleum. However, the collapse of Barings Bank in 1995 suggested to many investors that it may not be wise to rely on name recognition alone in today's marketplace. The tradition and reputation behind the Barings name allowed the bank to borrow at sub-LIBOR interest rates in the money markets, which put it on a par with highest quality clearing banks in terms of credit rating. The Barings case illustrated that name recognition needs to be augmented by other methods to reduce the risk of loss due to unforeseen events. Credit ratings are increasingly used to make investment decisions about corporate or lesser developed government debt.

FORMAL CREDIT RATINGS

On receipt of a formal request, the credit rating agencies carry out a rating exercise on a specific issue of debt capital. The request for a rating comes from the organisation planning the issue of bonds. Although ratings are provided for the benefit of investors, the issuer must bear the cost. However, it is in the issuer's interest to request a rating as it raises the profile of the bonds, and investors may refuse to buy paper that is not accompanied with a recognised rating. Although the rating exercise involves a credit analysis of the issuer, the rating is applied to a specific debt issue. This means that, in theory, the credit rating is applied not to an organisation itself, but to specific debt securities that the organisation has issued or is planning to issue. In practice, it is common for the market to refer to the creditworthiness of organisations in terms of the rating of their debt. A highly rated company such as Rabobank is therefore referred to as a 'triple-A rated' company, although it is the bank's debt issues that are rated as triple-A.

The rating for an issue is kept under review and if the credit quality of the issuer declines or improves, the rating will be changed accordingly. An agency may announce in advance that it is reviewing a particular credit rating, and may go further and state that the review is a precursor to a possible downgrade or upgrade. This announcement is referred to as putting the issue under *credit watch*. The outcome of a credit watch is, in most cases, likely to be a rating downgrade; however, the review may reaffirm the current rating or possibly upgrade it. During the credit watch phase the agency will advise investors to use the current rating with caution. When an agency announces that an issue is under credit watch, the price of the bonds will fall in the market as investors look to sell out of their holdings. This upward movement in yield will be more pronounced if an actual downgrade results. For example, in October 2008 the government of Ireland was placed under credit watch (and subsequently lost its AAA credit rating); as a result, there was an immediate and sharp sell-off in Irish government Eurobonds, before the rating agencies had announced the actual results of their credit review.

RATINGS CHANGES OVER TIME

Ratings Transition Matrix

We have noted that the rating agencies constantly review the credit quality of firms they have rated. As may be expected, the credit rating of many companies will fluctuate over time as they experience changes in their corporate wellbeing. As a guide to the change in credit rating that might be expected over a 1-year period, Moody's and S&P publish historical transition matrices, which provide average rating transition probabilities for each class of rating. An example is shown at Table 1.2, which is Moody's 1-year ratings transition matrix for 2002. These results are obtained from a sample of a large number of firms over many years. In Table 1.2, the first column shows the initial rating and the first row the final rating. For instance, the probability of an A-rated company being downgraded to Baa in one year is 4.63%. The probability of the A-rated company defaulting in this year is 0.00%.

There are some inconsistencies in the ratings transition table and this is explained by Moody's as resulting from scarcity of data for some ratings categories. For instance, an Aa-rated company has a 0.02% probability of

TABLE 1.2 Moody's one-year rating transition matrix, 2002.

	Aaa	Aa	A	Baa	Ba	B	Caa	Default
Aaa	93.40%	5.94%	0.64%	0.00%	0.02%	0.00%	0.00%	0.00%
Aa	1.61%	90.55%	7.46%	0.26%	0.09%	0.01%	0.00%	0.02%
A	0.07%	2.28%	92.44%	4.63%	0.45%	0.12%	0.01%	0.00%
Baa	0.05%	0.26%	5.51%	88.48%	4.76%	0.71%	0.08%	0.15%
Ba	0.02%	0.05%	0.42%	5.16%	86.91%	5.91%	0.24%	1.29%
B	0.00%	0.04%	0.13%	0.54%	6.35%	84.22%	1.91%	6.81%
Caa	0.00%	0.00%	0.00%	0.62%	2.05%	4.08%	69.20%	24.06%

being in default at year-end, which is higher than the supposedly lower rated A-rated company. Such results must be treated with caution. The conclusion from Table 1.2 is that the most likely outcome at year-end is that the company rating remains the same. It may be that a 1-year time horizon provides little real value; hence, the rating agencies also publish transition matrices for longer periods, such as five and ten years.

We might expect an increased level of default as we move lower down the credit ratings scale. This is borne out in Figure 1.5, which is a reproduction of data published by Moody's. It shows 1-year average cumulative default rates by credit rating category, for the period 1985–2000. We see that the average 1-year default rate rises from zero for the highest rated Aaa, to 15.7% for the B3 rating category. However, investors generally attach little value to 1-year results. Figure 1.6 shows average cumulative default rates for 5- and 10-year time horizons, for the same period covered in Figure 1.5. This repeats the results shown in Figure 1.5, with higher default rates associated with lower credit ratings.

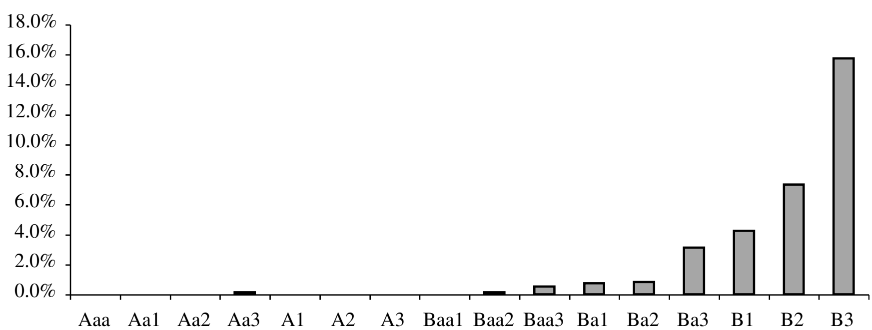

FIGURE 1.5 One-year cumulative default rates, 1985–2000.
Source: Moody's. Reproduced with permission.

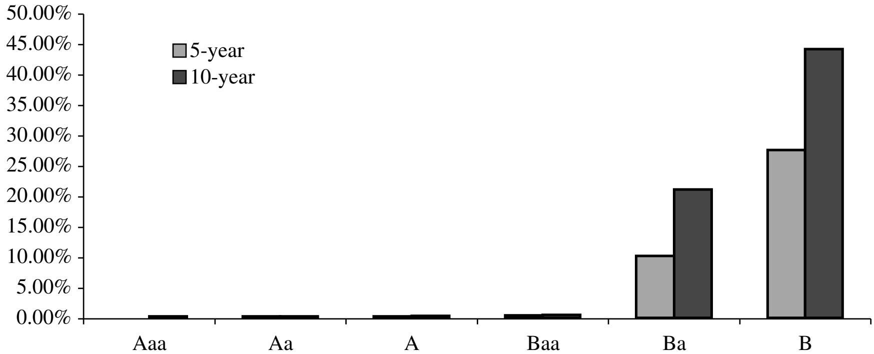

FIGURE 1.6 Five- and 10-year average cumulative default rates, 1985–2000.
Source: Moody's. Reproduced with permission.

Structured Finance Rating Transitions

In March 2009 Moody's published a *Special Comment* on ratings transitions for structured finance securities for the period 1983–2008, which covered the impact of the 2007–08 financial crisis.[1] The extent of the impact was evident from the statistics observed; for example the 12-month rate for downgrades in the global structured finance market reached an historical high of 35.5% in 2008, from a figure of 7.4% in 2007, while the upgrade rate reduced from 2.2% to 0.7%.[2] The primary driver of these results was the poor performance of the most recent structured finance deals, which had sourced the most recent (and poor quality) US sub-prime mortgage assets.

Figure 1.7 shows the global structured finance and global corporate finance 12-month rating transition matrices for the year 2008 and also for the period 1984–2008. Although structured finance assets performed worse than straight corporate bonds during 2008, it is noteworthy that over the longer term the former outperformed the latter.

Further illustration of the impact of the crisis on the structured finance market is given at Table 1.3, which is a summary of rating transition trends. Again, over the longer term structured finance assets have outperformed corporate assets, as shown in the table.

---

[1] This report is entitled *Structured Finance Rating Transitions: 1983–2008* and is dated March 2009. It is the seventh such annual report from Moody's. It may be obtained from www.moodys.com. Structured finance securities include asset-backed and mortgage-backed securities (ABS and MBS) as well as collateralised debt obligations (CDO), which are introduced in Chapter 12.

[2] Source: Moody's Investors Service.

	Structured Finance in 2008						
	Aaa	Aa	A	Baa	Ba	B	Caa and below
Aaa	73.89%	7.23%	6.31%	5.32%	2.84%	1.74%	2.66%
Aa	1.00%	55.51%	7.29%	5.68%	4.83%	7.98%	17.71%
A	0.27%	0.92%	58.86%	7.72%	4.78%	6.39%	21.07%
Baa	0.10%	0.05%	0.82%	55.42%	5.47%	6.26%	31.88%
Ba	0.05%	0.02%	0.05%	0.67%	54.67%	3.81%	40.74%
B				0.09%	0.21%	45.65%	54.04%
Caa and below						0.13%	99.87%

	Structured Finance: 1984-2008 average over 12-month horizon						
	Aaa	Aa	A	Baa	Ba	B	Caa and below
Aaa	97.79%	0.76%	0.53%	0.37%	0.19%	0.14%	0.21%
Aa	5.27%	87.19%	2.14%	1.12%	0.80%	1.72%	1.77%
A	1.10%	3.26%	85.61%	3.28%	1.39%	2.02%	3.34%
Baa	0.37%	0.47%	2.46%	83.17%	3.46%	2.92%	7.14%
Ba	0.15%	0.07%	0.45%	2.46%	82.33%	3.56%	10.98%
B	0.07%	0.04%	0.08%	0.34%	1.95%	83.63%	13.89%
Caa and below	0.03%			0.07%	0.08%	0.51%	99.30%

	Corporate Finance in 2008						
	Aaa	Aa	A	Baa	Ba	B	Caa and below
Aaa	95.85%	4.15%					
Aa	4.43%	91.25%	4.12%	0.10%		0.10%	
A		10.02%	87.10%	2.69%	0.06%		0.13%
Baa		0.18%	7.30%	88.63%	3.60%	0.28%	
Ba			0.18%	8.06%	83.70%	7.33%	0.73%
B	0.10%			0.19%	6.67%	83.60%	9.44%
Caa and below						15.12%	84.88%

	Corporate Finance: 1984-2008 average over 12-month horizon						
	Aaa	Aa	A	Baa	Ba	B	Caa and below
Aaa	92.76%	6.97%	0.26%		0.02%		
Aa	1.26%	91.45%	6.95%	0.27%	0.05%	0.02%	0.01%
A	0.07%	3.01%	90.91%	5.30%	0.55%	0.11%	0.04%
Baa	0.05%	0.21%	5.37%	88.33%	4.53%	1.00%	0.51%
Ba	0.01%	0.06%	0.43%	6.48%	81.47%	9.56%	2.00%
B	0.01%	0.05%	0.18%	0.40%	6.16%	81.72%	11.47%
Caa and below		0.03%	0.04%	0.19%	0.67%	11.44%	87.63%

FIGURE 1.7 Global structured finance and global corporate finance 12-month rating transition matrices.
Source: Moody's Investors Service. Reproduced with permission.

TABLE 1.3 Summary of rating transition trends, 1983–2008.

	Structured finance		Corporate finance	
	2008	1984-2008	2008	1984-2008
Downgrade rate	35.50%	6.25%	18.22%	13.47%
Upgrade rate	0.69%	2.24%	4.64%	9.86%
Average number of notches downgraded	8.30	6.99	1.64	1.78
Average number of notches upgraded	2.12	2.37	1.34	1.49

Source: Moody's Investors Service. Reproduced with permission.

It is apparent that straight corporate credit ratings are actually much less stable than ratings on structured finance securities, but that when rating changes do take place, the scale of the change is, on average, lower for the corporate ratings. In other words, the statistics appear to confirm that the higher return (on average) of structured finance securities compared to corporate bonds of the same rating reflects their higher risk, which manifests itself during extreme bear market situations.

Corporate Recovery Rates

When a corporate obligor experiences bankruptcy or enters into liquidation or administration, it defaults on its loans. However, this does not mean that all the firm's creditors will lose everything. At the end of the administration process, the firm's creditors will typically receive a portion of their outstanding loans, a *recovery* amount.[3] The percentage of the original loan that is received back is known as the *recovery rate*, which is defined as the percentage of par value that is returned to the creditor.

The seniority of a loan strongly influences the level of the recovery rate. Table 1.4 shows recovery rates for varying levels of loan seniority in 2002 as published by Moody's. The standard deviation for each recovery rate reported is high, which illustrates the dispersion around the mean and reflects widely varying recovery rates even within the same level of seniority. It is clear that the more senior a loan or a bond is, the higher the recovery rate it will have in the event of default.

Recovery rate is a key parameter used to price credit derivatives (see Chapter 6). During the 2007–2009 global recession recovery rates were lower for many industrial sectors and this impacted the settlement value of

[3] This recovery may be received in the form of other assets, such as securities or physical plant, instead of cash.

TABLE 1.4 Moody's recovery rates for varying levels of loan seniority, 2002.

Recovery rates according to loan seniority		
Seniority	*Mean*	*Standard deviation*
Senior secured bank loans	60.70%	26.31%
Senior secured	55.83%	25.41%
Senior unsecured	52.13%	25.12%
Senior subordinated	39.45%	24.79%
Subordinated	33.81%	21.25%
Junior subordinated	18.51%	11.26%
Preference shares	8.26%	10.45%

many CDS contracts. A PowerPoint slide pack in this book's CD-R discusses recovery rate as a factor in CDS evaluation.

Credit risk is measured using the value-at-risk (VaR) technique. This was first introduced as a market risk measurement tool, and subsequently applied to credit risk. Therefore in the next section we introduce the basics of the VaR methodology, which we require for an understanding of Credit VaR.

VALUE-AT-RISK (VaR)

The introduction of VaR as an accepted methodology for quantifying market risk is part of the evolution of risk management. The application of VaR has been extended from its initial use in securities houses to commercial banks and corporates, following its introduction in October 1994 when J.P. Morgan launched *RiskMetrics*™ free over the Internet.

VaR is a measure of the worst expected loss that a firm may suffer over a period of time that has been specified by the user, under normal market conditions and a specified level of confidence. This measure may be obtained in a number of ways, using a statistical model or by computer simulation. It is defined as follows:

VaR is a measure of market risk. It is the maximum loss that can occur with X% confidence over a holding period of n *days.*

Hence VaR is the expected loss of a portfolio over a specified time period for a set level of probability. For example, if a daily VaR is stated as £100,000 to a 95% level of confidence, this means that during the day there is a only a 5% chance that the loss the next day will be *greater* than £100,000. VaR measures the potential loss in market value of a portfolio using estimated volatility and correlation. The 'correlation' referred to is the correlation that exists between the market prices of different instruments in a bank's portfolio. VaR is calculated within a given confidence interval, typically 95% or 99%. It seeks to measure the possible losses from a position or portfolio under 'normal' circumstances. The definition of normality is critical and is essentially a statistical concept that varies by firm and by risk management system. Put simply, however, the most commonly used VaR models assume that the prices of assets in the financial markets follow a normal distribution. To implement VaR, all of a firm's positions data must be gathered into one centralised database. Once this is complete, the overall risk has to be calculated by aggregating the risks from individual instruments across the entire portfolio. The potential move in each instrument (that is, each risk factor) has to be inferred from past daily price movements over a given observation period. For regulatory purposes this period is at least one year. Hence the data on which VaR estimates are based should capture all relevant daily market moves over the previous year.

The main assumption underpinning VaR—and which in turn were shown to be its major weakness—is that the distribution of future price and rate changes will follow past variations. Therefore the potential portfolio loss calculations for VaR are worked out using distributions from historic price data in the observation period.

VaR is therefore a measure of a bank's risk exposure—it is a tool for measuring market risk exposure. There is no one VaR number for a single portfolio, because different methodologies used for calculating VaR produce different results. The VaR number captures only those risks that can be measured in quantitative terms, it does not capture risk exposures such as operational risk, liquidity risk, regulatory risk or sovereign risk.

Assumption of Normality

A distribution is described as *normal* if there is a high probability that any observation from the population sample will have a value that is close to the mean, and a low probability of having a value that is far from the mean. The normal distribution curve is used by many VaR models, which assume that asset returns follow a normal pattern. A VaR model uses the normal curve to estimate the losses that an institution may suffer over a given time period. Normal distribution tables show the probability of a particular observation moving a certain distance from the mean.

If we look along a normal distribution table, we see that at 21.645 standard deviations, the probability is 5%. This means that there is a 5%

probability that an observation will be at least 1.645 standard deviations below the mean. This level is used in many VaR models.

Calculation Methods

There are three common methods for calculating VaR. They are:

- the variance–covariance (or *correlation* or *parametric* method);
- historical simulation;
- Monte Carlo simulation.

Variance–Covariance Method

This method assumes the returns on risk factors are normally distributed, the correlations between risk factors are constant and the delta (or price sensitivity to changes in a risk factor) of each portfolio constituent is constant. Using the correlation method, the volatility of each risk factor is extracted from the historical observation period. Historical data on investment returns are therefore required. The potential effect of each component of the portfolio on the overall portfolio value is then worked out from the component's delta (with respect to a particular risk factor) and that risk factor's volatility.

There are different methods of calculating the relevant risk factor volatilities and correlations. Two alternatives are:

- simple *historic volatility:* this is the most straightforward method, but the effects of a large one-off market move can significantly distort volatilities over the required forecasting period. For example, if using 30-day historic volatility, a market shock will stay in the volatility figure for 30 days until it drops out of the sample range and correspondingly causes a sharp drop in (historic) volatility 30 days *after* the event. This is because each past observation is equally weighted in the volatility calculation;
- to weight past observations unequally: this is done to give more weight to recent observations so that large jumps in volatility are not caused by events that occurred some time ago. One method is to use exponentially weighted moving averages.

Historical Simulation Method

The historical simulation method for calculating VaR is the simplest method and avoids some of the pitfalls of the correlation method. Specifically, the three main assumptions behind correlation (normally distributed returns, constant correlations, constant deltas) are not needed in this case. For historical simulation, the model calculates potential losses using actual historical returns in the risk factors and so captures the non-normal distribution of risk factor returns. This means rare events and crashes can be included in the results. As the risk factor returns used for revaluing the portfolio are actual past movements, the correlations in the calculation are also actual past correlations. They capture the dynamic nature of correlation as well as scenarios when the usual correlation relationships break down.

Monte Carlo Simulation Method

The third method, Monte Carlo simulation is more flexible than the previous two. As with historical simulation, Monte Carlo simulation allows the risk manager to use actual historical distributions for risk factor returns rather than having to assume normal returns. A large number of randomly generated simulations are run forward in time using volatility and correlation estimates chosen by the risk manager. Each simulation will be different, but in total the simulations will aggregate to the chosen statistical parameters (that is, historical distributions and volatility and correlation estimates). This method is more realistic than the previous two models and therefore is more likely to estimate VaR more accurately. However, its implementation requires powerful computers and there is also a trade-off in that the time required to perform calculations is longer.

The level of confidence in the VaR estimation process is selected by the number of standard deviations of variance applied to the probability distribution. A standard deviation selection of 1.645 provides a 95% confidence level (in a 1-tailed test) that the potential estimated price movement will not be more than a given amount based on the correlation of market factors to the position's price sensitivity.

EXPLAINING VALUE-AT-RISK

Correlation

Measures of correlation between variables are important to fund managers who are interested in reducing their risk exposure through diversifying their portfolio. Correlation is a measure of the degree to which a value of one variable is related to the value of another. The correlation coefficient is a single number that compares the strengths and directions of the movements in two instruments' values. The sign of the coefficient determines the relative directions that the instruments move in, while its value determines the strength of the relative movements. The value of the coefficient ranges from 21 to 11, depending on the nature of the relationship. So if, for example, the value of the correlation is 0.5, this means that one instrument moves in the same direction by half of the amount that the other instrument moves. A value of zero means that the instruments are uncorrelated, and their movements are independent of each other.

Correlation is a key element of many VaR models, including parametric models. It is particularly important in the measurement of the variance (hence, volatility) of a portfolio. If we take the simplest example, a portfolio containing just two assets, (1.1) below gives the volatility of the portfolio based on the volatility of each instrument in the portfolio (x and y) and their correlation with one another.

$$V_{port} = \sqrt{x^2 + y^2 + 2xy \cdot \rho(xy)} \tag{1.1}$$

where

x is the volatility of asset x
y is the volatility of asset y
ρ is the correlation between assets x and y.

The correlation coefficient between two assets uses the covariance between the assets in its calculation. The standard formula for covariance is shown at (1.2):

$$\text{Cov} = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{(n-1)} \tag{1.2}$$

where the sum of the distance of each value x and y from the mean is divided by the number of observations minus one. The covariance calculation enables us to calculate the correlation coefficient, shown as (1.3):

$$r = \text{Cov}\frac{(1,2)}{\sigma_1\sigma_2} \tag{1.3}$$

where σ is the standard deviation of each asset.

Equation (1.1) may be modified to cover more than two instruments. In practice, correlations are usually estimated on the basis of past historical observations. This is an important consideration in the construction and analysis of a portfolio, as the associated risks depend to an extent on the correlation between its constituents.

From a portfolio perspective, a positive correlation increases risk. If the returns on two or more instruments in a portfolio are positively correlated, strong movements in either direction are likely to occur at the same time. The overall distribution of returns is wider and flatter, as there are higher joint probabilities associated with extreme values (both gains and losses). A negative correlation indicates that the assets are likely to move in opposite directions, thus reducing risk.

It has been argued that in extreme situations, such as market crashes or large-scale market corrections, correlations cease to have any relevance, because all assets are moving in the same direction. However, most market scenarios using correlations to reduce the risk of a portfolio is considered satisfactory practice, and the VaR number for a diversified portfolio is lower than that for an undiversified portfolio.

Simple VaR Calculation

To calculate the VaR for a single asset, we calculate the standard deviation of its returns, using either its historical volatility or implied volatility. If a 95% confidence level is required, meaning we wish to have 5% of the observations in the left-hand tail of the normal distribution, this means that the observations in that area are 1.645 standard deviations away from the mean. Let us consider the following statistical data for a government bond, calculated using one year's historical observations:

Nominal:	£10 million
Price:	£100
Average return:	7.35%
Standard deviation:	1.99%

The VaR at the 95% confidence level is 1.645 × 3 × 0.0199 or 0.032736. The portfolio has a market value of £10 million, so the VaR of the portfolio is 0.032736 × 3 × 10,000,000 or £327,360. Therefore this figure is the maximum loss that the portfolio may sustain over one year for 95% of the time.

We may extend this analysis to a 2-asset portfolio. In a 2-asset portfolio, we stated at (1.1) that there is a relationship that enables us to calculate the volatility of a 2-asset portfolio. This expression is used to calculate the VaR, and is shown at (1.4):

$$Var_{port} = \sqrt{w_1^2 s_1^2 + w_2^2 s_2^2 + 2w_1 w_2 \sigma_1 \sigma_2 r_{1,2}} \tag{1.4}$$

where

w_1 is the weighting of the first asset
w_2 is the weighting of the second asset
σ_1 is the standard deviation or volatility of the first asset
σ_2 is the standard deviation or volatility of the second asset
$r_{1,2}$ is the correlation coefficient between the two assets.

In a 2-asset portfolio, the undiversified VaR is the weighted average of the individual standard deviations. The diversified VaR, which takes into account the correlation between the assets, is the square root of the variance of the portfolio. In practice, banks calculate both diversified and undiversified VaR. The diversified VaR measure is used to set trading limits, while the larger undiversified VaR measure is used to gauge an idea of the bank's risk exposure in the event of a significant correction or market crash. This is because in a crash situation, liquidity dries up as market participants all attempt to sell off their assets. This means that the correlation relationship between assets ceases to have any impact on a book, as all assets move in the same direction. Under this scenario, it is more effective to use an undiversified VaR measure.

Although the description given here is very simple, nevertheless it explains the nature of the VaR measure. VaR is essentially the calculation of the standard deviation of a portfolio, which is used as an indicator of the volatility of that portfolio. A portfolio exhibiting high volatility has a high VaR number. An observer may then conclude that the portfolio has a high probability of making losses. Risk managers and traders may use the VaR measure to help them to allocate capital to more efficient sectors of the bank, as the return on capital can now be measured in terms of return on risk capital. Regulators may use the VaR number as a guide to the capital adequacy levels that they believe the bank requires.

VARIANCE–COVARIANCE VALUE-AT-RISK

Calculation of variance–covariance VaR

In the previous section, we illustrated how VaR can be calculated for a 2-asset portfolio. Here we illustrate how this is done using matrices.

Let us consider the following hypothetical portfolio, invested in two assets, as shown in Table 1.5. The standard deviation of each asset has been calculated on historical observation of asset returns. Note that *returns* are returns of asset prices, rather than the prices themselves. They are calculated from the actual prices by taking the ratio of closing prices. The returns

TABLE 1.5 Two-asset portfolio.

Assets	Bond 1	Bond 2	
Standard deviation	11.83%	17.65%	
Portfolio weighting	60%	40%	
Correlation coefficient			0.647
Portfolio value			£10,000,000
Variance			0.016506998
Standard deviation			12.848%
95% c.i. standard deviations			1.644853
Value-at-Risk			0.211349136
Value-at-Risk£			£2,113,491

are then calculated as the logarithm of the price relativities. The mean and standard deviation of the returns are then calculated using standard statistical formulae. This then gives the standard deviation of daily price relativities, which is converted to an annual figure by multiplying it by the square root of the number of days in a year, usually taken to be 250.

The standard equation (shown as (1.4)) is used to calculate the variance of the portfolio, using the individual asset standard deviations and the asset weightings. The VaR of the book is the square root of the variance. Multiplying this figure by the current value of the portfolio gives us the portfolio VaR, which is £2,113,491.

The *RiskMetrics*™ VaR methodology uses matrices to obtain the same results that we have shown here. This is because once a portfolio starts to contain multiple assets, the method we described above becomes inappropriate. Matrices allow us to calculate VaR for a portfolio containing many hundreds of assets, which would require assessment of the volatility of each asset and correlations of each asset to all the others in the portfolio. We can demonstrate how the parametric methodology uses variance and correlation matrices to calculate the variance, and hence standard deviation, of a portfolio. The matrices are shown in Choudhry (1999).

The advantages of the variance–covariance methodology are that:

- it is simple to apply, and straightforward to explain;
- datasets for its use are immediately available.

The drawbacks of the approach are that it assumes stable correlations and measures only linear risk, it also places excessive reliance on the normal distribution, and returns in the market are widely believed to have 'fatter tails' than a true to normal distribution. This phenomenon is known as *leptokurtosis*; that is, the non-normal distribution of outcomes. Another disadvantage is that the process requires *mapping*. To construct a weighting portfolio for the *RiskMetrics*™ tool, cash flows from financial instruments are mapped into precise maturity points, known as grid points. However, in most cases assets do not fit into neat grid points, and complex instruments cannot be broken down accurately into cash flows. The mapping process makes assumptions that frequently do not hold in practice.

Nevertheless the variance–covariance method is still popular in the market, and is frequently the first VaR method installed at a bank.

Historical VaR Methodology

The historical approach to VaR is a relatively simple calculation, and it is also easy to implement and explain. To implement it, a bank requires a database record of its past profit/loss figures for the total portfolio. The required confidence interval is then applied to this record, to obtain a cut-off of the worst-case scenario. For example, to calculate the VaR at a 95% confidence level, the 5th percentile value for the historical data is taken, and this is the VaR number. For a 99% confidence level measure, the 1% percentile is taken. The advantage of the historical method is that it uses the actual market data that a bank has recorded (unlike *RiskMetrics*™, for example, for which the volatility and correlations are not actual values, but estimated values calculated from average figures over a period of time, usually the last five years), and so produces a reasonably accurate figure. Its main weakness is that as it is reliant on actual historical data built up over a period of time—generally, at least one year's data is required to make the calculation meaningful. Therefore it is not suitable for portfolios with asset weightings that frequently change, as another set of data is necessary before a VaR number can be calculated.

In order to overcome this drawback, banks use a method known as *historical simulation*. This calculates VaR for the current portfolio weighting, using the historical data for the securities in the current portfolio. To calculate historical simulation VaR for our hypothetical portfolio considered earlier, comprising 60% of bond 1 and 40% of bond 2, we require the closing prices for both assets over the specified previous period (usually three or five years); we then calculate the value of the portfolio for each day in the period assuming constant weightings.

Simulation Methodology

The most complex calculations use computer simulations to estimate VaR. The most common is the Monte Carlo method. To calculate VaR using a Monte Carlo approach, a computer simulation is run in order to generate a number of random scenarios, which are then used to estimate the portfolio

VaR. The method is probably the most realistic, if we accept that market returns follow a similar 'random walk' pattern. However, Monte Carlo simulation is best suited to trading books containing large option portfolios, where price behaviour is not captured very well with the *RiskMetrics*™ methodology. The main disadvantage of the simulation methodology is that it is time-consuming and uses a substantial amount of computer resources.

A Monte Carlo simulation generates simulated future prices, and it may be used to value an option as well as for VaR applications. When used for valuation, a range of possible asset prices are generated and these are used to assess what intrinsic value the option will have at those asset prices. The present value of the option is then calculated from these possible intrinsic values. Generating simulated prices, although designed to mimic a 'random walk', cannot be completely random because asset prices, although not a pure normal distribution, are not completely random either. The simulation model is usually set to generate very few extreme prices. Strictly speaking, it is asset price *returns* that follow a normal distribution, or rather a *lognormal* distribution. Monte Carlo simulation may also be used to simulate other scenarios; for example, the effect on option 'greeks' for a given change in volatility, or any other parameters. The scenario concept may be applied to calculating VaR as well. For example, if 50,000 simulations of an option price are generated, the 95th lowest value in the simulation will be the VaR at the 95% confidence level. The correlation between assets is accounted for by altering the random selection programme to reflect relationships.

CREDIT VALUE-AT-RISK

Credit risk VaR methodologies take a portfolio approach to credit risk analysis. This means that:

- credit risks of each obligor across the portfolio are re-stated on an equivalent basis and aggregated in order to be treated consistently, regardless of the underlying asset class;
- correlations of credit quality movements across obligors are taken into account.

This allows portfolio effects—that is, the benefits of diversification and risks of concentration—to be quantified.

The portfolio risk of an exposure is determined by four factors:

- size of the exposure;
- maturity of the exposure;

- probability of default of the obligor;
- systemic or concentration risk of the obligor.

Credit VaR, like market risk VaR, considers (credit) risk in a mark-to-market framework. It arises from changes in value due to credit events; that is, changes in obligor credit quality including defaults, upgrades and downgrades.

Nevertheless, credit risk is different in nature to market risk. Typically, market return distributions are assumed to be relatively symmetrical and approximated by normal distributions. In credit portfolios, value changes are relatively small as a result of minor up/downgrades, but can be substantial upon default. This remote probability of large losses produces skewed distributions with heavy downside tails that differ from the more normally distributed returns assumed for market VaR models. This is shown in Figure 1.8.

This difference in risk profiles does not prevent us from assessing risk on a comparable basis. Analytical method market VaR models consider a time horizon and estimate VaR across a distribution of estimated market outcomes. Credit VaR models similarly look to a horizon and construct a distribution of value given different estimated credit outcomes.

When modelling credit risk the two main measures of risk are:

- distribution of loss: obtaining distributions of loss that may arise from the current portfolio. This considers the question of what the expected loss is for a given confidence level;

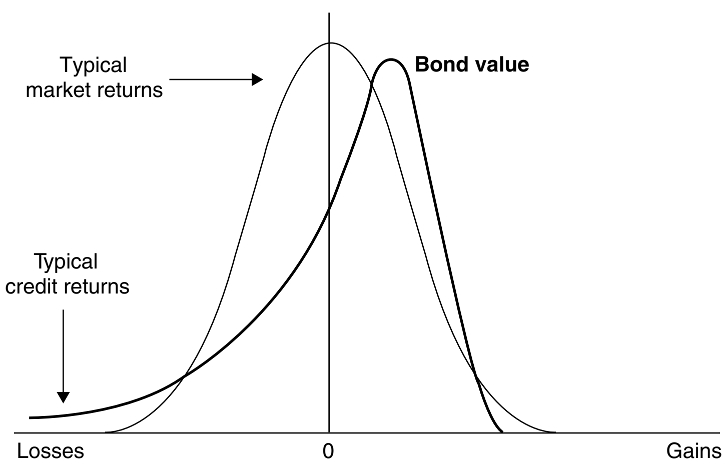

FIGURE 1.8 Comparison of distribution of market returns and credit returns.

- identifying extreme or catastrophic outcomes: this is addressed through the use of scenario analysis and concentration limits.

To simplify modelling, no assumptions are made about the causes of default. Mathematical techniques used in the insurance industry are used to model the event of an obligor default.

Time Horizon

The choice of time horizon will not be shorter than the timeframe over which risk-mitigating actions can be taken. Essentially there are two alternatives:

- a constant time horizon such as one year;
- a hold-to-maturity time horizon.

The constant time horizon is similar to the *CreditMetrics* approach and also to that used for market risk measures. It is more suitable for trading desks. The hold-to-maturity approach is used by institutions such as insurance companies and fund managers.

Data Inputs

Modelling credit risk requires certain data inputs; these include the following:

- credit exposures;
- obligor default rates;
- obligor default rate volatilities;
- recovery rates.

These data requirements present some difficulties. There is a lack of comprehensive default and correlation data and assumptions need to be made at certain times. The most accessible data are compiled by the credit ratings agencies such as Moody's and Standard & Poor's.

We now consider one methodology used for measuring credit VaR, the *CreditMetrics*™ model.

CREDITMETRICS™

CreditMetrics™ was J.P. Morgan's portfolio model for analysing credit risk, providing an estimate of VaR due to credit events caused by upgrades,

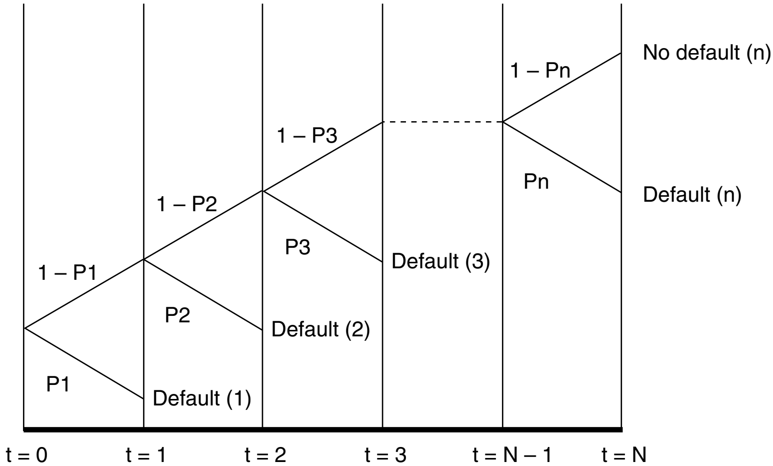

FIGURE 1.9 A binomial model of credit risk.
Source: J.P. Morgan; *RiskMetrics*™ technical document, 1997. Used with permission.

downgrades and default. A software package known as *CreditManager* is available that allows users to implement the *CreditMetrics*™ methodology.[4]

Methodology

There are two main frameworks in use for quantifying credit risk. One approach considers only two scenarios—default and no default. This model constructs a binomial tree of default versus no default outcomes until maturity. This approach is shown in Figure 1.9.

The other approach, sometimes called the RAROC (risk adjusted return on capital) approach holds that risk is the observed volatility of corporate bond values within each credit rating category, maturity band and industry grouping. The idea is to track a benchmark corporate bond (or index) that has observable pricing. The resulting estimate of volatility of value is then used as a proxy for the volatility of the exposure (or portfolio) under analysis.

The *CreditMetrics*™ methodology sits between these two approaches. The model estimates portfolio VaR at the risk horizon due to credit events that include upgrades and downgrades, rather than just defaults. Thus it adopts a mark-to-market framework. As shown in Figure 1.10, bonds within each credit rating category have volatility of value due to day-to-day

[4] The department in J.P. Morgan that developed *CreditMetrics*™ was transformed into a separate corporate entity, known as *RiskMetrics*™, during 1998.

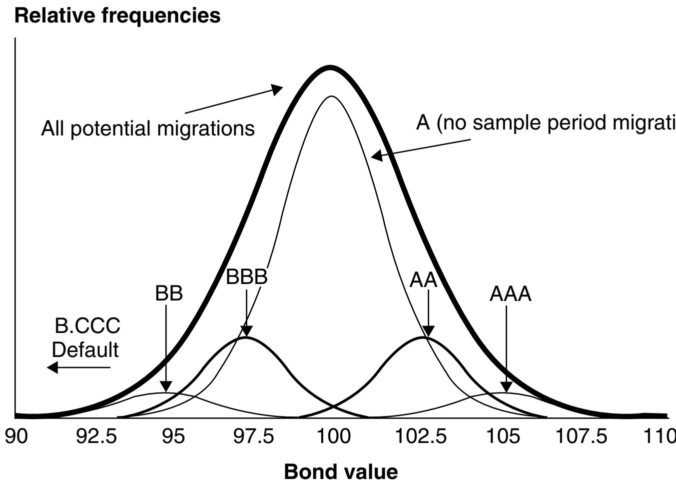

FIGURE 1.10 Distribution of credit returns by rating.
Source: J.P. Morgan; *RiskMetrics*™ technical document, 1997. Used with permission.

credit spread fluctuations. The exhibit shows the loss distributions for bonds of varying credit quality. *CreditMetrics*™ assumes that all credit migrations have been realised, weighting each by a migration likelihood.

Time Horizon

CreditMetrics™ adopts a 1-year risk horizon. The justification given in its technical document[5] is that this is because much academic and credit agency data are stated on an annual basis. This is a convenient convention similar to the use of annualised interest rates in the money markets. The risk horizon is adequate as long as it is not shorter than the time required to perform risk-mitigating actions. Users must therefore adopt their risk management and risk adjustments procedures with this in mind.

The steps involved in *CreditMetrics*™ measurement methodology are shown in Figure 1.11, described by J.P. Morgan as its analytical 'roadmap'.

The elements in each step are:

Exposures User portfolio
Market volatilities
Exposure distributions

[5] J.P. Morgan, Introduction to *CreditMetrics*™, J.P. Morgan & Co., 1997.

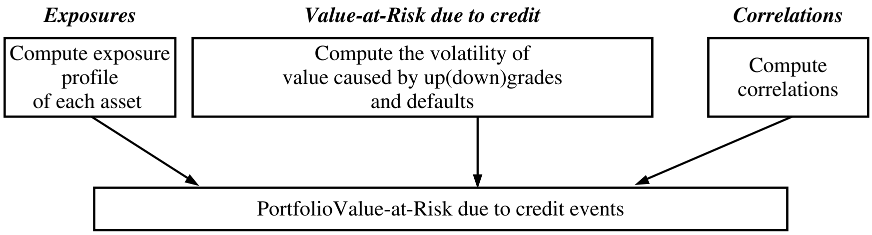

FIGURE 1.11 Analytics road map for *CreditMetrics*™.
Source: J.P. Morgan; *RiskMetrics*™ technical document, 1997. Used with permission.

VaR Due to Credit Events Credit rating
Credit spreads
Rating change likelihood
Recovery rate in default
Present value bond revaluation
Standard deviation of value due to credit quality changes

Correlations Ratings series
Models (for example, correlations)
Joint credit rating changes

Calculating the Credit VaR

CreditMetrics™ methodology assesses individual and portfolio credit VaR in three steps:

Step 1: it establishes the exposure profile of each obligor in a portfolio.

Step 2: it computes the volatility in value of each instrument caused by possible upgrade, downgrade and default.

Step 3: taking into account correlations between each of these events, it combines the volatility of the individual instruments to give an aggregate portfolio risk.

Step 1 Exposure Profiles *CreditMetrics*™ incorporates the exposure of instruments such as bonds (fixed or floating-rate) as well as other loan commitments and off-balance sheet instruments such as swaps. The exposure is stated on an equivalent basis for all products. Products covered include:

- receivables (or trade credit);
- bonds and loans;
- loan commitments;
- letters of credit;
- market-driven instruments.

Step 2 Volatility of Each Exposure from Up/Downgrades and Defaults The levels of likelihood are attributed to each possible credit event of upgrade, downgrade and default. The probability that an obligor will change over a given time horizon to another credit rating is calculated. Each change (migration) results in an estimated change in value (derived from credit spread data and in default, recovery rates). Each value outcome is weighted by its likelihood to create a distribution of value across each credit state, from which each asset's expected value and volatility (standard deviation) of value are calculated.

There are three steps to calculating the volatility of value in a credit exposure:

- the senior unsecured credit rating of the issuer determines the chance of either defaulting or migrating to any other possible credit quality state in the risk horizon;
- revaluation at the risk time horizon can be by either (1) the seniority of the exposure, which determines its recovery rate in case of default or (2) the forward zero-coupon curve (spot curve) for each credit rating category, which determines the revaluation upon up/downgrade;
- the probabilities from the two steps above are combined to calculate volatility of value due to credit quality changes.

Step 3 Correlations Individual value distributions for each exposure are combined to give a portfolio result. To calculate the portfolio value from the volatility of individual asset values requires estimates of correlation in credit quality changes. *CreditMetrics*™ allows for different approaches to estimating correlations including a simple constant correlation. This is because of frequent difficulty in obtaining directly observed credit quality correlations from historical data.

Our discussion of credit risk, and the VaR methodology for measuring such risk, is useful background for the following chapters. We are now in a position to consider the main instruments used to manage and trade credit risk exposure.

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by Moorad Choudhry

CHAPTER 2

Credit Derivatives I: Unfunded Instruments

Credit derivatives are financial instruments that enable credit risk on a specified entity or asset to be transferred from one party to another. Hence they are used to take on or lay off credit risk, with one party being the buyer of credit protection and the other party being the seller of credit protection. They have become a key tool in the management of credit risk for banks as well as other capital market participants. Credit derivatives allow investors to manage the credit risk exposure of their portfolios or asset holdings, essentially by providing insurance against deterioration in credit quality of the borrowing entity.[1] If there is a technical default by the borrower[2] or an actual default on the loan itself, and the bond is marked down in price, the losses suffered by the investor can be recouped in part or in full through the payout made by the credit derivative. The introduction of credit derivatives has resulted in the isolation of credit as a distinct asset class. This has improved the efficiency of the capital market because market participants can separate the functions of credit origination and credit risk-bearing. Banks have been able to spread their credit risk exposure across the financial system. The use of credit derivatives also improves market transparency by making it possible to better price specific types of credit risk.[3]

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[1] The simplest credit derivative works exactly like an insurance policy, with regular premiums paid by the protection buyer to the protection seller, and a payout in the event of a specified credit event. But for a number of reasons, mainly connected with the technical differences between the two products, we discourage recourse to this analogy.

[2] A technical default is a delay in timely payment of debt interest or coupon, or non-payment of the coupon altogether.

[3] Some commentators have suggested that credit derivatives have *reduced* market transparency because it may not be possible to track where credit risk has gone after it has been removed from bank balance sheets. It has also been suggested that the use of credit derivatives increases systemic risk because they spread risk and hence increase risk of contagion. We do not subscribe to this view, but this is not the place to debate it.

In this chapter we consider the various *unfunded* credit derivative instruments.[4] The following chapter looks at funded credit derivatives. We will go on later to look at various applications of the instruments and their pricing and valuation. We first discuss market volumes and participants. We then look at the concept of credit risk and risk mitigation, before looking at the products themselves.

MARKET VOLUMES

Credit derivatives are a relatively recent innovation in the capital markets, but their use has seen rapid growth. They were first introduced in 1994. Figure 2.1 shows growth in credit derivatives volumes from 1997, with an estimate for 2008. These are data published by the British Bankers Association (BBA). While this figure represents a small percentage of the total size of the over-the-counter (OTC) market (over US$100 trillion), it is still a significant number. This is because the underlying credit risk on most derivative contracts is no more than 5% of their notional value, whereas the corresponding risk for credit derivatives is essentially 100% of their notional value.

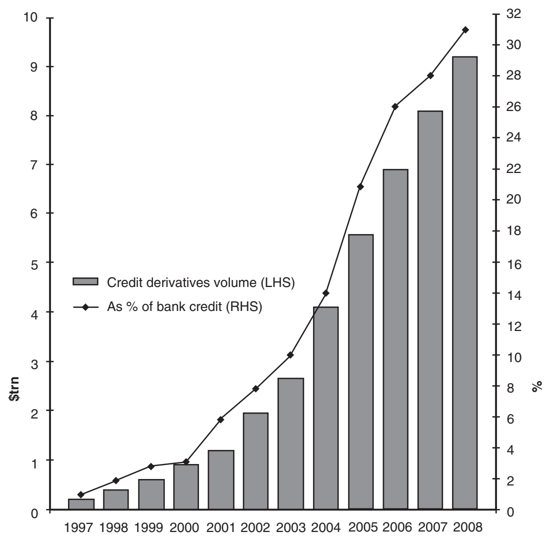

FIGURE 2.1 Credit derivatives volume growth, 1997–2008.
Sources: BBA, Bank for International Settlements.

[4] This term is explained in this chapter. The next chapter looks at *funded* credit derivatives.

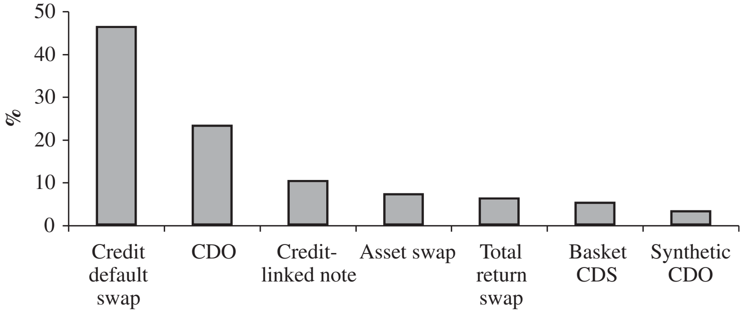

FIGURE 2.2a Credit derivative use by product, 2003.
Source: BBA.

There are a number of different types of credit derivative instruments, which we will consider in detail later. The most commonly encountered contract is the *credit default swap* (CDS). As shown in Figure 2.2a, CDS made up approximately 45% of the market in 2003. There had also been significant growth in structured credit products such as *collateralised debt obligations* (CDOs), which are better described as structured credit products, and synthetic CDOs, which make use of credit derivatives in their structure. Figure 2.2b shows the change in 2008.

Although banks are the main users of credit derivatives, as both protection sellers and buyers, they are also used by a range of other participants. Figures 2.3 and 2.4 on page 60 show the breakdown of each type of user. The figures suggest that banks are net buyers of protection while insurance companies (which are institutional investors) are net sellers of protection.

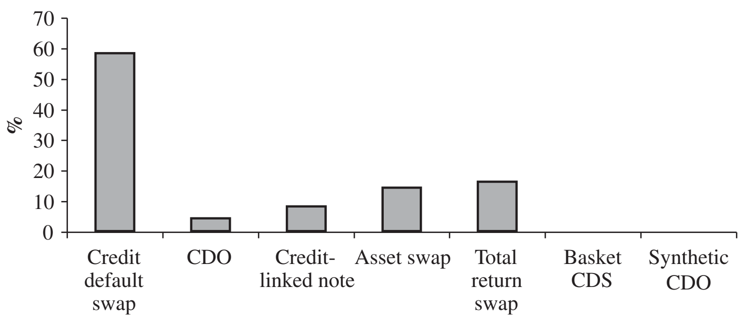

FIGURE 2.2b Credit derivative use by product, 2008.
Source: BBA.

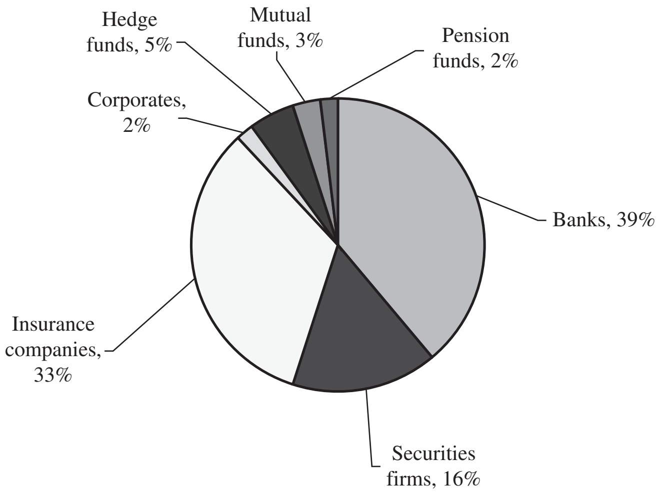

FIGURE 2.3 Protection sellers, 2003.
Source: BBA.

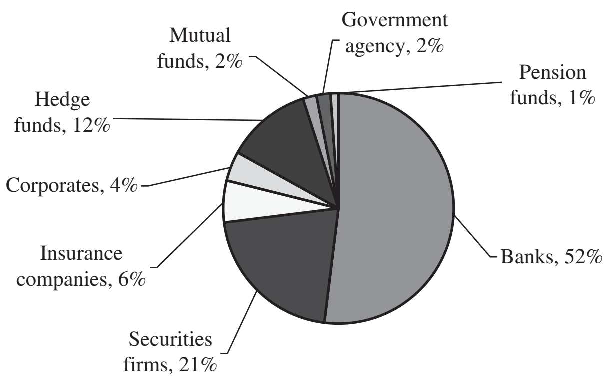

FIGURE 2.4 Protection buyers, 2003.
Source: BBA.

CREDIT RISK AND CREDIT DERIVATIVES

Credit derivatives are financial contracts designed to reduce or eliminate credit risk exposure by providing insurance against losses suffered due to *credit events*. A payout under a credit derivative is triggered by a credit event associated with the credit derivative's *reference asset* or *reference entity*. As banks define default in different ways, the terms under which a credit derivative is executed usually include a specification of what constitutes a credit event. The principle behind credit derivatives is straightforward. Investors desire exposure to debt that is not risk-free because of the higher returns this debt offers. However, such exposure brings with it concomitant credit risk. This can be managed with credit derivatives. At the same time, the exposure itself can be taken on synthetically if, for instance, there are compelling reasons why a cash market position cannot be established. The flexibility of credit derivatives provides users with a number of advantages and as they are over-the-counter (OTC) products they can be designed to meet specific user requirements. Some of the most common reasons for which they are used include:

- hedging credit risk: this includes credit default risk, dynamic credit risks and changes in credit quality;
- reducing credit risk with a specific client (*obligor*) so that lending lines to this client are freed up for other business;
- diversifying investment options; in other words, acquiring credit exposure without having to buy the cash product.

The intense competition among commercial banks, combined with rapid disintermediation, has meant that banks have been forced to evaluate their lending policies, with a view to improving profitability and return on capital. The use of credit derivatives assists banks with restructuring their businesses, because they allow banks to repackage and transfer credit risk, while retaining assets on balance sheet (when required) and thus maintain client relationships. As the instruments isolate certain aspects of credit risk from the underlying loan or bond and transfer them to another entity, it becomes possible to separate the ownership and management of credit risk from the other features of ownership associated with the assets in question. This means that illiquid assets such as bank loans, and illiquid bonds, can have their credit risk exposures transferred—the bank owning the assets can protect against credit loss even if it cannot transfer the assets themselves.[5]

The same principles apply to the credit risk exposures of portfolio managers. For fixed-income portfolio managers, some of the advantages of using credit derivatives include the following:

- they can be tailor-made to meet the specific requirements of the entity buying the risk protection, as opposed to the liquidity or term of the underlying reference asset;

[5] The bank may not wish to transfer the physical assets, in order to maintain client relationships. It can always transfer the assets in a securitisation transaction, which can also bring in funding (cash securitisation).

- they can be 'sold short' without risk of a liquidity or delivery squeeze, as it is a specific credit risk that is being traded. In the cash market, it is not possible to 'sell short' a bank loan for example, but a credit derivative can be used to establish synthetically the economic effect of such a position;
- as they isolate credit risk from other factors such as client relationships and interest rate risk, credit derivatives introduce a formal pricing mechanism to price credit issues only. This means a market is available in credit only, allowing more efficient pricing, and it becomes possible to model a term structure of credit rates;
- they are off-balance sheet instruments[6] and as such incorporate flexibility and leverage, exactly like other financial derivatives. For instance, bank loans are not particularly attractive investments for certain investors because of the administration required in managing and servicing a loan portfolio. However, an exposure to bank loans and their associated return can be achieved using credit derivatives while simultaneously avoiding the administrative costs of actually owning the assets. Hence credit derivatives allow investors access to specific credits while allowing banks access to further distribution for bank loan credit risk.

Thus credit derivatives can be an important instrument for bond portfolio managers as well as commercial banks, who wish to increase the liquidity of their portfolios, gain from the relative value arising from credit pricing anomalies and enhance portfolio returns.

CREDIT DERIVATIVE INSTRUMENTS

Before analysing the main types of credit derivatives, we now consider some generic features of all credit derivatives.

Background

Credit derivative instruments enable participants in the financial market to trade in credit as an asset, as they effectively isolate and transfer credit risk. They also enable the market to separate funding considerations from credit risk. A number of instruments come under the category of credit derivative. In this and the next chapter we consider the most commonly encountered credit derivative instruments. Irrespective of the particular instrument under consideration, all credit derivatives can be described as having the following characteristics:

[6] When credit derivatives are embedded in certain fixed-income products, such as structured notes and credit-linked notes, they are then off-balance sheet but part of a structure that will have on-balance sheet elements. Funded credit derivatives are on-balance sheet.

- the *reference entity*: which is the asset or name on which credit protection is being bought and sold;[7]
- the credit event, or events: which indicate that the reference entity is experiencing or about to experience financial difficulty and which act as trigger events for termination of and payments under the credit derivative contract;
- the settlement mechanism for the contract: whether cash settled or physically settled;
- (under physical settlement), the deliverable obligation: that the protection buyer delivers to the protection seller on the occurrence of a trigger event.

Within this broad framework, it is common to see wide variations in detail among specific types of credit derivative instruments.

Funded and Unfunded Contracts

Credit derivatives are grouped into *funded* and *unfunded* instruments. In a funded credit derivative, typified by a credit-linked note (CLN), the investor in the note is the credit-protection seller and is making an upfront payment to the protection buyer when it buys the note. This upfront payment is the price of the CLN. Thus, the protection buyer is the issuer of the note. If no credit event occurs during the life of the note, the redemption value (par) of the note is paid to the investor on maturity. If a credit event does occur, then on termination (in effect, maturity of the bond), a value less than par will be paid to the investor. This value will be reduced by the nominal value of the reference asset that the CLN is linked to. The exact process will differ according to whether *cash settlement* or *physical settlement* has been specified for the note. We will consider this later.

In an unfunded credit derivative, typified by a CDS, the protection seller does not make an upfront payment to the protection buyer. Thus the main difference between funded and unfunded is that in a funded contract, the insurance protection payment is made to the protection buyer at the start of the transaction: if there is no credit event, the payment is returned to the protection seller. In an unfunded contract, the protection payment is made on termination of the contract on occurrence of a triggering credit event. Otherwise it is not made at all. Therefore, when entering into a funded contract transaction, the protection seller (that is, the investor) must find the funds at the start of the trade.

[7] Note that a contract may be written in relation to a *reference entity*, which is the corporate or sovereign name, or a *reference obligation*, which is a specific debt obligation of a specific reference entity. Another term for reference obligation is *reference asset* or *reference credit*. We will use these latter terms interchangeably in the book.

Credit derivatives such as CDS have a number of applications and are used extensively for flow trading of single reference name credit risks or, in *portfolio swap* form, for trading a basket of reference obligations. CDSs and CLNs are used in structured products, in various combinations, and their flexibility has been behind the growth and wide application of the synthetic collateralised debt obligation (CDO) and other credit hybrid products. We look at these later.

Compared to cash market bonds and loans, an unfunded credit derivative isolates and transfers credit risk only. In other words, its value reflects only the credit quality of the reference entity. Compare this to a fixed-coupon corporate bond, the value of which is a function of both interest rate risk and credit quality, where the return to the investor depends on the investor's funding costs.[8] The interest rate risk element of the bond can be removed by combining the bond with an interest rate swap, to create an *asset swap*. An asset swap removes the interest rate risk of the bond, leaving only the credit quality and the funding aspects of the bond. With an unfunded credit derivative, the funding aspect is removed as well, leaving only the credit element. This is because no upfront payment is required, resulting in no funding risk to the protection seller. The protection seller, who is the investor, receives a return that is linked only to the credit quality of the reference entity.

This separation of credit risk from other elements of the cash market is shown in Figure 2.5.

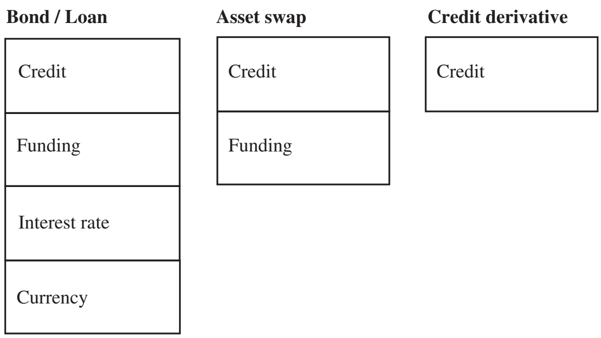

FIGURE 2.5 Credit derivatives isolate credit as an asset class and risk element.

[8] Funding refers to the cost of funds of the investor. For a bank, funding is based on LIBID. For a traditional investor, such as a pension fund manager, funding is more problematic, as the funds are in theory invested directly with the pension fund and so acquired 'free'. However, for economic purposes, such funds are valued at the rate that they can be invested in the money markets. For other investors, funding is based on LIBOR plus a spread, except for very highly rated market participants such as the World Bank, who can fund at sub-LIBOR rates.

EXAMPLE 2.1 REFERENCE ENTITY AND REFERENCE OBLIGATION

A reference obligation or reference asset is an obligation issued by a reference entity for which credit protection is required. The reference obligation usually has a pre-specified seniority, to facilitate ease of determination of the settlement payment. A higher seniority usually leads to a better recovery rate and hence a lower loss rate following a credit event. It is also reflected in a lower price for the credit derivative contract.

Credit Events

The occurrence of a specified credit event will trigger the termination of the credit derivative contract, and result in the transfer of the default protection payment from the protection seller to the protection buyer.

The following may be specified as 'credit events' in the legal documentation between counterparties:

- downgrade in S&P and/or Moody's credit rating below a specified minimum level;
- financial or debt restructuring; for example, occasioned under administration or as required under US bankruptcy protection;
- bankruptcy or insolvency of the reference asset obligor;
- default on payment obligations such as bond coupon and continued non-payment after a specified time period;
- technical default; for example, the non-payment of interest or coupon when it falls due;
- a change in credit spread payable by the obligor above a specified maximum level.

The International Swap and Derivatives Association (ISDA) compiled standard documentation governing the legal treatment of credit derivative contracts. The standardisation of legal documentation promoted ease of execution and was a factor in the rapid growth of the market. The 1999 ISDA CDS documentation specified bankruptcy, failure to pay, obligation default, debt moratorium and restructuring to be credit events. Note that it does not specify a rating downgrade to be a credit event.[9]

[9] The ISDA definitions from 1999, the restructuring supplement from 2001, the 2003 definitions and the 2009 protocols are available at www.ISDA.org.

A summary of the credit events as set forth in the ISDA definitions is given in Appendix 2.1. Note that for North American contracts rate these were affected in 2009, as discussed later in the chapter.

The precise definition of 'restructuring' is open to debate and has resulted in legal disputes between protection buyers and sellers. Prior to issuing its 1999 definitions, ISDA had specified restructuring as an event or events that resulted in making the terms of the reference obligation 'materially less favourable' to the creditor (or protection seller) from an economic perspective. This definition was open to more than one interpretation and it caused controversy when determining if a credit event had occurred. The 2001 definitions specified more precise conditions, including any action that resulted in a reduction in the amount of principal. In the European market, restructuring is generally retained as a credit event in contract documentation, but in the US market it is less common to see it included. Instead, US contract documentation tends to include as a credit event a form of *modified restructuring*, the impact of which is to limit the options available to the protection buyer as to the type of assets it could deliver in a physically settled contract. Further clarification was provided in the 2003 ISDA definitions,[10] and again as part of the 2009 ISDA 'Big Bang'.

Comparing Credit Derivatives to Cash Instruments

Both funded and unfunded credit derivatives act as alternatives to cash market products for investors. Funded credit derivatives are similar to cash

[10] The debate on restructuring as a credit event arose out of a number of events, notably the case involving a corporate entity, Conseco, in the US in 2000. It concerned the delivery option benefit afforded to the protection buyer in a physically settled credit derivative, and the *cheapest-to-deliver* asset. Under physical settlement, the protection buyer may deliver any senior debt obligation of the reference entity. When the triggering credit event is default, all senior obligations of the reference entity generally trade at approximately equal levels, mainly because of the expected recovery rate in a bankruptcy proceeding. However, where the triggering event is restructuring short-dated bank debt, which has been restructured to give lending banks better pricing and collateral, the short-dated bonds will trade at a significant premium to longer dated bonds. The pricing differential between the short-dated, restructured obligations and the longer dated bonds results in the delivery option held by the protection buyer carrying significant value, as the protection buyer will deliver the cheapest-to-deliver obligation. Under the modified restructuring definition, where the triggering event is restructuring, the delivered obligation cannot have a maturity that is longer than the original maturity date of the credit derivative contract, or more than 30 months after the original maturity date.

RESTRUCTURING, MODIFIED RESTRUCTURING AND MODIFIED-MODIFIED RESTRUCTURING

The original 1999 ISDA credit definitions defined restructuring among the standard credit events. The five specified definitions included events such as a reduction in the rate of interest payable, a reduction in the amount of principal outstanding and a postponement or deferral of payment. Following a number of high-profile cases where there was disagreement or dispute between protection buyers and sellers on what constituted precisely a restructuring, the Supplement to the 1999 ISDA limited the term to maturity of deliverable obligations. This was modified restructuring or Mod-R, which was intended to reduce the difference between the loss suffered by a holder of the actual restructured obligation and the writer of a CDS on that reference name. In practice this has placed a maturity limit on deliverable obligations of 30 months.

The 2003 Definitions presented further clarification and stated that the restructuring event had to be binding on all holders of the restructured debt. The modified-modified restructuring definition or Mod-Mod-R described in the 2003 ISDA defines the modified restructuring term to maturity date as the later of:

- the scheduled termination date;
- 60 months following the restructuring date

in the event that a restructured bond or loan is delivered to the protection seller. If another obligation is delivered, the limitation on maturity is the scheduled maturity date and 30 months following the restructuring date.

Restructuring does not now apply as a credit event in North American contracts.

bonds, but investors will need to assess their requirements more fully when assessing the relative merits of cash versus synthetic products.

In certain respects both products offer the same thing. The coupon cash flows of a corporate bond can be replicated using a CDS contract,

TABLE 2.1 Jackfruit Music Ltd, buying bonds versus selling protection.

Buy Jackfruit 5-year bonds	Sell 5-year protection on Jackfruit
Funded position	Unfunded position
Earn 195 bps over LIBOR	Earn 225 bps
Fund at LIBOR + 10.0	No funding cost
Net return 185 bps	Return 225 bps

and an investor can get synthetic access to a particular sovereign or corporate name in this way. In some cases the return can be higher for essentially the same commensurate risk. We can illustrate this with a hypothetical example. Assume a pension fund investor wishes to invest in the bonds of a hypothetical corporate credit, call it Jackfruit Music Limited, which is rated BBB–/Baa3. The investor can buy Jackfruit Music bonds or sell protection on Jackfruit Music instead. Either way, the investor is acquiring risk in Jackfruit Music.

Market makers quote the following for Jackfruit Music:

- 5-year bonds offered at 250 bps over benchmark government bonds;
- the CDS bid–offer price is 225–230 bps;
- the bond asset swap price is LIBOR + 195 bps (the 5-year inter-bank swap spread is 55 bps).

Assume further that the investor is part of a Group entity and funds at LIBOR plus 10 bps.

The alternatives are illustrated in Table 2.1.

By investing via the synthetic product, the investor earns a yield pick up of 40 bps over the cash position. This sounds too good to be true and in some cases will be; also, in some cases the CDS will be trading below the cash. However it illustrates the key issues. As we will see in Chapter 9, the CDS position in many cases exposes the investor to a greater risk exposure than the cash bond position, which is why the CDS price is in many cases higher. This difference between the CDS price and the cash bond price is known as the *basis*. The size of the basis is used as an indicator of deteriorating credit quality (or, as significant, potentially deteriorating credit quality) in a reference name.

Table 2.2 shows the key investor considerations for both markets.

We now consider the individual credit derivative instruments.

TABLE 2.2 Cash versus synthetic market considerations.

Buy cash bonds	Sell credit protection
Funded position	Unfunded position
Investor holds a specific bond and its risk exposure is to that specific bond	Unless written into the contract specifically, investor is selling protection on all obligations of the reference issuer
Risk to specific bond that is marked-to-market and may be sold in market if buyer is available	In event of credit event, which may not be complete default or full administration, protection seller will settle at par, minus market price of cheapest eligible reference bond (or receive this bond, for which it pays par)
Return on bond is net amount of funding cost	Return is CDS bid price

CREDIT DEFAULT SWAPS

We describe first the credit default swap (CDS), the most commonly traded credit derivative instrument.

Structure

The most common credit derivative is the *credit default swap*, sometimes called the *credit swap* or *default swap*.[11] This is a bilateral contract that provides protection on the par value of a specified reference asset, with a protection buyer that pays a periodic fixed fee or a one-off premium to a *protection seller*, in return for which the seller will make a payment on the occurrence of a specified credit event. The fee is usually quoted as a basis point multiplier of the nominal value. It is usually paid quarterly in arrears. The swap can refer to a specific single asset, known as the reference asset or underlying asset, a basket of assets, or a reference entity. The default payment can be paid in whatever way suits the protection buyer or both counterparties. For example, it may be linked to the change in price of the reference asset or another specified asset, it may be fixed at a pre-determined recovery rate, or it may be in the form of actual delivery of the reference asset at a specified price. The basic structure is shown in Figure 2.6.

The CDS enables one party to transfer its credit risk exposure to another party. Banks may use default swaps to trade sovereign and corporate

[11] The author prefers the first term, but the other two terms are also observed.

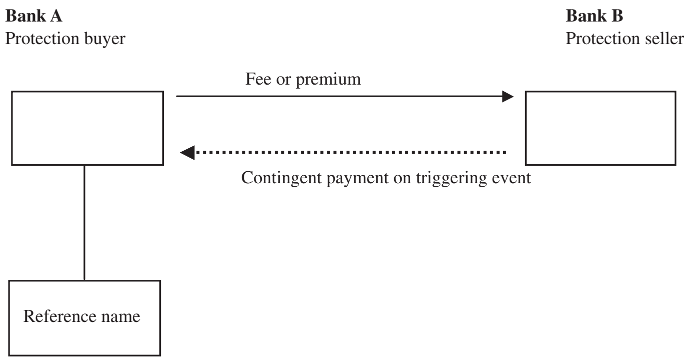

FIGURE 2.6 Credit default swap (CDS).

credit spreads without trading the actual assets themselves; for example, someone who has gone long a default swap (the protection buyer) will gain if the reference asset obligor suffers a rating downgrade or defaults, and can sell the default swap at a profit if they can find a buyer counterparty.[12] This is because the cost of protection on the reference asset will have increased as a result of the credit event. The original buyer of the credit default swap need never have shorted the bond issued by the reference asset obligor.

The maturity of the CDS does not have to match the maturity of the reference asset and often does not. On occurrence of a credit event, the swap contract is terminated and a settlement payment is made by the protection seller, or *guarantor,* to the protection buyer. This termination value is calculated at the time of the credit event, and the exact procedure that is followed to calculate the termination value depends on the settlement terms specified in the contract. This will be either cash settlement or physical settlement. We look at these options later.

For illustrative purposes, Figure 2.7 on page 71 shows investment-grade credit default swap levels during 2001 and 2002 for US dollar and euro reference entities (average levels taken), while Table 2.3 on page 72 shows sample CDS prices during September 2003. We update the latter for December 2008 at Table 2.4 on page 72.

Appendix 2.2 shows a sample term sheet for a CDS contract.

[12] Be careful with terminology here. To 'go long' of an instrument generally is to purchase it. In the cash market, 'going long the bond' means one is buying the bond and so receiving coupon—the buyer has therefore taken on credit risk exposure to the issuer. In a CDS, 'going long' is to buy the swap, but the buyer is purchasing protection and therefore paying premium. The buyer has in effect 'gone short' on the reference name (the equivalent of 'shorting a bond' in the cash market and paying coupon). So buying a CDS is frequently referred to in the market as 'shorting' the reference entity.

EXAMPLE 2.2 CREDIT DEFAULT SWAP EXAMPLE

XYZ plc credit spreads are currently trading at 120 bps over 5-year government bond maturities and 195 bps over 10-year government bond maturities. A portfolio manager hedges a $10 million holding of 10-year paper by purchasing the following CDS, written on the 5-year bond. This hedge protects for the first five years of the holding, and in the event of XYZ's credit spread widening, will increase in value and may be sold before expiry at profit. The 10-year bond holding also earns 75 bps over the shorter term paper for the portfolio manager.

Term:	5 years
Reference credit:	XYZ plc 5-year bond
Credit event:	The business day following occurrence of specified credit event
Default payment:	Nominal value of bond × 3 × [100 × 2 × price of bond after credit event]
Swap premium:	3.35%

Assume that midway into the life of the swap there is a technical default on the XYZ plc 5-year bond, such that its price now stands at $28. Under the terms of the swap the protection buyer delivers the bond to the seller, who pays $7.2 million to the buyer.

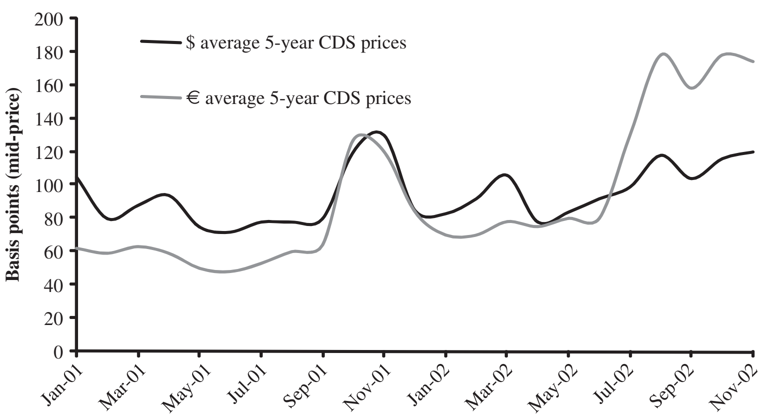

FIGURE 2.7 Investment-grade CDS levels, 2001–2002.
Source: Bloomberg L.P.

TABLE 2.3 Sample 5-year CDS premiums, September 2003.

Reference name	Mid-price bps	Moody's/S&P
Automobiles		
Ford Motor Co.	318	Baa1/BBB2
General Motors	269	Baa1/BBB
GMAC	229	A3/BBB
Banks		
Bank of America	23	Aa2/A1
Wells Fargo	33	Aa2/A1
Asia-Pacific region	**Bid–ask**	**Moody's/S&P**
Hutchison Whampoa	96/106	A3/A2
PR China	22/26	A3/BBB
Republic of Korea	67/74	A3/A2
NEC	46/53	Baa2/BBB2
Qantas	74/84	Baa1/BBB1

Sources: Morgan Stanley, Bloomberg, Risk.

TABLE 2.4 Sample 5-year CDS premiums, 8 December 2008.

Reference name	Mid-price bps	Rating: S&P/Moody's/Fitch
Automobiles		
Ford Motor Co.	2508	CCC+/Caa2/CCC
General Motors	11064	CCC+/NR/CCC
GMAC	3443	CC/C/CCC
Banks		
Bank of America	193	AA–/Aa2/A+
Wells Fargo	155	AA–/Aa2/A+
Asia-Pacific region	**Bid-Ask**	**S&P/Moody's/Fitch**
Hutchison Whampoa	423	A–/A3/A
PR China	239	NR/A1/NR
Republic of Korea	419	A/A2/AA
NEC	195	BBB/Baa1/BBB
Qantas	348	BBB+/Baa1/NR

Source: Bloomberg L.P.

Bloomberg users can also access the price histories of CDS contracts on specific reference entities. This is done in the first instance by obtaining the tickers for each contract, which are listed by currency. So to obtain a ticker list for euro-denominated contracts, the user types:

EUR CDS ⟨Crncy⟩ ⟨go⟩

and this screen is shown at Figure 2.8. We have paged forward to obtain the ticker for British Telecom, and this is shown for various maturities at Figure 2.8. We then select the 5-year CDS, detailed at Figure 2.9, which is the DES page for this contract. This gives the 52-week high and low for this contract as well as its current spread. From this page we can select the CDS spread curve by hitting 2 ⟨go⟩, and for this example the curve is shown at Figure 2.10.

To view the historical range of this particular contract, we type the ticker and select GP, which is:

CBTE5 ⟨Crncy⟩ GP ⟨go⟩

and this screen is shown at Figure 2.11 on page 75. To view this data in tabular form we hit ‘page forward’, and this is reproduced at Figure 2.12.

FIGURE 2.8 Menu page, EUR CDS price histories.

FIGURE 2.9 British Telecom 5-year CDS description on Bloomberg.

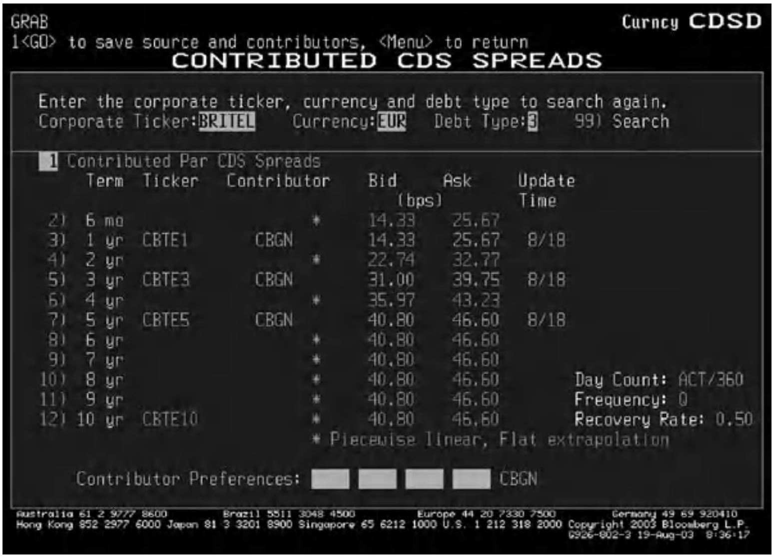

FIGURE 2.10 British Telecom current CDS spread curve.

FIGURE 2.11 Selected British Telecom CDS contract, price history.
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GRAB Curncy GP
Hit <MENU> to return to graph or <PAGE> to continue.
PRICE TABLE PAGE 2 OF 2

CBTE5 EUR CDS/BRITEL 5 YR
THIS PAGE: 8/18/03 TO: 6/27/03

	DATE	PRICE		DATE	PRICE		DATE	PRICE
F			F	8/ 1	42.2000	F	7/11	47.6875
T			T	7/31	39.9286	T	7/10	49.4153
W			W	7/30	38.5833	W	7/ 9	50.2381
T			T	7/29	38.4167	T	7/ 8	50.1667
M	8/18	43.7000	M	7/28	38.8000	M	7/ 7	
F	8/15	44.3333	F	7/25	39.5833	F	7/ 4	51.5803
T	8/14	44.3333	T	7/24	39.7500	T	7/ 3	52.7222
W	8/13	43.8750	W	7/23	40.3125	W	7/ 2	53.0000
T	8/12	44.3000	T	7/22	41.6875	T	7/ 1	52.5000
M	8/11	46.6000	M	7/21	42.6875	M	6/30	
F	8/ 8	46.6000	F	7/18	43.3750	F	6/27	54.1224
T	8/ 7	47.6000	T	7/17	43.5625			
W	8/ 6	46.5833	W	7/16	44.1250			
T	8/ 5	43.8571	T	7/15	47.4286			
M	8/ 4	43.9286	M	7/14				

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2003 Bloomberg L.P.
G926-802-2 19-Aug-03 8:35:23

FIGURE 2.12 Price history in table format.
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ROLLING MATURITY SWAPS AND CONSTANT MATURITY SWAPS

Innovation in CDS during 2003 was that of rolling maturity swaps. This is where there is a set of rolling quarterly maturity dates, rather like the futures market. The dates are 20 March, 20 June, 20 September and 20 December. A CDS contract traded on any day with a (say) 5-year maturity will mature on the relevant quarterly maturity date in five years. So, for example, the active 3-year CDS contract on 20 April 2004 will mature on 20 June 2007. This will be the expiry date for all rolling maturity CDS contracts traded from that date until 21 June 2004, when the active-maturity CDS will expire on 20 September 2007 and so on.

A later innovation (during 2004) was the constant maturity CDS. This is not a plain vanilla CDS. A constant maturity CDS has its maturity date re-set periodically, say at 3-month or 6-month intervals. Its premium is also re-set at each roll date, so a constant maturity swap has a varying premium. In theory a constant maturity CDS is of value to a loan portfolio manager who wishes to maintain the maturity of their hedges at a set period, without transacting new trades. For instance, the portfolio manager may wish to maintain a constant 5-year hedge for its portfolio because this is the most liquid part of the CDS curve. The premium of a constant maturity swap for a particular reference name will lie above that of a vanilla swap for the same name, say 10 or 15 bps higher.

However, a constant maturity swap carries price risk for the protection buyer (and conversely for the protection seller) because the portfolio manager does not know at what level the swap premium will be re-set at each roll date. It may be simpler and less risky to simply roll actual contracts at quarterly or semi-annual intervals, with a new contract traded as each one matures.

TECHNICAL FEATURES OF CDS

The CDS should be viewed primarily as an investment instrument. This is subtly different from viewing it as a risk management or risk mitigation tool. The terminology used in the market is a throwback to the days when

TABLE 2.5 CDS positions.

CDS market	CDS cash flow	Investment position
Buying protection	Pay (fixed) premium	Short the cash asset
Selling protection	Receive (floating) premium	Long the cash market
Bond market	**Bond cash flow**	**Investment position**
Buying the bond	Receive fixed or floating coupon	Long the cash market
Selling the bond	Pay fixed or floating coupon	Short the cash asset

CDS was considered the same way as an insurance contract. Hence, dealing in a CDS is known as buying or selling protection. From an investor viewpoint of course one is either buying a product (to 'go long') or selling a product (to 'go short'). So 'buying a CDS' is often used to refer to buying protection, which is equivalent to going short the asset. Table 2.5 makes the meanings clear.

To avoid any confusion the best approach is to always speak in terms of buying or selling protection, rather than simply buying or selling or going long or short.

Annuity Valuation and Survival Probability The mark-to-market valuation of a CDS contract can be thought of in simple annuity terms. To illustrate by way of an example, consider a 5-year CDS in which the investor sells protection on €10 million at 100 bps. After one year the position is offset with a 4-year CDS priced at 75 bps (a locked in profit of 25 bps).[13] The valuation is a simple present value calculation of the cash flows, as shown in Figure 2.13 below. This assumes no credit event.

The simple valuation is not the true risk-reward exposure, however, because there is credit risk in the contract. Occurrence of a credit event at any point during the life of the two offsetting contracts would terminate both positions, leaving a net zero position. As there is risk of the annuity terminating ahead of its maturity date, the actual premium income earned may be less than what is expected at trade inception.

To allow for this risk exposure in valuation, each cash flow in the annuity stream of a CDS is weighted by the probability of there being no credit event before each coupon payment date. In other words, we weight the cash

[13] In practice, the investor is more likely simply to close out the first trade. Pricing CDS is discussed in more detail in Chapter 7.

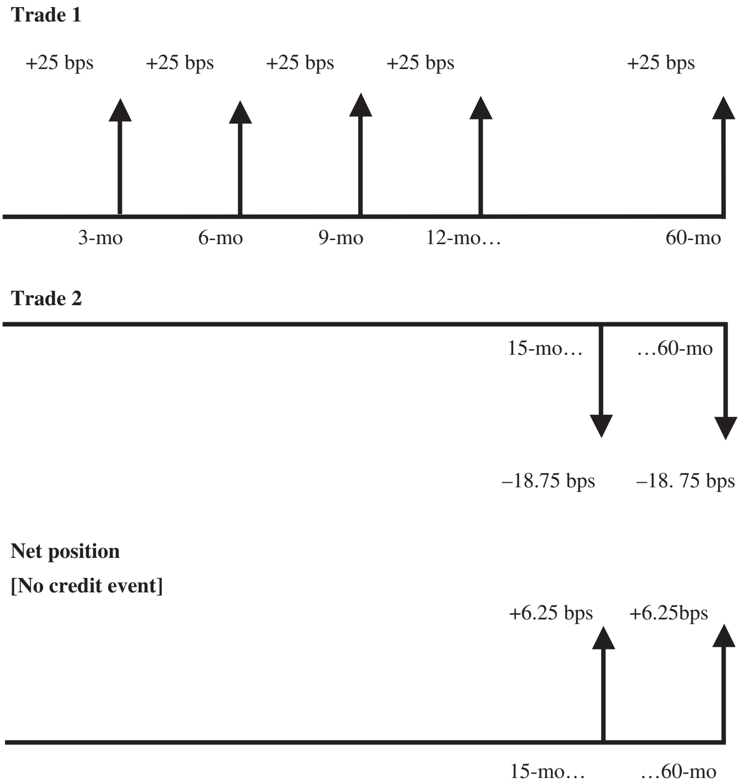


FIGURE 2.13 Annuity stream valuation of offsetting CDS positions.

flow at each payment date with its survival probability. With this parameter, the expected value of the annuity, and therefore the mark-to-market valuation of a CDS position, is given by:

$$MTM = \sum_{i=1}^{N} C \times SP_i \times Df_i \tag{2.1}$$

where N is the number of coupon periods in the annuity
C is the annuity payment
SP_i is the survival probability of the reference entity from time t_0 to t_i
Df_i is the risk-free discount factor from time t_0 to t_i

Using survival probabilities has the effect of reducing the absolute mark-to-market value. This results in a smaller profit from the unwinding of a profitable CDS position and a smaller loss from the unwinding of a loss-making position.

We can adjust (2.1) above by using risky discount factors rather than risk-free ones. The risky discount factors are given by $(SP \times Df_{risk-free})$ at each cash flow date. Given these discount factors, we adjust (2.1) as follows:

$$MTM = C \times PV01 \tag{2.2}$$

where *PV01* is defined as the present value of a 1 bp risky annuity terminating on occurrence of a credit event or on maturity, whichever comes first. That is,

$$PV01 = (Notional/10,000) \times \sum \left(SP \times Df_{risk\text{-}free}\right). \tag{2.3}$$

Hence the MTM of a CDS position is a function of the default probability of the reference name and the survival probability of each successive cash flow.

Appendix 2.5 discusses the market-implied timing of default that can be derived from CDS prices.

Unwinding a CDS Position A CDS is better viewed as a credit asset in its own right because its value moves in line with credit spreads generally and it is marked-to-market in a bank's trading book. This is unlike an insurance contract and more like a corporate bond floating-rate note (FRN). The premium in a CDS contract, like the spread over LIBOR in an FRN coupon payment, is fixed at trade inception; however, in the secondary market this premium will change as the credit risk perception of the reference asset changes. In an FRN the payable coupon spread does not change; rather, the actual price of the bond in the secondary market rises or falls as credit perception improves or worsens.

In the cash bond market there is no issue with 'unwinding' a position. If one is long a bond, one will simply sell it. A short position is flattened out by buying it back. For a CDS, the unwind can be carried out in one of three ways:

- entering into an offsetting CDS position: a bought/sold protection position is effectively closed out by entering into a new sold/bought protection CDS position of matching tenor. This crystallises the mark-to-market profit/loss on the original trade, but note that both trades remain live until maturity on occurrence of a credit event. If the second trade has been entered into with a different counterparty, then the bank will have counterparty exposure in both cases; however, if a credit event does occur, the bank will have counterparty exposure with regard to the bought protection position. This type of offset does not truly unwind the original position;

- terminate the CDS: the trader will cancel the position with the existing counterparty. The present value of the contract, based on its current mark-to-market value vis-à-vis the original trade price, is paid or received by the trader. This closes out the position and the contract, which terminates;
- novation or assignment: the trader hands the CDS contract to a third party, which takes over the position of the trader. The trader will pay or receive the current mark-to-market value of the contract, which continues in existence.

Only termination of a contract actually unwinds it; as we observe above, the other two options result in the exposure being retained, albeit in hedged form or residing with another entity.

Recovery Rates As we shall see in Chapter 7, the concept of the 'recovery rate' (RR) is a key parameter in CDS valuation. This is somewhat unfortunate, because the nature of markets is such that an assumed rate must be used. In the real world, actual recovery value from a defaulted obligation may not be known for years.

The procedure for determining the recovery rate in the cash market is a long drawn-out affair. Debt investors take their place in the queue with all other creditors and receive their due after the administrators have completed their work. This process can take a matter of months or over 10 years. The rating agencies make an assumption of what the final recovery amount will be from the market price of the debt asset at the time bankruptcy or default is announced. This approach is carried over to an extent into the credit derivative market.

The definition of recovery rate in the CDS market differs slightly from that in the cash bond market, for reasons of practicality. This is because the contract must settle fairly soon after the notice of a credit event has been announced, and the real 'recovery rate' is not at that point. At the same time, the model approach under which the CDS would have been priced and valued up to now would have used a 'recovery rate' as one of its parameters. So in the CDS market recovery is defined as the market value of the 'delivered obligation'. This market value is determined by a poll of CDS dealers bidding for the defaulted assets of the reference entity.

Note that recovery rates for the two markets will therefore differ from those in the cash market in practice. This arises for a number of reasons, one of which is that in the CDS market a credit event will encompass circumstances that fall short of full default in the cash market. For example, Moody's notes three categories of default for the purposes of its ratings and historical default statistics:

- delayed or failed coupon or principal payments;
- bankruptcy or receivership;
- distressed exchange that results in investors having a lower obligation value, undertaken by the obligor in order to avoid default.

Recovery rates in practice vary widely, as we note below. In essence, what the 2007–08 credit crunch has taught us is that if one is using CDS to hedge credit risk, the safest approach is to assume a 0% recovery rate. This is because in the event of default it will be some time before the investor receives the recovery value, while in the meantime the payment from the CDS that was used to hedge the asset will be (100 – RR) so the investor will actually have lost out on some of the investment until recovery is received. In the meantime, the investor's accountants would most probably have written down the entire par value of the investment. Therefore for complete hedging it is best to assume a zero recovery value when calculating the notional amount of the CDS used to hedge the investment.

Despite the RR being a key parameter in CDS pricing models, it is not apparent that it is influencing CDS premiums heavily, or that actual historical RRs are used when selecting the input level. A look at CDS spreads during the period 2000–2004 shows that while 'recovery value' varies widely, the CDS premium across all industries is fairly similar (see Figure 2.14)

We observe that most industries were trading at levels fairly close to each other: within 10 or 20 bps of each other. Industries traditionally regarded as higher risk (for example, computers and electronics) or in more

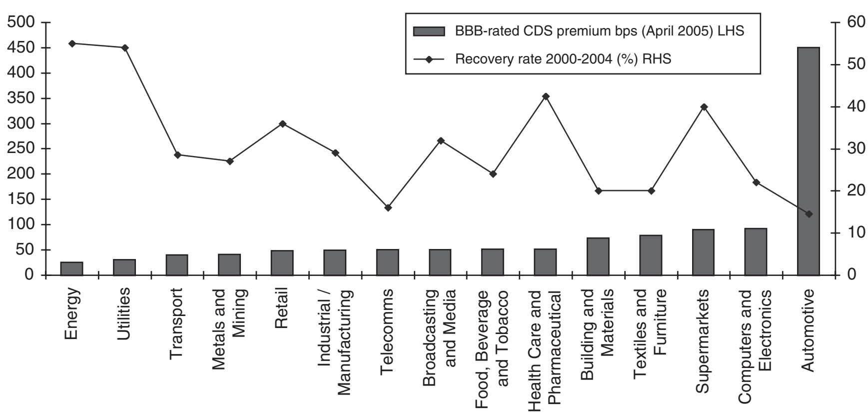


FIGURE 2.14 BBB CDS level versus historic recovery rate. (Rates are average for industry in April 2005.)
Source: Fitch. Used with permission.

difficult circumstances such as automotive are marked up. But otherwise the closeness is noteworthy.

These observations are noteworthy because RR assumption is a required, and important, parameter in CDS pricing. However, it is usually set at 40% for all reference names (for example, the Bloomberg page CDSW defaults to this value. Post the credit crunch and global recession however, it is more usually set at 50% for most names). The chart is interesting because it implies there is little variation in RR assumption—if we adjusted for it we should have observed greater variation in CDS prices. Note the approximation of market implied default probability, which uses the RR assumption, showing the relationship between them which is as follows:

$$\text{P(default)} = \text{CDS spread}/[1 - \text{RR}]$$

Generally, the market gives little weight to the RR assumption when the probability of default is low. But during a recession or in a bear market environment when default probability is higher, this approach is risky and can lead to less accuracy in hedging. A report from Fitch[14] (that pre-dated the credit crunch) suggests the following reasons behind the small differences between industry spread, given that the variation in recovery rate is so much larger:

- at the time, the low-default environment may have made this a non-issue;
- when actual recovery values are received, the ultimate result will probably be very similar;
- given the real difficulty in estimating actual recovery values, which may be many years into the future, the market may prefer a standardised assumption;
- historical rates may not be any more realistic a guide to future rates;
- historical data on recovery values varies widely year-to-year across industries, rendering them less meaningful.

The recovery value of an investment-grade reference name can be more difficult to estimate than a high-yield name given that for the former, any default is likely to occur further in the future.

In practice, as we might expect, there is considerable variation in default rates over time. Average default rate by industry for the US market (see Figure 2.15 on page 83) shows the variation over time historically, although if we standardised by credit rating some of this variation would reduce.

Recovery rates also exhibit great variation. In practice, recovery rates and default rates tend to be inversely related: high default rates are associated with lower average recovery rates (see Figure 2.16 on page 83). Note that most

[14] Fitch special report, 8 June 2005.

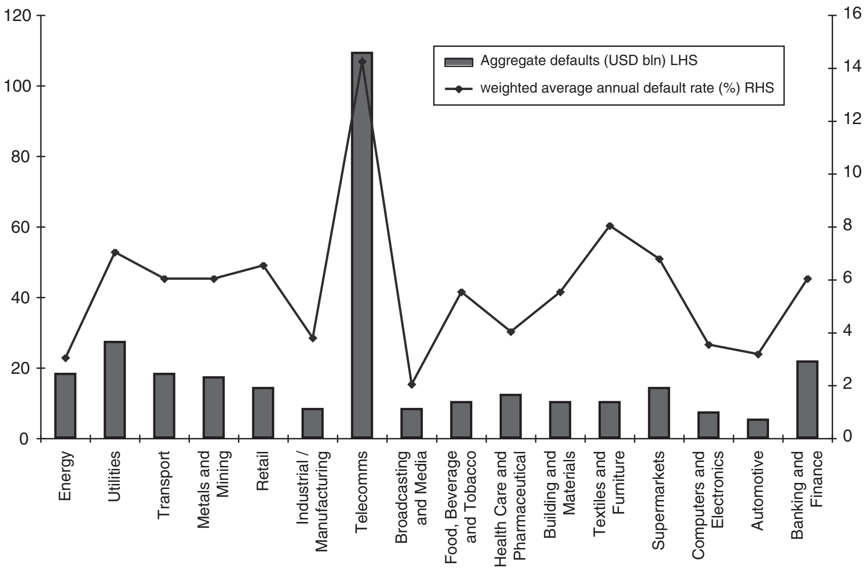


FIGURE 2.15 Average default rate by industry 1980–2004.
Source: Fitch.

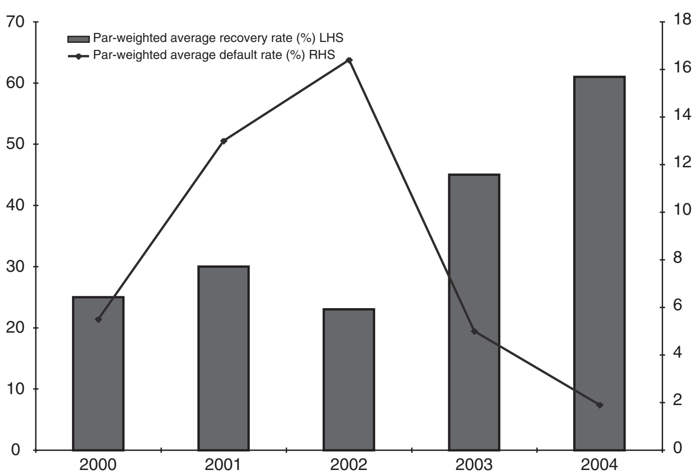


FIGURE 2.16 HY default rate versus recovery rate.
Source: Fitch.

market practitioners, and the Fitch report we quote from, measure 'recovery rate' as recovery value, and the market price of the defaulted loan 30 days after default. As we noted above this will be different from the actual recovery value. The actual loss experienced by investors will be increased by poor recovery rates during times of high default rate. A rough calculation is given by:

$$\text{Loss} = \text{Notional} \times [\text{Default rate} \times (1 - \text{RR})]$$

Low recoveries are more likely during a period of high defaults and this reflects economic reality, as supply and demand depresses secondary market price for defaulted loans. This was observed during the 2008–09 recession and is in effect a 'double whammy' for investors. It also means it is difficult to estimate a 'normal' recovery rate (one more reason for the standard level used in CDS pricing).

BASKET DEFAULT SWAPS

The simplest CDS is the single-name credit default swap, which references one reference entity or the specific asset of an entity. A basket default swap is linked to a group of reference entities. There may be five, 10, 20 or more reference names in the basket. While it is possible to buy a CDS that covers all the named assets in the event of default, this is rare and the most common basket CDS provides protection on a selection of the names in the basket only. For instance, if there are q names in the basket, the basket CDS may be one of the following:

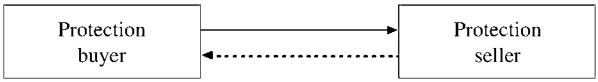
- first-to-default, which provides credit protection on the first default in the basket only;
- second-to-default, which provides credit protection on the second default in the basket (but not the first);
- nth-to-default, which provides protection on the first n (out of q) defaults in the basket;
- last pth-to-default, which provides protection on the last p (out of q) defaults.

Basket default swaps require special treatment in their pricing and valuation compared to single-name CDS contracts. Following the advent of a liquid market in index CDS contracts, the iTraxx and CD-X indices, basket CDS became rare. However, it is worth being aware of them because occasionally they are still used to tailor credit risk exposure hedges.

Basket default swaps are required for specific applications of credit exposure and hedging. First-to-default basket CDS are the most common

TABLE 2.6 First-to-default basket CDS on hypothetical reference names.

Reference name	Credit rating	Premium (bps)
Bank	AA/Aa	53
Non-bank financial	A/A2	120
Airline	BBB-/Baa2	130
Utility	BBB+/Baa1	110
Transport	BBB+/Baa2	120



CDS premium 285 basis points per annum—contingent payment of par minus recovery value of first default.

in the market. They enable investors to spread out their credit risk but without increasing their downside credit risk exposure. The maximum loss for the investor in the basket is (as for a single-name CDS) par minus the recovery value of the first asset that experiences a credit event, which is the same risk exposure were they to be long the bond in the cash market. The advantage of the basket CDS though is that the protection premium paid to the investor will be a higher spread that that paid by any of the individual names in the basket. We illustrate this Table 2.6 below, with some hypothetical industry sectors. Each individual name does not pay more than 130 bps, with an average premium of 107 bps. However, a first-to-default basket CDS on all these names will pay 285 bps.

The variations in basket CDS present different risk/return profiles. For example, a second-to-default basket CDS will only pay protection after the second and subsequent reference asset has experienced a credit event. Thus it is a lower risk investment with a lower level of credit risk exposure than the first-to-default basket, but paying a higher premium than a single-name CDS on any of the names in the basket.

Basket products also exist in funded form as CLNs (see Chapter 3), usually issued by a special purpose vehicle (SPV).

Illustration of a Basket Credit Default Swap

Figure 2.17 shows a basket CDS written on a portfolio of five reference names. The protection seller writes protection on the basket, for which it receives the CDS premium. A notional amount is specified for each reference entity in the basket. During the term of the CDS if one of the reference entities experiences a credit event, the protection seller will make a protection

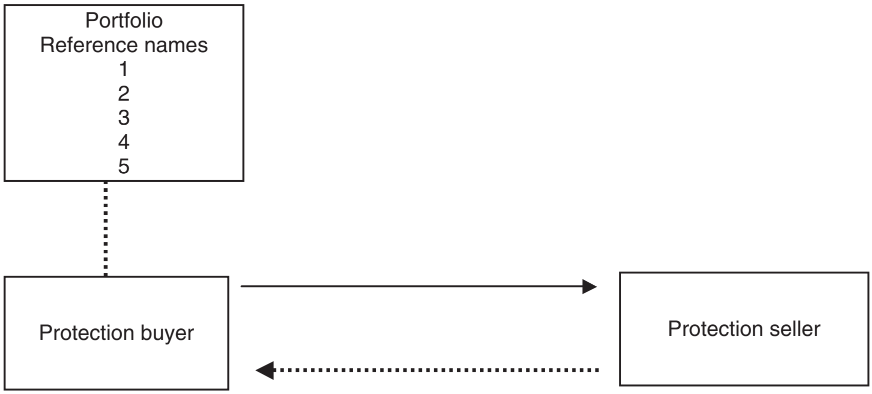


FIGURE 2.17 Basket CDS.

payment to the protection buyer, to the value of the pre-specified notional amount (minus the usual value in accordance with the type of settlement mechanism chosen). On occurrence of a credit event, the affected reference entity is removed from the basket. However, the CDS itself still runs to its original maturity date, covering the remaining entities in the basket.

As an example consider a basket CDS as shown in Figure 2.17, written on a portfolio of five reference entities. A protection buyer enters into a basket CDS with a market-maker with the following terms:

Trade date	17 February 2004
Value date	19 February 2004
Maturity date	19 February 2009
Notional amounts	\$20 million for each entity
Portfolio notional value	\$100 million
Settlement	Cash
Premium	285 bps

Assume that one year into the transaction, one of the reference entities experiences a credit event. Its recovery value is determined to be 70%. The protection seller makes a payment of:

$$\$20 \text{ million} \times (1.00 - 0.70)$$

or \$6.66 million at the time of the credit event. The affected reference name then drops out of the basket.

The CDS will then continue to maturity, and assuming the portfolio experienced no further credit events, would expire on 19 February 2009 having not paid out any more cash flows (apart from the ongoing premium). The terms of the CDS would have changed to reflect an $80 million notional basket value, covering four reference entities.

If any of the remaining four entities experience a credit event, the same procedure will apply again. The main difference between a single name CDS and the basket is that the CDS would have terminated on occurrence of the credit event, whereas the basket will continue, albeit covering only for the remaining unaffected names, to its original maturity date. The key advantage of the basket CDS is that it typically offered protection for multiple names at a lower cost than if the protection buyer had taken out a series of single-name CDS for each name in the portfolio.

The protection provided by the basket discussed above could also be traded in funded form, as a basket credit-linked note (CLN). In the example given above, the nominal value of the note would be $100 million, paid up front by the investor (protection seller). If we assume the same credit event as above, there will be a payout on occurrence of the credit event of $6.66 million, and on maturity of the note (assuming no further credit events) the redemption proceeds would be $93.7 million rather than $100 million. Investors receive a pro rata amount of the remaining total principal available in accordance with the amount of the note they are holding. If the CLN was issued as a series of notes with differing seniority, the senior notes would be paid off in full first, before investors holding the more junior notes are paid their redemption proceeds.

The basket CLN is shown in Figure 2.18.

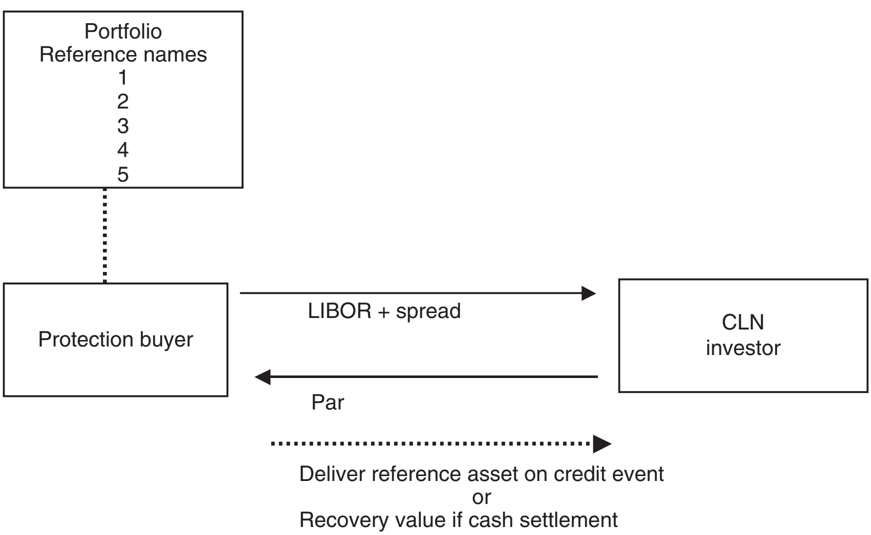


FIGURE 2.18 Basket CLN.

First-to-Default Portfolio CDS

A first-to-default CDS (FtD) is similar to the basket CDS described above, with one key difference: unlike with a standard basket CDS, on occurrence of a credit event the entire FtD CDS will terminate and settlement will be with regard to the entire notional amount following the first credit event affecting one of the reference entities.

If we assume the same circumstances as the earlier basket CDS, with the FtD CDS written on five reference entities for a notional total of $100 million, following the first credit event the swap will terminate with a settlement of $93.7 million.

As we see in the next section the key issue for those analysing FtD swaps is the correlation between the different reference entity names. Correlation is assessed with respect to each name's industrial sector, credit rating, geographical region and so on. In contrast to an investor in (say) a cash flow CDO, where diversifying among the names in the portfolio will, in theory at least, reduce the risk exposure to the credit protection seller, with an FtD CDS greater diversity may in fact increase the risk factor. This is because it may increase the probability of default or other credit event, since as soon as the first reference entity experiences a credit event, it triggers termination of the entire CDS. For this reason, an FtD CDS will be priced at a higher level than a basket CDS for the same reference name, to compensate investors for the higher resultant risk exposure.

Pricing Considerations

For instance, consider that a fund manager is holding three bonds issued by three different issuers. If the fund manager is worried about one of the bonds defaulting, it can buy a first-to-default swap contract. If instead it was to buy three different CDSs then in order for the contract to be used all three bonds would have to default. But if the fund manager does not believe that all three bonds would default, then it would not be worth paying for three separate CDS contracts. Hence, it is a cheaper hedge to buy a basket CDS that covers all three bonds in the portfolio and set the CDS as an *n*th-to-default swap contract.

The degree to which the *n*th-to-default basket would be cheaper than buying three separate CDSs depends on the default correlation between the reference entities in the basket. Consider two extreme examples; let us say that we have three bonds of different issuers and that all of them have a default correlation of 100%. This would mean that a fair price for the first to default is the same as the premium of the most expensive single name CDS. To explain the logic behind this let us take a look at this from a risk perspective. If we have CDSs on three reference entities A, B and C at a price of 50, 50 and 50 bps respectively and all of them have the same time to default (by definition 100% default correlation), then the first to default premium should be the 50 bps. If *t(i)* is the time to default then all of them will default at time *t(i)*, and as only payments of the first to default will be made the seller of the first-to-default swap will charge the same premium as that of the single name CDS on say C.[15] Now let us assume that there is no default correlation between any of the above reference entities. Here the risk to the seller of the first to default is greater. We cannot take the perspective of selling one CDS, say C and assuming one payment will be made when C defaults and the seller of the CDS will not have to worry about the others defaulting, because their defaults are perfectly correlated and only a risk of 50 bps can be attached. Here the two other reference entities can default at completely different times. Now from the perspective of the seller of the CDS if the three reference entities can default at different times, the probability of a default occurring until the maturity of the basket contact is greater. This results in a higher premium than in the first case. By the above logic, there is a simple formula for the first to default, second to default and first two to default, and this would be the sum of the premium between the first and second to default.

Essentially first-to-default baskets are an efficient way for portfolio managers to hedge their exposure when they believe that not all of the bonds in their portfolio can default within short periods of time. This makes it cheaper for them to hedge using basket CDS contracts.

Default Correlation

A basket CDS is a *default correlation* instrument. The main determinant of the price of an nth-to-default basket is the correlation of default. So, for instance, assets issued within the same geographical or industrial sector will have a higher correlation of default than assets that are more diverse.

Let us say that we have a basket with two reference entities, A and B. The default correlation is represented by:

$$\rho(ab) = \frac{\pi ab(T) - Qa(T)Qb(T)}{\sqrt{[Qa(1 - Qa)][Qb(1 - Qb)]}}$$

[15] The above is a theoretical simplification for demonstration purposes. Using strict statistical definitions we imply the probability that one of the reference entities has experienced a default on condition that none of the other reference entities has defaulted. Although the above is a simplification, in the limit of there being a 100% default correlation the above example is valid.

where $\pi(ab)$ is the probabilities of both reference entities a and b defaulting between time $t = 0$ and T, and $Qa(T)$ is the cumulative probability of a default at time T.

The above form is used when the default probabilities follow a normal distribution. A preferable method of structuring correlation relation when variables are normally distributed is the *Gaussian Copula* approach. This subject is outside the scope of the book. Suppose that Ta and Tb are the times to default of reference entities a and b, which are not normally distributed. If we let Ta be the time to default of reference entity a and Tb be the time for B, we imply

$$\begin{aligned} \mu_a &= N^{21}\,[Qa(Ta)] \\ \mu_b &= N^{21}\,[Qb(Tb)]. \end{aligned}$$

Here μ_a and μ_b are normally distributed, which means that the correlation is $ab = \text{corr}[\mu_a(Ta), \mu_b(Tb)]$.

QUANTO DEFAULT SWAPS

A *quanto default swap* is a CDS in which the swap premium payments, and/or the cash proceeds in the event of termination, are in a different currency to that of the reference asset. An example is a CDS written on a euro-denominated bond, for which the premium is payable in US dollars. Quanto swaps are used to hedge holdings in bonds or bank loans that are in a different currency to the investor's 'home' currency and may be illiquid or not traded.

STRUCTURED FINANCE SECURITY CDS

The advent of a liquid and transparent market in credit derivatives has meant that investors began to look at synthetic access to the asset-backed security (ABS) and mortgage-backed security (MBS) market. Here we discuss credit default swaps written on ABS. This is a more recent market, with the first products being made available to investors in 2004. The demand for such synthetic assets arose from a shortage of ABS paper in the cash market that year. These products enabled certain market counterparties with more foresight than others to short the US sub-prime market during 2007, by buying protection on sub-prime MBS and CDO of ABS that held sub-prime linked underlying assets. Such traders were one of the few that profited from the liquidity and credit crunch that followed the delinquencies in the US mortgage market. After the crash, CDS of ABS became much less frequently traded, mirroring the collapse in liquidity in the ABS cash market that also resulted.

Credit Derivatives and ABS Markets

Credit derivatives markets extended into the asset-backed and mortgage-backed markets mainly due to the shortage of paper in the cash market. It was the standardisation of CDS contracts and trading terminology facilitated the expansion of credit derivatives into structured finance markets.

There are a number of detail differences between ABS credit risk and corporate credit risk. A single-name corporate CDS transacted under the standard 2003 ISDA Credit Derivatives definitions[16] will be based on clearly defined trigger events ('credit events') and a transparent process of settlement, either physical or cash settlement. A CDS written on an ABS issue can present problematic issues with regard to both these items. Corporate CDS trigger events are, following some initial problems with definitions, straightforward to describe. They include bankruptcy, failure to pay, debt restructuring and in some cases ratings downgrade. Such occurrences can be identified easily in most cases. Also, the outstanding debt of a corporate entity can be expected to trade at roughly the same level in the event of issuer default, irrespective of coupon or maturity.

Structured finance securities such as ABS and MBS differ in both these respects. The key difference is that unlike corporate bonds, most ABS are issued by SPVs, bankruptcy-remote legal entities created solely for the purpose of facilitating the bond issue. Bankruptcy and restructuring rarely apply to SPVs. Also it may be less clear in the case of an SPV that there has been a failure to pay. Unlike corporate entities, credit ratings of SPVs are based essentially on the quality of the underlying assets. The repayment of these assets is not known with certainty, which is why ABS bonds are given long legal final maturities. Other issues that complicate the matter of CDS on ABS include the following:

- ABS structures with an element of uncertain cash-flow patterns include the provision for the write-down of principal in the event of losses. This does not always constitute a 'default' as the write-down can be reversed and made good later.
- Many ABS structures allow for a delay in interest payment; for example, during a time when the excess spread in the vehicle has been reduced. 'Again this may not constitute default and may not necessarily lead instantly to a ratings downgrade as the interest coverage may be expected to become sufficient again.

[16] See www.isda.org

- The structure represents a distinct pool of assets, ring-fenced within the SPV. This contrasts with the general pool of assets represented in a corporate entity.

It is quite possible for the more junior tranches of an ABS issue to be in default while the senior tranches are not, again representing the way the asset pool is performing.

The significant difference therefore, between an ABS CDS and a single-name corporate CDS is that the former is written against a specific security, while the latter is written at an entity level on a corporate name. However, writing a contract on a specific security means that physical settlement on occurrence of a credit event is impractical. For this reason physical settlement is not used. Cash settlement may also be problematic because of the difficulty with ascertaining the market value of the ABS tranche. A different type of CDS, the pay-as-you-go CDS (PAUG CDS), was developed for this market.

Pay-As-You-Go CDS

PAUG CDSs were developed to meet the distinct requirements of synthetic investment in ABS issues. A PAUG CDS acts like a standard CDS, with provision for termination on occurrence of specified credit events. The protection buyer pays a fixed basis point fee to the protection seller, which is also standard. However, the PAUG contract also permits the following:

- payment of an additional floating payment from protection seller to protection buyer in the event of a principal write-down;
- payment of a fixed payment from protection buyer to protection seller in the event of a write-up;
- provision of altering cash flows in the event of an interest shortfall of ABS vehicle.

To illustrate, consider the case where the performance of the underlying asset pool in an ABS, due to underperformance or default, means that the principal amount of one or more of the overlying note tranches must be reduced.[17] The protection seller would make a floating payment to the protection buyer to cover this written-down amount. The CDS itself would not terminate. If at a later date the principal balance is reinstated—for example, because the portfolio performance has improved—the protection buyer would then make a fixed payment to the seller.

Figure 2.19 on page 93 illustrates the mechanics of a PAUG CDS in the event of write-down.

[17] This would normally be decided by the Trustee or the Servicer to the transaction.

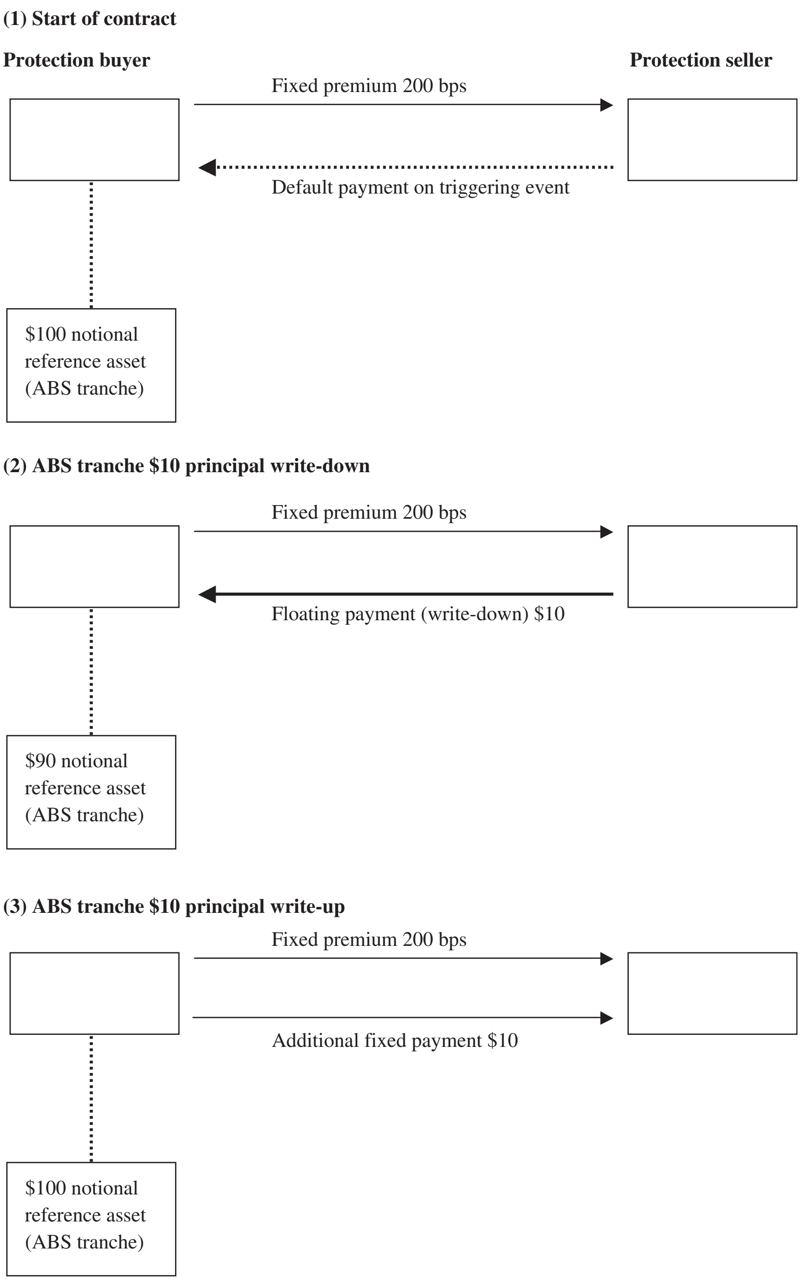


FIGURE 2.19 PAUG CDS cash-flow mechanics in event of ABS note principal write-down.

A standard CDS would generally cover the following credit events:

- failure to pay;
- credit rating downgrade to sub-investment grade;
- permanent write-down.

A PAUG CDS would also cover the following without being terminated:

- principal write-down;
- interest shortfall;
- failure to pay principal.

By incorporating this flexibility, investors are better able to gain a realistic exposure to the ABS market, albeit synthetically.

Market Considerations

Generally, the protection sellers in the ABS CDS market include investors who would normally hold cash ABS bonds. This is marked when there is a shortage of paper in the cash market. The ability to short ABS tranches means that investors can also take a view on ABS credit; previously this would not necessarily have been straightforward because of the illiquid nature of the ABS repo market. The differences between the corporate and ABS markets are mirrored in the synthetic market. Investors will be aware that corporate entities are dynamic corporations that are proactively able to avoid credit events, which is not the case with SPVs. Synthetic ABS investors must therefore still be concerned primarily with the quality of the underlying collateral and the specific risk/return profile of the individual ABS tranche. Also, there is the issue of prepayment uncertainty. Most corporate bonds have a bullet maturity or fixed redemption date. Non-redemption would constitute a credit event. ABS securities however amortise over time, with the redemption date not known with certainty. (For analysis purposes the *average life* of the ABS note is used, this figure is an estimated repayment term based on an assumed level of prepayments). However, the non-redemption of a tranche in accordance with an average life estimate would not be deemed a credit event.

ABS tranches experience a declining notional balance over time as principal is repaid in stages in the underlying asset pool, due to prepayments and other factors. The outstanding notional value of ABS tranches therefore reduces over time; investors would observe this also occurring with ABS CDS contract notionals as they mirror the behaviour of the cash bond.

ABS CDS and Cash Bond Valuation

In theory the basis between a PAUG CDS and its reference cash bond should be small because the contract mirrors the profile and behaviour of the cash bond closely.[18] In practice a number of market and structural factors cause the cash and synthetic markets to trade at a negative or positive basis. These include the following:

- In the synthetic market, the investor is exposed additionally to counterparty risk, as it is the counterparty who is paying the coupon (CDS premium). The cash investor is exposed to the quality of the reference collateral only.
- The ABS CDS is an unfunded instrument and so carries no funding cost; this is an additional factor in relative value analysis.
- Supply and demand factors may be more prevalent in the synthetic market, as the availability of protection buyers may be limited (unlike ABS transaction originators in the cash market, there is no natural market for protection buyers in the ABS CDS market outside market-makers).

The depth and transparency of the ABS CDS market decreased in the wake of the 2007 market fall-out, as market-making banks willing to write protection on such securities (which included AIG, Bear Stearns and Lehman Brothers, among others), withdrew from the market. However, as investors return to ABS products generally, CDS of ABS should also regain liquidity.

EXAMPLE 2.3 CDS OF ABS

The CDS of ABS market-maker that is the counterparty to the CDS investor may gain from acting in this business in the following ways:

- buying protection on this class of assets releases economic capital that can be invested in higher yielding assets elsewhere;
- it may be able to find similar assets in the cash market that yield a higher spread than the CDS protection it is paying for;
- it can treat this business as trading activity—CDS market-making—and seek to gain a trading profit.

(*continued*)

[18] See Chapter 8 on the CDS basis.

Irrespective of the motivation of the investor and the CDS counterparty to these trades, this business illustrates the impact of supply and demand on reversing the market convention of a positive basis.

We assume a tranche of an existing MBS issue that pays LIBOR plus 50 bps (L + 50) and a CDS contract written on this tranche that pays L + 50 to the protection seller. To illustrate the cash market investment against the synthetic investment, consider Figure 2.20 below, which compares and contrasts each type for a holding of $10 million nominal.

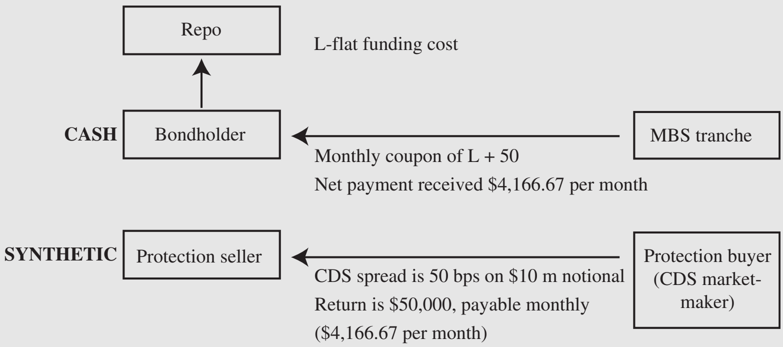


FIGURE 2.20 Illustrating Cash and Synthetic Investment in an MBS Note.

Note that for the cash investor, we assume that the bondholding can be funded at LIBOR-flat, so that the net return remains L + 50. Although this is an unrealistic assumption (during 2004–2005 even a AAA-rated MBS bond would be funded no better than L + 5 and possibly L + 10, depending on the type of counterparty), we have done this for ease of illustration.

Under the basic scenario, there are no credit events during the life of the CDS, and no interest shortfalls during this term for the cash bond. The return on both the CDS and bond are therefore identical. Consider if the MBS tranche is written down by 20%. In this event, under the terms of the contract, the CDS suffers a nominal write-down of 20%. Both the MBS bond and the CDS pay coupon during the write-down period. For the cash bondholder there is a loss of $1 million, while on the CDS a protection payment of $1 million is made by the protection seller (investor) to the protection buyer. In other words, the economic impact is identical for both types of investor.

Following the write-down, cash flows for both the bond and the CDS are also identical; that is:

- on the bond there is a new face value of $9 million; hence, the coupon payment received is L + 50 on notional of $9 million or $3,750.00 per month;
- on the CDS the new notional is $9 million; hence, the contract now pays L + 50 or $3,750.00 per month.

Now consider an event where on final maturity of the bond there is a failure to pay 50% of the principal balance. On CDS maturity, the reference bond pays only 50% of the scheduled principal. In this case, the protection seller pays $5 million to the protection buyer. The bondholder will suffer this loss of $5 million, which actually needs to be paid to its repo counterparty, who is actually holding the bond.

Our final scenario concerns a non-payment of interest for a period of time, let us say six months. During this period no coupon is paid to the MBS bondholder, although the bondholder is still liable to pay the repo interest to the repo counterparty. For the CDS contract, the protection buyer will pay a reduced amount of premium because the reference security is not paying the full coupon, and so in this case premium payments will cease as well.

However, because the CDS contract is an unfunded investment, the investor does not suffer the negative funding that the cash bondholder experiences. This is an advantage for the investor in the synthetic MBS. Assuming that the MBS starts to pay interest after the sixth month no-interest period, the cash bondholder will recover all the unpaid interest to date, as does the CDS investor.

ASSET SWAPS[19]

Description

Asset swaps pre-date the introduction of the other instruments we discuss in this chapter and strictly speaking are not credit derivatives: they are viewed as being part of the 'cash market'. However, they are used for

[19] This section was co-written with Richard Pereira.

similar purposes and there is considerable interplay between the cash and synthetic markets using asset swaps, hence we include them here. An asset swap is a combination of an interest rate swap and a bond, and is used to alter the cash flow profile of a bond.[20] The asset swap market is an important segment of the credit derivatives market since it explicitly sets out the price of credit as a spread over LIBOR. Pricing a bond by reference to LIBOR is commonly used and the spread over LIBOR is a measure of credit risk in the cash flow of the underlying bond. This is because LIBOR—the rate at which banks lend cash to each other in the inter-bank market—is viewed as representing the credit risk of banks. As such it can be viewed as a AA or AA– credit rating. The spread over LIBOR therefore represents additional credit risk over and above that of bank risk.

Asset swaps are used to transform the cash flow characteristics of a bond, either fixed-rate into floating-rate or floating-rate into fixed-rate. This enables investors to hedge the currency, credit and interest rate risks to create investments with more suitable cash-flow characteristics for themselves. An asset swap package involves transactions in which the investor acquires a bond position and then enters into an interest rate swap with the bank that sold them the bond. If it is a fixed-rate bond, the investor will pay fixed and receive floating on the interest rate swap. This transforms the fixed coupon of the bond into a LIBOR-based floating coupon.

For example, assume that a protection buyer holding a fixed-rate 'risky' bond wishes to hedge the credit risk of this position via a credit default swap. By means of an asset swap, the protection seller (for example, a bank) will agree to pay the protection buyer LIBOR–/–spread in return for the cash flows of the risky bond. In this way, the protection buyer (investor) may be able to explicitly finance the CDS premium from the asset swap spread income if there is a negative basis between them. If the asset swap is terminated, it is common for the buyer of the asset swap package to take the 'unwind' cost of the interest rate swap.

Asset swaps have some similarities with TRS, but the key difference is that there is no concept of a 'credit event' with an asset swap. Upon default of the underlying asset, a TRS will terminate, whereas with an asset swap the interest rate swap will continue until its scheduled maturity.

The generic structure for an asset swap is shown in Figure 2.21.

[20] For a background on interest rate swaps, see Das (1994), Kolb (1999), Decovny (1999), Choudhry (2001), and so on.

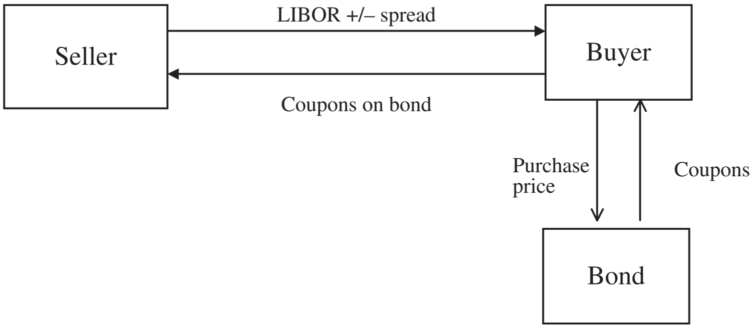


FIGURE 2.21 Asset swap structure.

Illustration Using Bloomberg

We can illustrate the asset swap spread for a credit-risky corporate bond using Bloomberg screens. In Figure 2.22 we show the 7% 2007 bond issued by British Telecom, a UK telecommunication company. The bond is

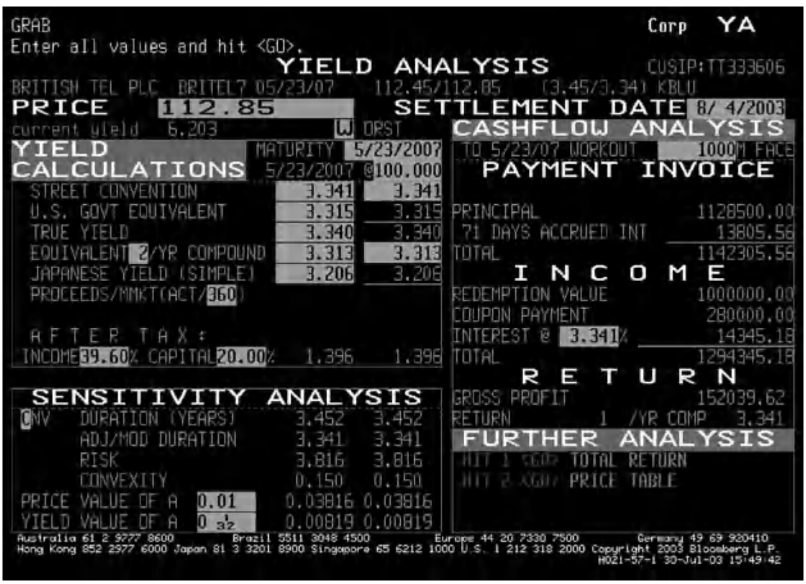


FIGURE 2.22 Bloomberg screen YA for British Telecom 7% 2007 bond, as at 11 June 2003.

denominated in US dollars. The screen is Bloomberg's YA page for yield analysis, which is obtained by typing:

BRITEL 7 07 ⟨CORP⟩ YA ⟨GO⟩

and shows the bond as at 4 August 2003, at an offered price of 112.85, which represents a yield of 3.340%. Combining this with an interest rate swap to create an asset swap will convert the bond's fixed-rate coupon to a floating-rate coupon for the bondholder, who pays fixed and receives floating in the associated interest rate swap.

To establish what the spread for this bond would be in an asset swap, we call up screen ASW. This is shown in Figure 2.23 and we see that the asset swap spread for the bond, which is rated Baa1 by Moody's and A– by S&P, is 30.7 bps. The bond price on the screen is user-input at 112.85 as before. Another screen can be used to see the bond spread over other references and benchmarks, and this is shown at Figure 2.24. We see that the interpolated spread over US Treasuries is 69 bps. This compares to a spread of just over 60 bps over Treasuries at the time the bond was issued. In other words, the bond has cheapened in the market since issue in May 1997, when it was priced off the US 10-year active bond. This reflects market

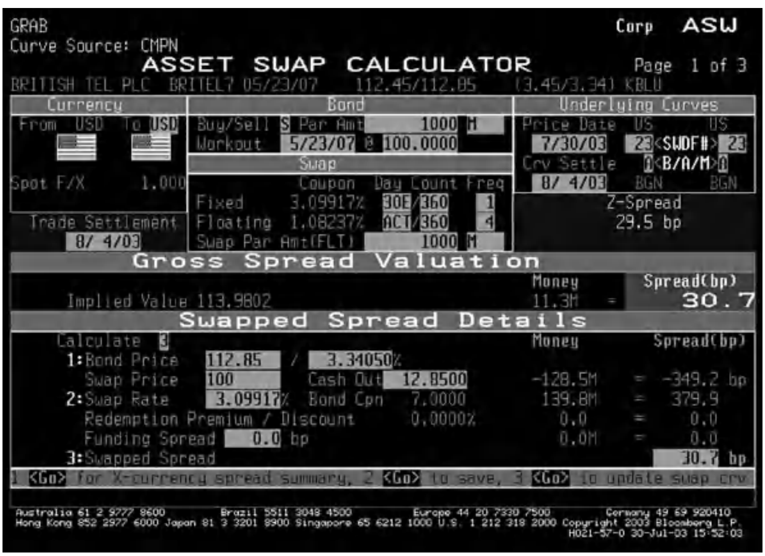


FIGURE 2.23 Bloomberg screen ASW for British Telecom 7% 2007 bond, as at 4 August 2003 settlement.

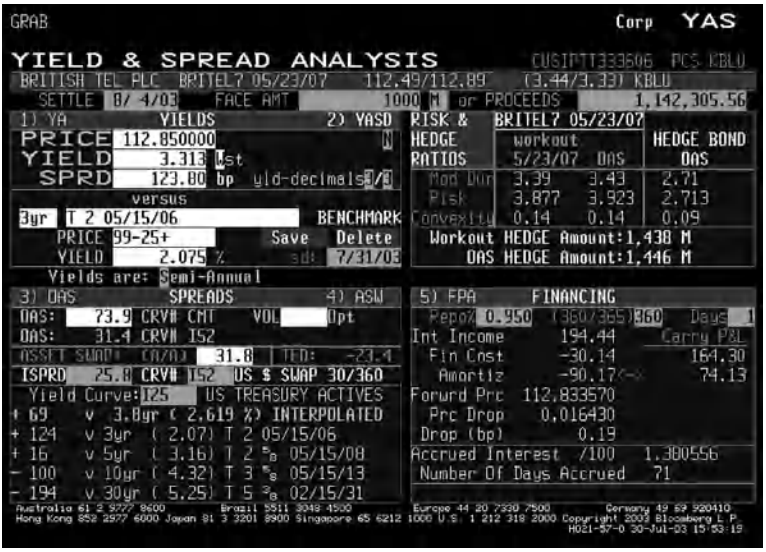


FIGURE 2.24 Determination of British Telecom 7% 2007 bond yield spreads, using Bloomberg Screen YAS, as at 4 August 2003 settlement.
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interest rate conditions generally as well as the fact that the issuer has been downgraded in that time.

Selecting the generic credit-risky industrials yield curve for USD bonds (numbered I52 on Bloomberg), we see that the asset swap spread is actually 31.8 bps for this bond also shown in Figure 2.24. This is because the screen has calculated the asset swap spread over a specific, and hence more appropriate yield curve, rather than the generic inter-bank LIBOR curve used by screen ASW.

TOTAL RETURN SWAPS

A *total return swap* (TRS), sometimes known as a *total rate of return swap* or *TR swap*, is an agreement between two parties that exchanges the total return from a financial asset between them. This is designed to transfer the credit risk from one party to the other. It is one of the principal instruments used by banks and other financial instruments to manage their credit risk exposure, and as such is a credit derivative. One definition of a TRS is given in Francis *et al* (1999), which states that a TRS is a swap agreement in which the *total return* of a bank loan or credit-sensitive security is exchanged for some other cash flow, usually linked to LIBOR or some other loan or credit-sensitive security.

The TRS trade itself can be to any maturity term; that is, it need not match the maturity of the underlying security. In a TRS, the total return from the underlying asset is paid to the counterparty in return for a fixed or floating cash flow. This makes it slightly different to other credit derivatives, as the payments between counterparties to a TRS are connected to changes in the market value of the underlying asset, as well as changes resulting from the occurrence of a credit event. So, in other words, TRS cash flows are not solely linked to the occurrence of a credit event—in a TRS the interest rate risk is also transferred. The transaction enables the complete cash flows of a bond to be received without the recipient actually buying the bond, which makes it a synthetic bond product and therefore a credit derivative. An investor may wish to receive such cash flows synthetically for tax, accounting, regulatory capital, external audit or legal reasons. On the other hand, it may be easier to source the reference asset synthetically—via the TRS—than in the cash market. This happens sometimes with illiquid bonds.

In some versions of a TRS, the underlying asset is actually sold to the counterparty, with a corresponding swap transaction agreed simultaneously. In other versions, there is no physical change of ownership of the underlying asset. This makes TRS akin to a synthetic repo transaction. This is discussed in Appendix 2.3.

Figure 2.25 illustrates a generic TRS. The two counterparties are labelled as banks, but the party termed 'Bank A' can be another financial institution, including cash-rich fixed-income portfolio managers such

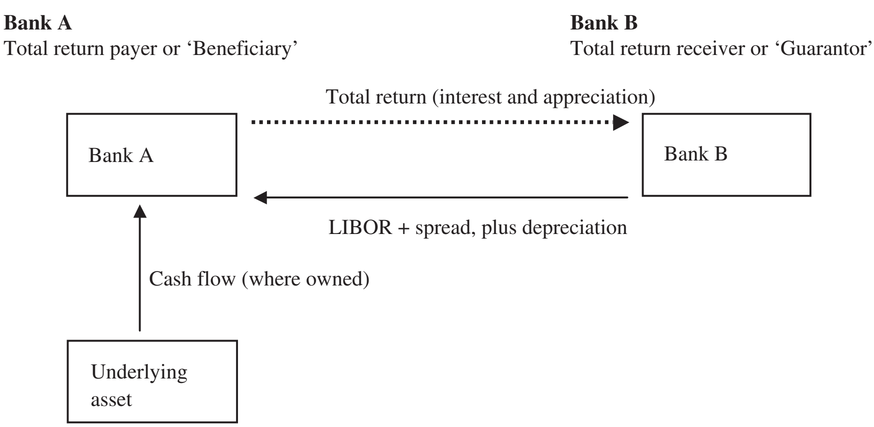

FIGURE 2.25 Total return swap.

as insurance companies and hedge funds. In Figure 2.25, Bank A has contracted to pay the 'total return' on a specified reference asset, while simultaneously receiving a LIBOR-based return from Bank B. The reference or underlying asset can be a bank loan such as a corporate loan or a sovereign or corporate bond. The total return payments from Bank A include the interest payments on the underlying loan as well as any appreciation in the market value of the asset. Bank B will pay the LIBOR-based return and it will also pay any difference if there is a depreciation in the price of the asset. The economic effect is as if Bank B owned the underlying asset, so as such TR swaps are synthetic loans or securities. A significant feature is that Bank A will usually hold the underlying asset on its balance sheet, so that if this asset were originally on Bank B's balance sheet, this is a means by which the latter can have the asset removed from its balance sheet for the term of the TR swap.[21] If we assume Bank A has access to LIBOR funding, it will receive a spread on this from Bank B. Under the terms of the swap, Bank B will pay the difference between the initial market value and any depreciation, so it is sometimes termed the 'guarantor' while Bank A is the 'beneficiary'.

The total return on the underlying asset is the interest payments and any change in the market value if there is capital appreciation. The value of an appreciation may be cash settled, alternatively there may be physical delivery of the reference asset on maturity of the swap, in return for a payment of the initial asset value by the total return 'receiver'. The maturity of the TR swap need not be identical to that of the reference asset, and in fact it is rare for it to be so.

The swap element of the trade will usually pay on a monthly, quarterly or semi-annual basis, with the underlying asset being revalued or *marked-to-market* on the re-fixing dates. The asset price is usually obtained from an independent third party source such as Bloomberg or Reuters, or as the average of a range of market quotes. If the *obligor* of the reference asset defaults, the swap may be terminated immediately, with a net present value payment changing hands according to what this value is, or it may be continued with each party making appreciation or depreciation payments as appropriate. This second option is only available if there is a market for the asset, which is less likely in the case of a bank loan. If the swap is terminated, each counterparty is liable to the other for accrued interest plus any appreciation or depreciation of the asset. Commonly under the terms of the trade, the guarantor bank has the option to purchase the underlying asset from the beneficiary bank, and then deal directly with loan defaulter.

[21] Although it is common for the receiver of the LIBOR-based payments to have the reference asset on its balance sheet, this is not always the case.

The TRS can also be traded as a funded credit derivative, and we look at this in the next chapter. The use of TRS for funding purposes is considered in Chapter 5.

Banks employ a number of methods to price credit derivatives and TR swaps. Essentially the pricing of credit derivatives is linked to that of other instruments; however, the main difference between credit derivatives and other off-balance sheet products such as equity, currency or bond derivatives is that the latter can be priced and hedged with reference to the underlying asset, which can be problematic when applied to credit derivatives. Credit products pricing uses statistical data on likelihood of default, probability of payout, level of risk tolerance and a pricing model. With a TRS the basic concept is that one party 'funds' an underlying asset and transfers the total return of the asset to another party, in return for a (usually) floating return that is a spread to LIBOR. This spread is a function of:

- the credit rating of the swap counterparty;
- the amount and value of the reference asset;
- the credit quality of the reference asset;
- the funding costs of the beneficiary bank;
- any required profit margin;
- the capital charge associated with the TRS.

The TR swap counterparties must consider a number of risk factors associated with the transaction, which include:

- the probability that the TR guarantor or receiver may default while the reference asset has declined in value;
- the reference asset obligor defaults, followed by default of the TR swap receiver before payment of the depreciation has been made to the payer or 'provider'.

The first risk measure is a function of the probability of default by the TR swap receiver and the market volatility of the reference asset, while the second risk is related to the joint probability of default of both factors as well as the recovery probability of the asset.

A formal pricing formula for a TRS contract is given in Chapter 6.

CREDIT OPTIONS AND CREDIT SPREAD OPTIONS

Credit options are also bilateral OTC financial contracts. A credit option is a contract designed to meet specific hedging or speculative requirements of an entity, which may purchase or sell the option to meet its objectives. A credit call option gives the buyer the right, but not the obligation, to purchase the underlying credit-sensitive asset, or a credit spread, at a specified price and specified time (or period of time). A credit put option gives the buyer the right, but not the obligation, to sell the underlying credit-sensitive asset or credit spread. By purchasing credit options, banks and other institutions can take a view on credit spread movements for the cost of the option premium only, without recourse to actual loans issued by an obligor. The writer of credit options seeks to earn premium income.

Credit option terms are similar to those used for conventional equity options. A *call* option written on a stock grants the purchaser the right, but not the obligation, to purchase a specified amount of the stock at a set price and time. A credit option can be used by bond investors to hedge against a decline in the price of specified bonds, in the event of a credit event such as a ratings downgrade. The investor purchases an option which has a payoff profile that is a function of the credit quality of the bond, so that a loss on the bond position is offset by the payout from the option.

As with conventional options, there are both vanilla credit options and exotic credit options. The vanilla credit option[22] grants the purchaser the right, but not the obligation, to buy (or sell if a *put* option) an asset or credit spread at a specified price (the *strike* price) for a specified period of time up to the maturity of the option. A credit option allows a market participant to take a view on credit only, and no other exposure such as interest rates. For example, consider an investor who believes that a particular credit spread, which can be that of a specific entity or the average for a sector (such as 'all AA-rated sterling corporates'), will widen over the next six months. They can buy a 6-month call option on the relevant credit spread, for which a one-off premium (the price of the option) is paid. If the credit spread does widen beyond the strike price during the six months, the option will be in-the-money and the investor will gain. If not, the investor's loss is limited to the premium paid.[23]

Exotic credit options are options that have one or more of their parameters changed from the vanilla credit option, the same terms are used as in other option markets. Examples include the barrier credit option, which specifies a credit-event that *triggers* (activates) the option or inactivates it. A digital credit option has a payout profile that is fixed, irrespective of how much in-the-money it was on expiry, and a zero payout if out-of-the-money.

[22] Sometimes referred to as the standard credit option.

[23] Depending on whether the option is an American or European one will determine whether it can be exercised before its expiry date or on its expiry date only.

Credit spread options are options on specific credit spreads. The protection buyer pays an upfront premium to the protection seller. In return for this, on option exercise the protection buyer receives from the protection seller the difference between the yield on the underlying reference asset over a benchmark and the strike yield of the option. The benchmark might be a Treasury security or EURIBOR. With a *credit spread call*, the buyer has the right to buy the reference asset at a pre-specified strike yield. In a *credit spread put*, the buyer has the right to sell the reference asset at a pre-specified strike yield.

Under the call option, the payout on exercise increases as the credit spread decreases (the bond price is rising), and with the put option the payout increases as the credit spread widens. Credit spread options are used by banks and investors to protect against changes in credit spreads, or to trade credit spread volatility. Like other credit derivatives, they can be cash-settled or physically settled. For a credit spread option under physical settlement, the protection buyer can sell the reference asset to the protection seller for the strike credit spread.

The reference asset on a credit option is usually a floating-rate note or a fixed coupon bond referenced via an asset swap. For a call credit spread option, which would be held if one had a negative view of the reference name, exercise will take place on occurrence of a credit event. The strike 'price' for a credit spread option is quoted as a spread over LIBOR. For instance, an investor or hedger might buy an option that grants the right to enter into an asset swap with a strike price of LIBOR plus 50 bps. As long as the asset swap spread remains below 50 bps over LIBOR, the option will be in-the-money. The investor in this case has a positive view on the reference credit, which it has expressed by purchasing the call on the asset swap.

We illustrate this example at Figure 2.26.

A credit spread option may be used instead of other unfunded credit derivatives to express a view on a particular reference credit. The value of the option is not linked to the general level of interest rates; being a pure credit view, it is linked to the fluctuation in the credit spread of the reference

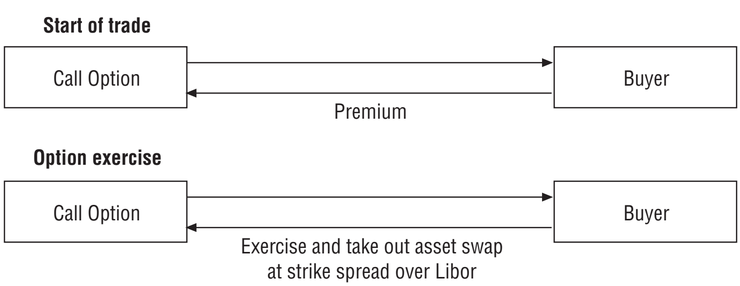

FIGURE 2.26 A call option on an asset swap.

name relative to the spread specified in the strike price. For instance, the value of a 6-month call option that gives the buyer the right to enter into a 3-year asset swap is a function of the 3-year asset swap spread in six months. So the option expresses a view on the forward credit spread. As with other types of options, a higher level of volatility (in this case volatility of credit spreads) will lead to a higher option value. Because a higher volatility increases the value of an option especially if there is a greater time-value, buying call credit spread option can also be undertaken as a view on credit spread volatility, providing the purchaser has hedged his position by purchasing the underlying reference credit.

THE CDS ITRAXX INDEX

The iTraxx series is a set of credit indices that enable market participants to trade funded and unfunded credit derivatives linked to a credit benchmark. There are a number of different indices covering different sectors; for example, iTraxx Europe, iTraxx Japan, iTraxx Korea and so on. The equivalent index in the North American market is known as CD-X. The iTraxx exhibits relatively high liquidity and for this reason is viewed as a credit benchmark, and its bid–offer spread is very narrow at 1–2 bps. This contrasts with spreads of anything between 10 and 50 bps for single-name CDS contracts. Because of its liquidity and benchmark status, the iTraxx is increasingly viewed as a leading indicator of the credit market overall, and the CDS index basis is important in this regard as an indicator of relative value.

The iTraxx series is a basket of reference credits that is reviewed on a regular basis. For example, the iTraxx Europe index consists of 125 corporate reference names, so that each name represents 0.8% of the basket. Figure 2.27 shows the an extract from a Bloomberg screen for the June 2011 iTraxx Europe index, with the first page of reference names. Figure 2.28 shows additional terms for this index contract.[24]

The index rolls every six months (in March and September), when reference names are reviewed and the premium is set. Hence there is a rolling series of contracts with the 'front contract' being the most recent. There are two standard maturities, which are 5.25 years and 10.25 years. Figure 2.29 shows a list of iTraxx indices as at June 2006; the second-listed contract is the current one, with a June 2011 maturity and a premium of 40 bps (see Figure 2.27). All existing indices can be traded, although the most liquid index is the current one. Reference names are all investment-grade rated and are the highest traded names by CDS volume in the past six months.

[24] The screens for the iTraxx are found by typing ITRX CDS <Corp> <go>.

<HELP> for explanation, <MENU> for similar functions. P174 **Corp**

CREDIT DEFAULT SWAPS for ticker ITRX CDS Page 1/ 11
Found 194

	ISSUER	SPREAD	MATURITY	SERS	RTNG	FREQ	TYPE	CNTRY/CURR
1)	ITRX EUR	25	6/20/09	5EU	N.A.	Qtr	iTRAXX	EU /EUR
2)	ITRX EUR	40	6/20/11	5EU2	N.A.	Qtr	iTRAXX	EU /EUR
3)	ITRX EUR	50	6/20/13	5EU3	N.A.	Qtr	iTRAXX	EU /EUR
4)	ITRX EUR	60	6/20/16	5EU4	N.A.	Qtr	iTRAXX	EU /EUR
5)	ITRX SDI	45	6/20/16	2SD	N.A.	Qtr	iTRAXX	GB /GBP
6)	ITRX INDS	40	6/20/11	5IND	N.A.	Qtr	iTRAXX	EU /EUR
7)	ITRX INDS	60	6/20/16	5IN2	N.A.	Qtr	iTRAXX	EU /EUR
8)	ITRX SUB	25	6/20/11	5SUB	N.A.	Qtr	iTRAXX	EU /EUR
9)	ITRX SUB	45	6/20/16	5SU2	N.A.	Qtr	iTRAXX	EU /EUR
10)	ITRX SNR FIN	15	6/20/11	5SNR	N.A.	Qtr	iTRAXX	EU /EUR
11)	ITRX SNR FIN	25	6/20/16	5SN2	N.A.	Qtr	iTRAXX	EU /EUR
12)	ITRX CROSS	290	6/20/11	5XOV	N.A.	Qtr	iTRAXX	EU /EUR
13)	ITRX CROSS	350	6/20/16	5XO2	N.A.	Qtr	iTRAXX	EU /EUR
14)	ITRX NON-FINL	40	6/20/11	5NF1	N.A.	Qtr	iTRAXX	EU /EUR
15)	ITRX NON-FINL	60	6/20/16	5NF2	N.A.	Qtr	iTRAXX	EU /EUR
16)	ITRX TMT	40	6/20/11	5TMT	N.A.	Qtr	iTRAXX	EU /EUR
17)	ITRX TMT	60	6/20/16	5TM2	N.A.	Qtr	iTRAXX	EU /EUR
18)	ITRX HVOL	40	6/20/09	5HI	N.A.	Qtr	iTRAXX	EU /EUR
19)	ITRX HVOL	70	6/20/11	5HI2	N.A.	Qtr	iTRAXX	EU /EUR

FIGURE 2.27 List of iTraxx Indices as shown on Bloomberg, 19 June 2006.

<HELP> for explanation. P174 **Corp** **CDSW**
<Menu> to return

ADDITIONAL DESCRIPTIVE INFORMATION

Announcement Date: 0/ 0/00
Int. Accrual Date: 3/20/06

1st Settle Date: 3/20/06
1st Coupon Date: 6/20/06

Maturity Date: 6/20/11

Payment Frequency: Q Quarterly
Day Count Basis: ACT/360

Business Days: EUR
Business Day Adj: 1 Following

Issue Spread: 40.0 bps

Currency: EUR

Amt Issued: 0.00
Amt Outstanding: 0.00

Par Amount: 0.00

FIGURE 2.28 Additional terms for June 2011 iTraxx Europe Index.

<HELP> for explanation. P174 **Corp** **CDSW**
1<GO> to sort by name. 3<Go> to sort by weight. 4<Go> to download to Excel.
Page 1/7

REFERENCE ENTITY LIST

Reference Entity Legal Name	Weight (%)
ABN AMRO Bank N.V.	0.800
ACCOR	0.800
Adecco S.A.	0.800
Aegon N.V.	0.800
Aktiebolaget Electrolux	0.800
Aktiebolaget Volvo	0.800
AKZO Nobel N.V.	0.800
Allianz Aktiengesellschaft	0.800
ALTADIS, S.A.	0.800
ARCELOR FINANCE	0.800
ASSICURAZIONI GENERALI - SOCIETA PER A	0.800
AVIVA PLC	0.800
AXA	0.800
BAA PLC	0.800
BAE SYSTEMS PLC	0.800
BANCA INTESA S.P.A.	0.800
BANCA MONTE DEI PASCHI DI SIENA S.P.A.	0.800
BANCA POPOLARE ITALIANA - BANCA POPOLA	0.800
BANCO BILBAO VIZCAYA ARGENTARIA, SOCIE	0.800
Banco Comercial Portugues, S.A.	0.800

FIGURE 2.29 Page 1 of List of reference names in iTraxx Europe June 2011 Index. © Bloomberg L.P. Used with permission. Visit www.bloomberg.com

A bank buying protection in €10 million notional of the index has in effect bought protection on €80,000 each of 125 single-name CDS. The premium payable on a CDS written on the index is set at the start of the contract and remains fixed for its entire term; the premium is paid quarterly in arrears in the same way as a single-name CDS. The premium remains fixed, but the market value fluctuates on a daily basis. This works as follows:

- The constituents of the index are set about one week before it goes live, with the fixed premium being set two days before. The premium is calculated as an average of all the premiums payable on the reference names making up the index. In June 2006 the current 5-year index for Europe was the iTraxx Europe June 2011 contract. The reference names in the index were set on 13 March 2006, with the premium fixed on 18 March 2006. The index went live on 20 March 2006. The index is renewed every six months in the same way.
- After the roll date, a trade in the iTraxx is entered into at the current market price.
- Since this is different to the fixed premium, an upfront payment is made between the protection seller and protection buyer, which is the difference between the present values of the fixed premium and the current market premium.

So for example, on 21 June 2006 the market price of the June 2011 iTraxx Europe was 34 bps. An investor selling protection on this contract would receive 40 bps quarterly in arrears for the five years from June 2006 to June 2011. The difference is made up front: the investor receives 40 bps although the market level at time of trade is 34 bps.[25] Therefore the protection seller pays a one-off payment of the difference between the two values, discounted. The present value of the contract is calculated assuming a flat spread curve and a 40% recovery rate. We can use Bloomberg screen CDSW to work this out, and Figure 2.30 shows such a calculation using this screen. This shows a trade for €10 million notional of the current iTraxx Europe index on 19 June 2006. We see the deal spread is 40 bps; we enter the current market price of 34 bps, and assume a flat credit term structure.

From Figure 2.30 we see that the one-off payment for this deal is €27,280. The protection seller, who will receive 40 bps quarterly in arrears for the life of the deal, pays this amount at trade inception to the protection buyer.[26]

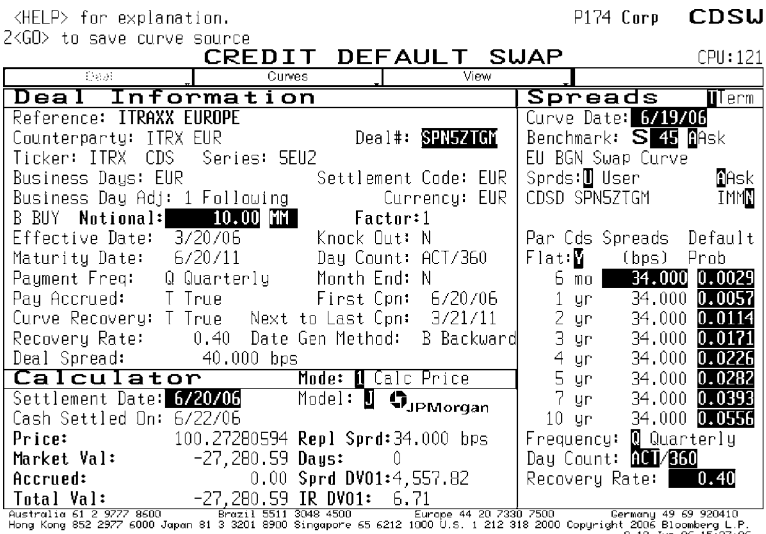

FIGURE 2.30 Screen CDSW used to calculate upfront present value payment for trade in €10 million notional iTraxx Europe Index CDS contract, 19 June 2006. © Bloomberg L.P. Used with permission. Visit www.bloomberg.com

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[25] Three years later on 22 June 2009 the iTraxx Europe was trading at 126 bps. Of course, there had been a global credit crunch in the meantime . . .

[26] The one-off payment reflects the difference between the prevailing market rate and the fixed rate. If the market rate was above 40 bps at the time of this trade, the protection buyer would pay the protection seller the one-off payment reflecting this difference.

TABLE 2.7 Example of iTraxx Index Skew for Series 8 Crossover Index.

Series 8	3-yr		5-yr		7-yr		10-yr	
	level	skew	level	skew	level	skew	level	skew
Crossover	562	8.9	586	8.5	589	13.4	587.6	18.6

Source: KBC Financial Products.

If a credit event occurs on one of the reference entities in the iTraxx, the contract is physically settled, for that name, for 0.8% of the notional value of the contract. This is similar to the way that a single-name CDS would be settled. Unlike a single-name CDS, the contract continues to maturity at a reduced notional amount. Note that European iTraxx indices trade under Modified–Modified restructuring (MMR) terms, which is prevalent in the European market. Under MMR, a debt restructuring is named as a credit event.[27]

iTraxx Index Skew

As an aside, in the ambiguous world of credit, skew has multiple meanings. Generally, however, the 'index skew', in the context of Table 2.7 below, is referring to the basis (another term that has more than one meaning). Basis in general, and in this context, is referring to fair value or market value of the index versus the theoretical value. In other words, if we were to compare the value of the index using all of the underlying credit names versus where the index is actually trading in the market, this difference is the 'skew'. In general, a positive basis (skew) means that the index is trading wider than its fair value.

We discuss the iTraxx index basis in greater detail in Chapter 9.

Example 2.4 iTraxx PRESENT VALUE CALCULATION[28]

Figure 2.31 shows how to calculate the default probabilities of the CDSW page on Bloomberg. The Excel spreadsheet (see Figure 2.32) shows the present value calculation.

[27] This contrasts with the North American market, which includes the CDX family of indices, where CDSs trade under no-restructuring terms; this describes only bankruptcy and liquidation as credit events.

- Counterparty buys 10m iTraxx Europe
- CDS references the credit spread of the most current series at launch
  - For example, the premium of the current iTraxx Europe is 45 bps
- After two days:
  - The fair value of CDS is 40 bps
  - Counterparty wants to buy €10m DJ iTraxx Europe exposure in CDS form
- The CDS is executed at the fixed premium level of 45bps
  - The market-maker pays 45 bps p.a. quarterly to counterparty on notional amount of €10m
  - The present value of the difference between premium and CDS fair value is settled through an upfront payment on T + 3 days
  - Counterparty pays to the market maker the PV of 5 bps plus accrued interest
  - This equals €24,004 (which can be calculated) by CDSW screen on Bloomberg shown opposite)

FIGURE 2.31 iTraxx trading example.

BLOOMBERG SCREENS

The Bloomberg system provides a number of pages for CDS and asset swap analytics, as well as contributed pages for CDS prices.

Market prices are supplied by a number of investment banks. Most banks make their price screens available only to clients, or on request. Banco Bilbao Vizcaya Argentaria (BBVA) is a market-maker whose screen is available to all users. Their screen of CDS prices for the Utilities and Industrial sectors is shown in Figure 2.33, this shows three- and five-year indicative CDS quotes, both bid and offer, together with the change from the last quote. We show at Figure 2.33(a) and (b) on page 117 two pages from the BBVA price menu, which is a comprehensive set of CDS prices across the sectors. Figures 2.34 and 2.35 on page 118 show the main menu page and the Airline/Aerospace sector CDS page from BBVA.

Other screens are supplied for analysis of CDS written on individual bonds. We illustrate these with selected bonds. Our first example is a bond issued by Toyota Motor Credit, the 5.5% 2008, which is a US dollar-denominated bond. Figure 2.36 on page 119 shows the description of the bond, which is Bloomberg's DES page. We select this bond on the Bloomberg system by typing:

Toyota 5.5 08 ⟨Corp⟩ DES ⟨GO⟩

FIGURE 2.32 Excel present value calculation.

Single-name CDS (quarterly) **Only one example for single-name CDS because no coupon**

Coupon is set as strike or trade price

Volvo AB	
Tenor	5 yr
Bid	300 bps
Offer	350 bps
Margin	10%

Trader A sells protection, then closes out trade later by buying protection

Open	Trader A wants to sell credit protection, hitting bid at		→ 3.00%
	Size	100,000.00 €	
	Spread	3.00%	(becomes fixed coupon)
	Trade Date (T)	**21-Jun-04**	
	Effective Date (T+1)	**22-Jun-04**	
	Next Coupon Date	**20-Sep-04**	(set as next quarterly month, on 20th of the month)
	Maturity Date	**20-Jun-09**	(set as five years from Trade Date, on 20th of the month)
	Accrued Int	**0.00 €**	(always zero at start for single name CDS)
	PV	**0.00 €**	(always zero at start for single name CDS)
	Net payment	0.00 €	
	Trader A pays to trade	0.00 €	
	Trader A deposits	10,000.00 €	
	Trader A account is	10,000.00 €	

(*Continued*)

FIGURE 2.32 (Continued)

Single name CDS (quarterly)			Only one example for single name CDS because no coupon	
Close	Trader A wants to close out trade by buying protection at		→ 3.50%	
	Size	100,000.00 €		
	Spread	3.50%		
	Trade Date (T)	**14-Dec-04**		
	Effective Date (T+1)	**15-Dec-04**		
	Next Coupon Date	**20-Mar-05**		
	Total Interest payments	**1,466.67 €**	(interest payments due to Trader A)	
	Capital Gain or (Loss)	**−1,993.94 €**	Capital loss	Because buying protection wider than coupon
	Net payment	−527.27 €		
	Trader A receives	−527.27 €		
	Trader A account before close out	10,000.00 €		
	Trader A account after close out	9,472.73 €		
	Overall cash flows			
	Trader A pays to open	0.00 €		
	Trader A deposits	10,000.00 €	(as margin)	
	Trader A receives to close	−527.27 €	net payment (Interest payments + Capital gain [or minus Capital loss)	
	Net final position	9,472.73 €		

# days from next coupon to maturity date	Divide by days/year	Divide by 4 quarters
1553	4.31	17.26

Trader B buys protection, then closes out trade by selling protection

Open	Trader B wants to buy credit protection, lifting offer at → 3.50%		
	Size	100,000.00 €	
	Spread	3.50%	(becomes coupon)
	Trade Date (T)	**21-Jun-04**	
	Effective Date (T+1)	**22-Jun-04**	
	Next Coupon date	**20-Sep-04**	(quarterly after trade date, on 15th of the month)
	Accrued Int	**0.00 €**	(always zero at start)
	PV	**0.00 €**	(always zero at start)
	Net payment	0.00 €	
	Trader B pays to trade	0.00 €	
	Trader B deposits	10,000.00 €	
	Trader B account is	10,000.00 €	
Close	Trader B wants to close out trade by selling protection at →		3.00%
	Size	100,000.00 €	
	Spread	3.00%	
	Trade Date (T)	14-Dec-04	
	Effective Date (T+1)	15-Dec-04	
	Next Coupon Date	20-Mar-05	

# days from next coupon to maturity date	Divide by days/year	Divide by 4 quarters
1553	4.31	17.26

(*Continued*)

FIGURE 2.32 (Continued)

Single name CDS (quarterly)	Only one example for single name CDS because no coupon		
Total Interest Payments	**1,711.11 €**	(Interest payments due to market-maker)	
Capital Gain or (Loss)	**−2,016.13 €**	Capital loss	Because selling protection tighter than coupon
Net payment	−3,727.24 €		
Trader B pays	−3,727.24 €		
Trader B account before close out	10,000.00 €		
Trader B account after close out	13,727.24 €		
Summary cash flows			
Trader B pays to open	0.00 €		
Trader B deposits	10,000.00 €		
Trader B pays to close	−3,727.24 €	net payment (Interest payments +	
Net final position	13,727.24 €	Capital gain [or minus Capital loss)	

16 N2N299 Govt **BBCS**

7:58 **Utilities / Energy** PAGE 1 / 2

Utilities / Energy		3 Y - CDS Quotes BID	/	ASK	CHG			5 Y - CDS Quotes BID	/	ASK	CHG	TIME
AGBAR	1)	10	/	20		7:25	16)	15	/	25		7:25
BIRKA	2)	25	/	35		7:25	17)	36	/	46		7:25
E.ON	3)	17	/	27		7:25	18)	23	/	33		7:25
ELEC. FRANCE	4)	15	/	25		7:25	19)	22	/	32		7:25
ELEC. PORTUGAL	5)	26	/	36		7:25	20)	35	/	45		7:25
ENBW	6)	26	/	36		7:25	21)	34	/	44		7:25
ENDESA	7)	31	/	41		7:25	22)	36	/	46		7:25
ENEL	8)	20	/	30		7:25	23)	25	/	35		7:25
ENECO HOLDING	9)		/			4/16	24)		/			4/16
ESSENT NV	10)	18	/	28		7:25	25)	25	/	35		7:25
GECC	11)	20	/	30		7:25	26)	22	/	32		7:25
IBERDROLA	12)	15	/	25		7:25	27)	26	/	36		7:25
NATIONAL GRID	13)	25	/	35		7:25	28)	38	/	48		7:25
RWE	14)	16	/	26		7:25	29)	26	/	36		7:25
SUEZ	15)	31	/	41		7:25	30)	41	/	51		7:25

Tel: +34 91 537 6087
INDICATIVE PRICES FOR CREDIT DEFAULT SWAPS ON STANDARD
ISDA 2003 DOCUMENTATION WITH 3 CREDIT EVENTS
MATURITIES ARE ON QUARTERLY BASIS

BBVA

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2004 Bloomberg L.P.
G926-802-0 19-Apr-04 7:58:34

Bloomberg

FIGURE 2.33a CDS prices page from BBVA, 19 April 2004.

Page N299 Govt **BBCS**

7:58 **INDUSTRIALS** PAGE 1 / 2

Industrials		3 Y - CDS Quotes BID	/	ASK	CHG			5 Y - CDS Quotes BID	/	ASK	CHG	TIME
BRISA	1)		/				16)	40	/	60		7:25
CIR INTL	2)		/				17)	270	/	280		7:25
DBFIN	3)		/				18)		/			
DEUTSCHE POST	4)		/				19)	26	/	30		7:25
EKSPORTFINANS	5)		/				20)	5	/	12		7:25
FINMECANICA	6)	47	/	57		7:25	21)	56	/	66		7:25
FKI Plc	7)		/				22)	90	/	100		7:25
HAMMERSON Plc	8)		/				23)	40	/	50		7:25
HOLCIM	9)		/				24)	46	/	54		7:25
HUTCHISON WHAM	10)		/				25)		/			
INVESTOR AB	11)		/				26)	50	/	60		7:25
ISS GLOBAL A/S	12)		/				27)		/			
METSO	13)	125	/	150		7:25	28)	145	/	155		7:25
RENTOKIL	14)		/				29)	35	/	45		7:25
SCHNEIDER	15)	18	/	28		7:25	30)	48	/	58		7:25

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INDICATIVE PRICES FOR CREDIT DEFAULT SWAPS ON STANDARD
ISDA 2003 DOCUMENTATION WITH 3 CREDIT EVENTS
MATURITIES ARE ON QUARTERLY BASIS

BBVA

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2004 Bloomberg L.P.
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FIGURE 2.33b CDS prices page from BBVA, 19 April 2004.

Menu N2199n Govt **BBCS**

BBVA

CREDIT DEFAULT SWAPS

CREDIT DERIVATIVES INDICES	11) Media
1) BBIB iBOXX Indices	12) Oil/Gas
CREDIT DEFAULT SWAPS	13) Retail
2) Spanish References	14) Telecoms
CORPORATES	15) Tobacco
3) Airline/Aerospace/Defense	16) Utilities
4) Autos	FINANCIALS
5) Building Materials	17) Financials
6) Chemicals/Pharmaceuticals	18) Insurance
7) Food	LATAM & EM & SOVEREIGNS
8) Hotel/Leisure/Restaurants	19) Latam & Emerging Markets
9) Industrials	20) Sovereigns
10) Iron/Steel	

FIGURE 2.34 BBVA main CDS menu.

3 N2N299 Govt **BBCS**

7:59 AIRLINE/AEROSPACE/DEFENSE PAGE 1 / 1

AIRLINE/AEROSPACE DEFENSE		3 Y - CDS Quotes BID	/	ASK	CHG			5 Y - CDS Quotes BID	/	ASK	CHG	TIME
AIR FRANCE	1)	60	/	70		7:25	9)	75	/	85		7:25
BRITISH AIRPOR	2)	32	/	42		7:25	10)	41	/	51		7:25
BAE SYSTEMS	3)	45	/	55		7:25	11)	55	/	65		7:25
BRITISH AIRWAY	4)	250	/	400		7:25	12)	250	/	260		7:25
EADS	5)	22	/	32		7:25	13)	32	/	42		7:25
LUFTHANSA	6)	55	/	65		7:25	14)	65	/	75		7:25
ROLLS ROYCE	7)	35	/	45		7:25	15)	59	/	69		7:25
THALES	8)	19	/	29		7:25	16)	28	/	38		7:25

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INDICATIVE PRICES FOR CREDIT DEFAULT SWAPS ON STANDARD
ISDA 2003 DOCUMENTATION WITH 3 CREDIT EVENTS
MATURITIES ARE ON QUARTERLY BASIS

BBVA

FIGURE 2.35 BBVA airline and aerospace sector CDS prices, 19 April 2004.

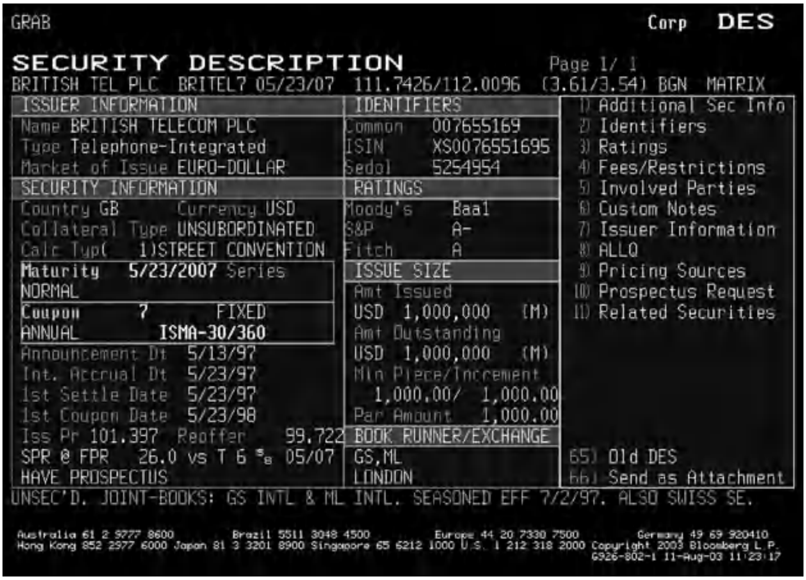

FIGURE 2.36 Bloomberg pages DES for Toyota 5 1/2% 2008 bond.
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which brings up the DES page. This is a highly rated bond, with a AAA rating from S&P and an Aa1 rating from Moody's. To look at the bond's yield spread to various benchmarks, we select screen YAS, which is shown in Figure 2.37. We see that the bond has a 34-bp interpolated yield spread to US Treasuries, but a negative spread to the swap curve. This is confirmed in Figure 2.38, which is Bloomberg page ASW and shows the bond's asset swap spread. A negative asset swap spread is common with AAA-rated bonds, indicating that these bonds fund at sub-LIBOR rates in the cash market. Page RVS graphs the spread of the bond's historical yield against the interest rate swap curve, and we see from Figure 2.39 that this bond had only recently started to trade at a negative spread to the swap curve.

To undertake analysis of a CDS written on this bond, we select screen CDSW. This is shown at Figures 2.40 on page 121 and 2.41 on page 122. Screen CDSW calculates the price of a CDS on the selected bond using one of three pricing approaches, noted as:

- discounted spreads;
- the J.P. Morgan model;
- the modified Hull–White model.

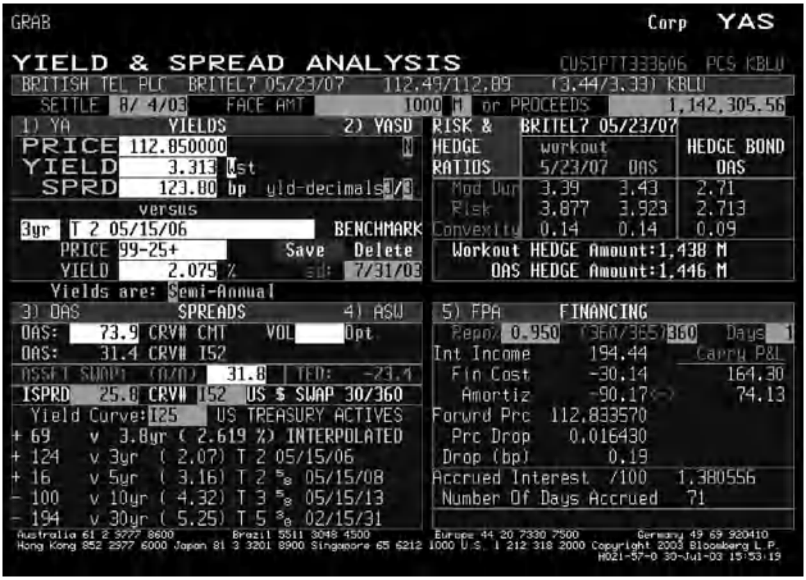

FIGURE 2.37 Bloomberg pages YAS for Toyota 5 1/2% 2008 bond, 21 July 2003.

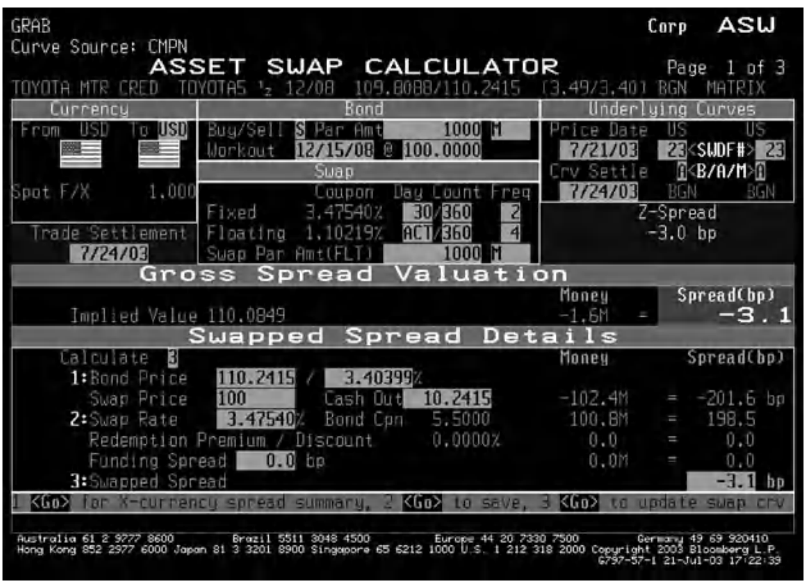

FIGURE 2.38 Bloomberg pages ASW for Toyota 5 1/2% 2008 bond, 21 July 2003.

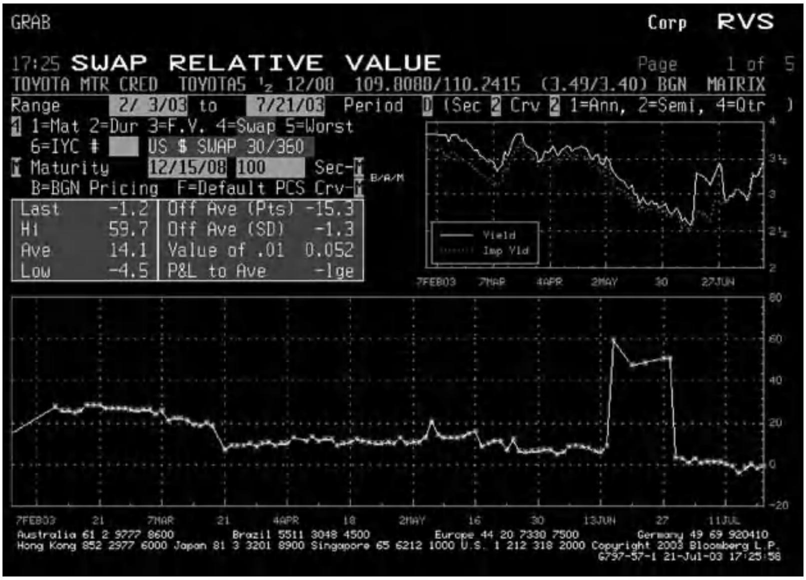

FIGURE 2.39 Bloomberg pages RVS for Toyota 5 1/2% 2008 bond, 21 July 2003.
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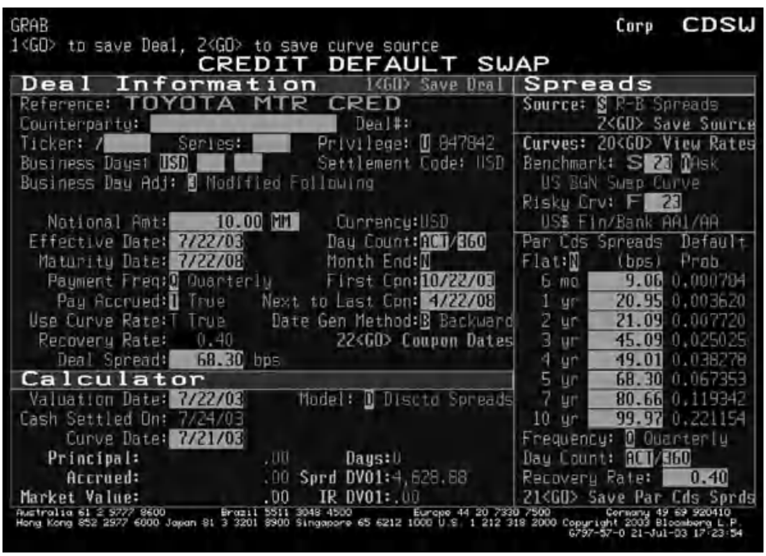

FIGURE 2.40 Bloomberg pages CDSW for Toyota 5.5% 2008 bond, 21 July 2003.
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FIGURE 2.41 Bloomberg pages CDSW for Toyota 5.5% 2008 bond, 21 July 2003, Using Hull–White Pricing Model.

Pricing models are discussed in Chapter 6. As well as selecting the pricing model, the user also selects the benchmark yield curve and the credit-risky yield curve, from which the CDS is priced off. The user also selects the recovery rate.

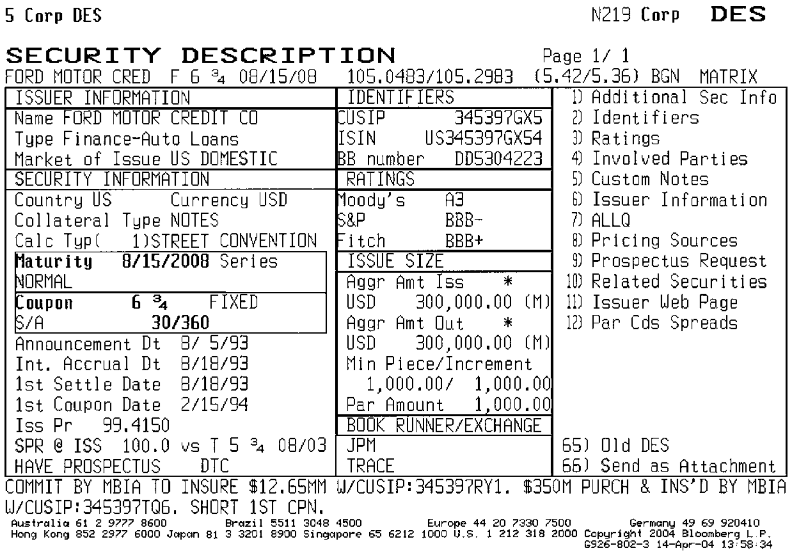
We can see from Figure 2.40 that the discounted spreads approach gives a 5-year CDS price of 68.3 bps, whereas selecting the Hull–White model gives a price for the same CDS of 70.73 bps.

From screen CDSW it is possible to view the contributing yield curves that have been used in pricing the CDS. We will use a different bond to illustrate this. Figure 2.42 shows page DES again, this time for the Ford 6.75% 2008 bond. This bond is rated BBB by S&P and A3 by Moody's.

Figure 2.43 CDSW again, for the Ford Motor Credit bond, this time with the JPMorgan model selected.[29] Typing:

$$20\ \langle \mathrm{GO} \rangle$$

[29] Note that from August 2009 the 'JPMorgan model' was no longer available on Bloomberg page CDSW. The screen defaults to the ISDA non-SNAC fair value model.


5 Corp DES N219 Corp DES

SECURITY DESCRIPTION Page 1/ 1
FORD MOTOR CRED F 6 ¾ 08/15/08 105.0483/105.2983 (5.42/5.36) BGN MATRIX

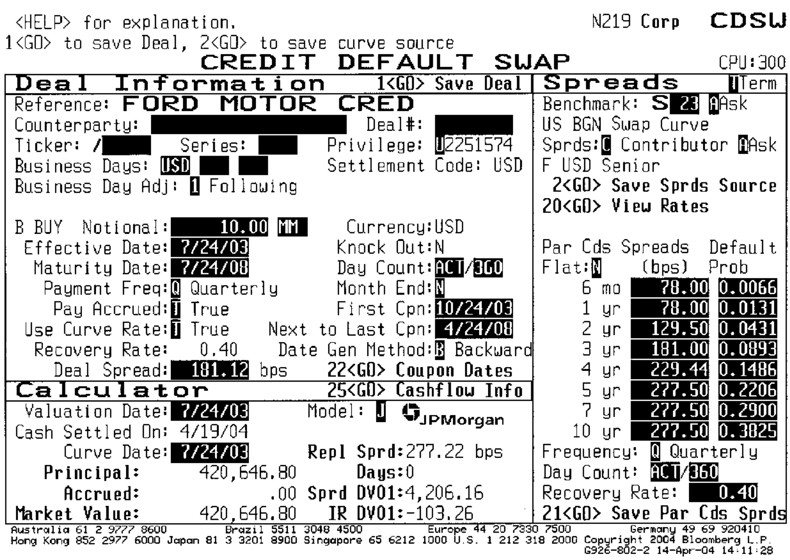
ISSUER INFORMATION
Name FORD MOTOR CREDIT CO
Type Finance-Auto Loans
Market of Issue US DOMESTIC
SECURITY INFORMATION
Country US Currency USD
Collateral Type NOTES
Calc Typ(1)STREET CONVENTION
Maturity 8/15/2008 Series
NORMAL
Coupon 6 ¾ FIXED
S/A 30/360
Announcement Dt 8/ 5/93
Int. Accrual Dt 8/18/93
1st Settle Date 8/18/93
1st Coupon Date 2/15/94
Iss Pr 99.4150
SPR @ ISS 100.0 vs T 5 ¾ 08/03
HAVE PROSPECTUS DTC

IDENTIFIERS
CUSIP 345397GX5
ISIN US345397GX54
BB number DD5304223
RATINGS
Moody's A3
S&P BBB-
Fitch BBB+
ISSUE SIZE
Aggr Amt Iss *
USD 300,000.00 (M)
Aggr Amt Out *
USD 300,000.00 (M)
Min Piece/Increment
1,000.00/ 1,000.00
Par Amount 1,000.00
BOOK RUNNER/EXCHANGE
JPM
TRACE

1) Additional Sec Info
2) Identifiers
3) Ratings
4) Involved Parties
5) Custom Notes
6) Issuer Information
7) ALLQ
8) Pricing Sources
9) Prospectus Request
10) Related Securities
11) Issuer Web Page
12) Par Cds Spreads
65) Old DES
66) Send as Attachment

COMMIT BY MBIA TO INSURE $12.65MM W/CUSIP:345397RY1. $350M PURCH & INS'D BY MBIA W/CUSIP:345397TQ6. SHORT 1ST CPN.
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2004 Bloomberg L.P.
G926-802-3 14-Apr-04 13:58:34

FIGURE 2.42 Bloomberg DES screen showing Ford 6.75% 2008 bond.


<HELP> for explanation. N219 Corp CDSW
1<GO> to save Deal, 2<GO> to save curve source
CREDIT DEFAULT SWAP CPU:300

Deal Information 1<GO> Save Deal
Reference: FORD MOTOR CRED
Counterparty: [redacted] Deal#: [redacted]
Ticker: /[redacted] Series: [redacted] Privilege: J2251574
Business Days: USD [redacted] Settlement Code: USD
Business Day Adj: 1 Following

B BUY Notional: 10.00 MM Currency:USD
Effective Date: 7/24/03 Knock Out:N
Maturity Date: 7/24/08 Day Count:ACT/360
Payment Freq:Q Quarterly Month End:N
Pay Accrued:T True First Cpn:10/24/03
Use Curve Rate:T True Next to Last Cpn: 4/24/08
Recovery Rate: 0.40 Date Gen Method:B Backward
Deal Spread: 181.12 bps 22<GO> Coupon Dates

Calculator 25<GO> Cashflow Info
Valuation Date: 7/24/03 Model: J JPMorgan
Cash Settled On: 4/19/04
Curve Date: 7/24/03 Repl Sprd:277.22 bps
Principal: 420,646.80 Days:0
Accrued: .00 Sprd DV01:4,206.16
Market Value: 420,646.80 IR DV01:-103.26

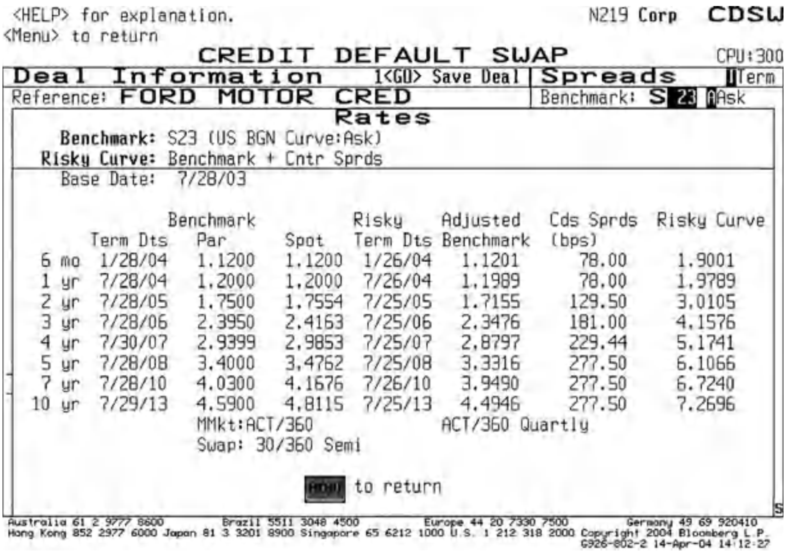
Spreads 1Term
Benchmark: S 23 AAsk
US BGN Swap Curve
Sprds:C Contributor AAsk
F USD Senior
2<GO> Save Sprds Source
20<GO> View Rates

Par Cds Spreads Default
Flat:N (bps) Prob

	Par Cds Spreads (bps)	Default Prob
6 mo	78.00	0.0066
1 yr	78.00	0.0131
2 yr	129.50	0.0431
3 yr	181.00	0.0893
4 yr	229.44	0.1486
5 yr	277.50	0.2206
7 yr	277.50	0.2900
10 yr	277.50	0.3825

Frequency: Q Quarterly
Day Count: ACT/360
Recovery Rate: 0.40
21<GO> Save Par Cds Sprds
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2004 Bloomberg L.P.
G926-802-2 14-Apr-04 14:11:28

FIGURE 2.43 Bloomberg page CDSW for Ford 6% 2008 bond, 24 July 2003.



<HELP> for explanation. N219 Corp CDSW
<Menu> to return
CREDIT DEFAULT SWAP CPU:300
Deal Information 1<GO> Save Deal | Spreads Term
Reference: FORD MOTOR CRED | Benchmark: S 23 Ask

Rates
Benchmark: S23 (US BGN Curve:Ask)
Risky Curve: Benchmark + Cntr Sprds
Base Date: 7/28/03

	Term Dts	Benchmark Par	Spot	Risky Term Dts	Adjusted Benchmark	Cds Sprds (bps)	Risky Curve
6 mo	1/28/04	1.1200	1.1200	1/26/04	1.1201	78.00	1.9001
1 yr	7/28/04	1.2000	1.2000	7/26/04	1.1989	78.00	1.9789
2 yr	7/28/05	1.7500	1.7554	7/25/05	1.7155	129.50	3.0105
3 yr	7/28/06	2.3950	2.4163	7/25/06	2.3476	181.00	4.1576
4 yr	7/30/07	2.9399	2.9853	7/25/07	2.8797	229.44	5.1741
5 yr	7/28/08	3.4000	3.4762	7/25/08	3.3316	277.50	6.1066
7 yr	7/28/10	4.0300	4.1676	7/26/10	3.9490	277.50	6.7240
10 yr	7/29/13	4.5900	4.8115	7/25/13	4.4946	277.50	7.2696

MMkt:ACT/360 ACT/360 Quartly
Swap: 30/360 Semi

MENU to return

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2004 Bloomberg L.P.
G926-802-2 14-Apr-04 14:12:27

FIGURE 2.44 Contributing yield curve for Figure 2.43, 24 July 2003.

brings up the contributing yield curve used with this page, shown in Figure 2.44.

In addition to calculating the CDS price, screen CDSW also provides a risk measure for the CDS contract. This is shown in Figure 2.43 as ‘Spread DV01’. This is a measure of how much the contract value changes for a 1 bp change in the credit spread. From the screen, we can see this is \$4,206. Changing the recovery rate will impact the spread, we see the impact of this in Figure 2.45, which is CDSW again for the same Ford bond but now showing different values after the change in recovery rate from 40% to 30%. We see that for a 5-year CDS, a recovery rate of 30% has changed the DV01 value to \$4,278. The CDS premiums are unchanged.

Finally, we show screen ASW for this bond in Figure 2.46 page 125. This indicates an asset swap spread of 216 bps, compared to the 5-year CDS spread of 277 bps. This is an example of a positive basis, which we explore in Chapter 9.

Using Bloomberg screen CDSW when breaking a CDS deal

In certain cases a dealer may cancel or ‘break’ a CDS contract that it has entered into earlier, rather than netting it out by taking out a CDS contract on

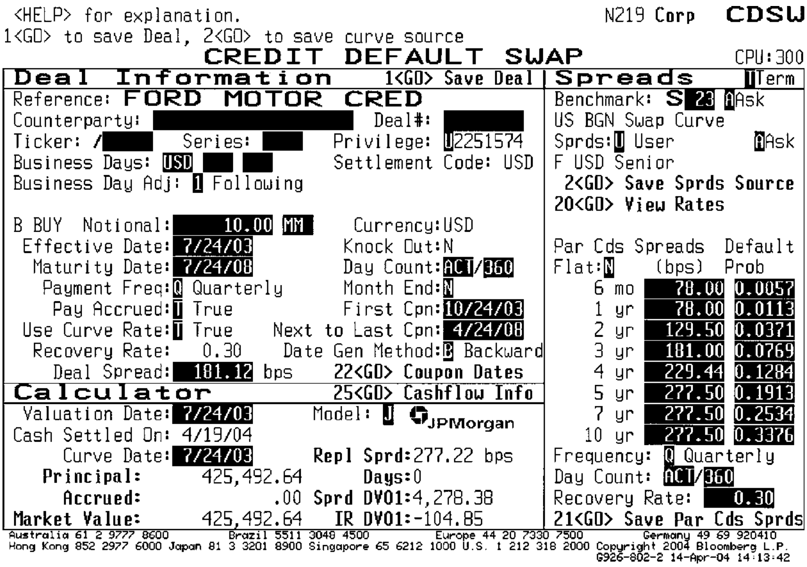


FIGURE 2.45 Bloomberg page CDSW for Ford 6% 2008 bond, impact of change in recovery rate on DV01 value.
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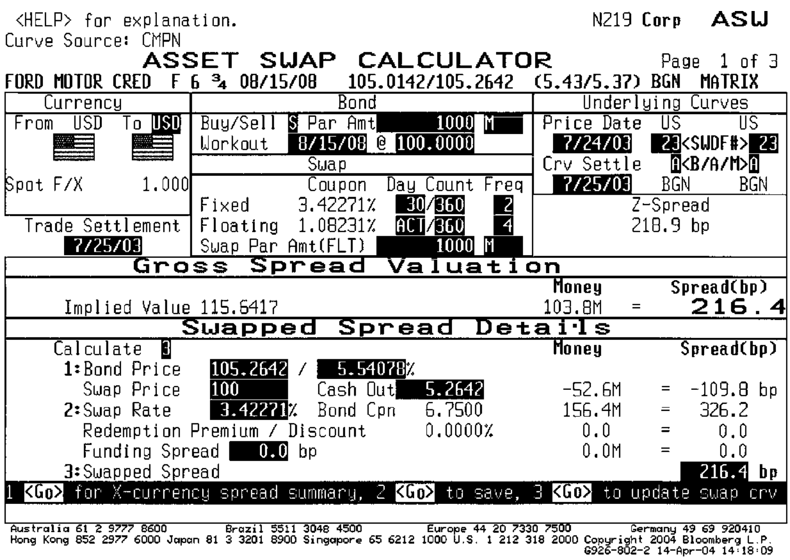

FIGURE 2.46 Bloomberg page ASW for Ford 6% 2008 bond, 24 July 2003.
© Bloomberg L.P. Used with permission. Visit www.bloomberg.com

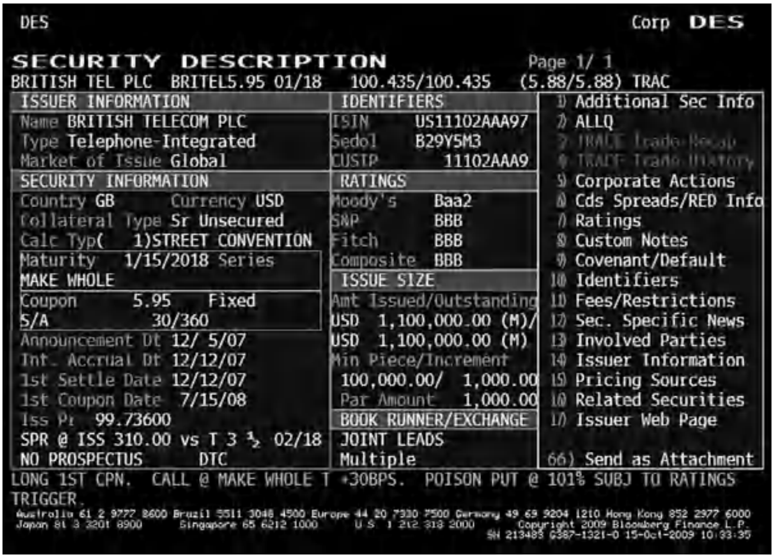

FIGURE 2.47 Screen for British Telecom 5.95% 2018 bond.

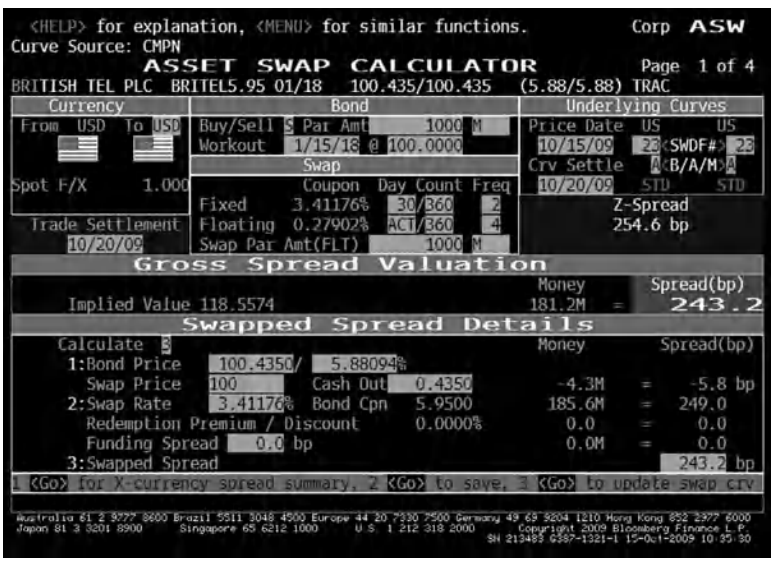

FIGURE 2.48 Screen ASW for British Telecom 5.95% 2018 bond as at 15 October 2009.

FIGURE 2.49 Screen CDSW used to value CDS contract for British Telecom traded in October 2008, as at 15 October 2009.

the other side. This may be done for its own reasons or at customer request. Screen CDSW may then be used to value the contract at the breaking date, which confirms the 1-off payment that is due from the protection buyer.

Figure 2.47 on page 126 shows screen DES for the 5.95% 2018 bond issued by British Telecom plc in December 2007. Its asset swap spread, shown by Figure 2.48 on page 126, is around 243 bps on 15 October 2009. Assume that a dealer has entered into a £10 million notional 5-year CDS contract referencing this bond as at October 2008. Assume further that the dealer wishes to cancel this contract; the start and end dates for the contract are entered on screen CDSW and a flat credit curve is used. The curve itself is set at 243 bps, which is a zero basis. As at the break date, the value of the contract under these conditions, for a 40% recovery rate, is shown to be $529, 233 at Figure 2.49.

SETTLEMENT

Credit derivative settlement can follow one of two procedures, specified at deal inception. We consider these here.

With all credit derivatives, upon occurrence of a credit event, a credit event notice must be submitted. Typically, the notice must be supported by information posted on public news systems such as Bloomberg or Reuters. When used as part of a structured product, the terms of the deal may state that a credit event must be verified by a third-party *verification agent*. Upon verification, the contract will be settled in one of two ways: cash settlement or physical settlement.

A report from the BBA suggests that between 75%–85% of credit derivatives written in 2002 were physically settled, while about 10%–20% were cash settled. About 5% of contracts were settled under the *fixed amount* approach, under which the protection seller delivers a pre-specified amount to the protection buyer ahead of the determination of the reference asset's recovery value. However, as the fixed amount approach is essentially cash settlement, we will consider it as such and prefer the more technical term for it noted below.

By 2009, following the financial crash of 2007–08 that saw a large increase in the number of credit events, the vast majority of CDS contracts were cash settled, and physical settlement was very rare. We discuss below the basic practical procedure in the markets; before that we describe the formal legal definitions.

Contract settlement options

Credit derivatives have a given maturity, but will terminate early if a credit event occurs. On occurrence of a credit event, the swap contract is terminated and a settlement payment is made by the protection seller or guarantor to the protection buyer. This termination value is calculated at the time of the credit event, and the procedure that is followed to calculate the termination value depends on the settlement terms specified in the contract. Credit derivatives specify either physical or cash settlement. In physical settlement, the protection buyer transfers the deliverable obligation (usually the reference asset or assets) to the protection seller, with the total principal outstanding equal to the nominal specified in the default swap contract. The protection seller simultaneously pays to the buyer 100% of the nominal. In cash settlement, the protection seller pays the buyer the difference between the nominal amount of the default swap and the final value for the same nominal amount of the reference asset. This final value is usually determined by means of a poll of dealer banks. This final value is, in theory, the recovery value of the asset; however, as the recovery process can take some time, often the reference asset market value at time of default is taken and this amount is used in calculating the final settlement amount paid to the protection buyer.

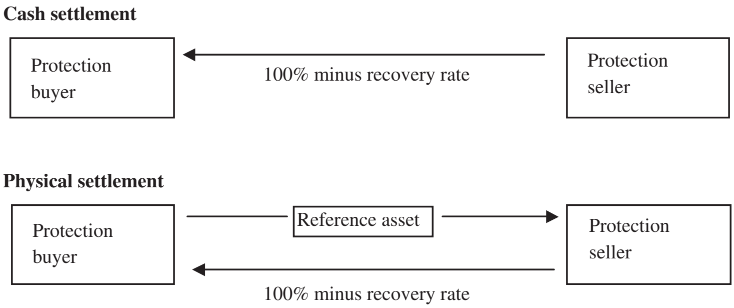

FIGURE 2.50 Physical and Cash Settlement.

The settlement mechanisms are shown in Figure 2.50 and take place as follows:

- *Cash settlement:* the contract may specify a pre-determined pay-out value on occurrence of a credit event. This may be the nominal value of the swap contract. Such a swap is known as a *fixed amount* contract or in some markets as a *digital credit derivative*. Alternatively, the termination payment is calculated as the difference between the nominal value of the reference asset and either its market value at the time of the credit event or its recovery value. This arrangement is more common with cash-settled contracts.[31]
- *Physical settlement:* on occurrence of a credit event, the buyer delivers the reference asset to the seller, in return for which the seller pays the face value of the delivered asset to the buyer. The contract may specify a number of alternative assets that the buyer can deliver—these are known as *deliverable obligations*. This may apply when a swap has been entered into on a reference name rather than a specific obligation (such as a particular bond) issued by that name. Where more than one deliverable obligation is specified, the protection buyer will invariably deliver the asset that is the cheapest on the list of eligible assets. This gives rise to the concept of the *cheapest-to-deliver*, as encountered with government bond futures contracts, and is in effect an embedded option afforded to the protection buyer.

In theory, the value of protection is identical irrespective of which settlement option is selected. However, under physical settlement the protection seller

[31] Determining the market value of the reference asset at the time of the credit event may be a little problematic—the issuer of the asset will most likely be in default or administration. An independent third-party Calculation Agent is usually employed to make the termination payment calculation.

can gain if there is a recovery value that can be extracted from the defaulted asset, or its value may rise as the fortunes of the issuer improve.

Swap market-making banks often prefer cash settlement because there is less administration associated with it, since there is no delivery of a physical asset. For a CDS used as part of a structured product, cash settlement may be more suitable because such vehicles may not be set up to take delivery of physical assets. Another advantage of cash settlement is that it does not expose the protection buyer to any risks should there not be any deliverable assets in the market; for instance, due to shortage of bond or asset liquidity. Should this occur, the buyer may find the value of their settlement payment reduced. Nevertheless, physical settlement is widely used because counterparties wish to avoid the difficulties associated with determining the market value of the reference asset under cash settlement.[32] Physical settlement also permits the protection seller to take part in the creditor negotiations with the reference entity's administrators, which may result in improved terms for them as holders of the asset.

Cash settlement is sometimes adopted even for contracts that are physically settled in situations when, for one reason or another, it is not possible to deliver a physical asset; for example, if none is available.

Market Requirements

Different market participants have different requirements and so may have their own preferences with regard to the settlement mechanism. A protection seller may prefer physical settlement for particular reference assets if they believe that a higher recovery value for the asset can be gained by holding onto it and/or entering into the administration process. A protection buyer may have different interests. For example, unless the protection buyer already holds the deliverable asset (in which case the transaction they have entered into is a classic hedge for an asset already owned), they may prefer cash settlement, if they have a negative view of the reference obligation and have used the CDS or other credit derivative to create a synthetic short bond position. Alternatively, the protection buyer may prefer physical settlement because they view the delivery option as carrying some value.

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[32] Credit derivative market-makers may value two instruments written on the same reference entity, and with all other terms and conditions identical except the one that is cash settled and the other that is physically settled, at the same price. This is because while the protection buyer has a delivery option and will deliver the cheapest bond available, an option that carries theoretical value, in a cash settled contract the protection buyer will nominate this same bond to be used in the calculation of the settlement of the contract. Therefore the value of the delivery option may not result in a higher price quote from a market-maker for a physically delivered contract.

Settlement Process

We describe below the formal process by which the physical settlement procedure works. This procedure is modified in practice, and we describe this later in the section.

To be triggered, physical settlement requires a *Credit event notice*, a *Notice of physical settlement* and, if specified in the related confirmation, a *Notice of publicly available information*. After a credit event has occurred, the protection buyer must send the Notice of physical settlement to the seller no later than 30 days after the other notices are delivered. This notice confirms that the protection buyer will physically settle the credit derivative transaction and contains a detailed description of the deliverable obligations that the buyer of protection will deliver to the seller, including their nominal value and accrued but unpaid interests.

The buyer then *delivers to the protection seller bonds or loans* (known as 'deliverable obligations') with a notional amount identical to the notional amount of the CDS and the protection seller pays the protection buyer the notional amount of the CDS (known as the Physical settlement amount).

In theory, if credit events are linked to a reference obligation, the scope of deliverable obligations usually includes all obligations that have the same level of seniority (that is, rank *pari passu*) with the reference obligation. In practice the protection seller will be delivered the obligation that is cheapest-to-deliver.

Cash settlement requires a credit event notice and if specified in the related confirmation, a Notice of publicly available information. In theory, the cash settlement amount is calculated using market prices for defaulted reference obligations. The seller pays the buyer the notional amount of the trade (floating rate calculation amount) multiplied by the loss of value of the defaulted reference obligations. By doing so, the seller covers the loss of value of the reference obligations caused by the credit event.

More formally, the cash settlement amount is the floating rate payer calculation amount multiplied by the reference price minus the final price, where the floating rate payer calculation amount is the notional amount of the transaction and the final price is the price of the reference obligation. The final price is determined through a valuation method and the parties choose, at the time of the trade, between methods based on 'market value' or 'highest quotations'.

We summarise the processes below.

Physical Settlement This involves physical delivery of the reference or equivalent asset. Once the notice of default—accompanied by two pieces of publicly available information—has been served, the buyer of protection has up to *30 days* to select the individual deliverable obligation for settlement of the contract. Against this the buyer receives the notional of the CDS contract.

By delivering an asset worth the recovery value, the buyer of protection has removed the need to wait until the final legal recovery value is determined in order to receive the compensation due from the seller of protection. By taking the delivery of the defaulted bonds, the seller of protection is left with a residual exposure to the defaulted entity, creating a position that must be managed. However, this does ensure that the final price is truly reflective of the recovery value.

Physical settlement is increasingly rare in CDS markets. However an excellent account of the implications of physical settlement for CDS pricing, and the analysis of delivery options, is given in Boberski (2009).

Cash Settlement Cash settlement works by agreeing to a value of the individual bond that would have been delivered for physical settlement, and paying the compensation net of this amount. Prior to the 2007–08 crisis, the most common method was to use a single valuation, via a dealer poll of five dealers.

The valuation date is agreed at the time of executing the contract, but could be up to 122 days after the credit event. It was also possible to use multiple valuation dates. The final price would be determined by the highest bid price for a specified notional of bonds, and this price is used to determine the compensation amount. This final amount is paid five days after the dealer poll.

The seller of protection is not left with a residual exposure to the defaulted entity. The advantage is that the dealer poll method can be used to agree on the settlement values of all relevant contracts with agreements between the counterparties, thus reducing operational workloads.

ISSUES WITH THE SETTLEMENT MECHANISM

In the physical settlement process, the need for the 30-day notification and delivery window occurs when the total notional of deliverable obligations is less than the total notional of CDS of the reference entity (that is, there aren't enough bonds). In this case, the window allows settlement of different contracts on the defaulted reference entity to occur on different days, making it possible for the same notional of bonds to be used to settle contracts.

The difficultly with this approach is that it cannot guarantee a result that exactly reflects the market at the time of the poll so there is a price difference between physical and cash settlement. In addition, the price of the defaulted bonds can vary significantly during the 60 days following the credit event, thus resulting in a material difference in the settlement values determined through the two processes.

One further issue, when offsetting positions it is important to ensure that the contracts on which protection were sold are triggered no later than the date for the purchases of protection. This means that the market participant knows which bonds will be delivered before declaring which ones to deliver. Complications arise when there are multiple deliverable obligations trading at different prices, and so careful monitoring is required to ensure that one will not be delivered the cheapest bond while having brought a more expensive one to deliver.

Essentially then, the elimination of the price basis between cash and physical settlement would allow the entire market to agree on a single price for settling all CDS contracts on a defaulted reference entity, significantly reduce operational and settlement risk, as well as time and resources.

The next section reviews developments following the events of 2007–2008.

Developments Post-Credit Crunch

After the disruption in the markets following the 2007 US sub-prime mortgage-related default and the Lehman crash in 2008, the market reviewed operational procedures and various adjustments were agreed to, separately in the North American and European sectors.

The following changes were implemented during 2009:

- Modified Restructuring was removed from the definitions to streamline the process of credit events and eliminate soft credit events.
- To facilitate the hardwiring of the auction mechanism, the ISDA established a Dispute Resolution Board, which will make binding decisions when a credit event has occurred and will be referenced in the contract.
- A rolling 60-day effective date. For American CDS the effective date is now T-60 days. The reason for this relates to liability in respect to a credit event and not for payment accruals, which will still accrue from last payment date or have a fixed first coupon.
- Under the CDS 'big bang' in April 2009 (see separate section later in this chapter) contracts were moved to 'payment upfront', and 100/500 coupons. The new product (Standard North American Corporate) will trade with USD coupon payment upfront and a standard coupon of either 100 or 500 bps.
- Elimination of senior reference obligations. It is now simply 'reference obligation'.

One of the suggested benefits of 100/500 and a rolling effective date was that it would make transparency easier and also help to reduce the middle-office risks associated with trades conducted bilaterally. ISDA published Supplement (SNAC) and Protocols (NAC) ahead of the 'big bang'. Firms were allowed to decide bilaterally what they would do with existing populations; some banks chose not to update.

The settlement process in 2009, for liquid names, had simplified as follows:

- on occurrence of a credit event, an auction (dealer poll) is held within 30 days of the notice of event, with dealers putting in prices to buy and sell bonds. In practice, this takes place within 27 days;
- the auction result determines the recovery rate (RR);
- all CDS contracts cash-settle at this RR;
- before the auction takes place, a CDS holder can put in an order to the dealer to state that it wishes to elect for physical settlement (that is, to buy or sell bonds). Those that are sellers of protection may get delivered either loans or bonds.

In practice then, it has been observed that the large majority of CDS contracts (either single-name or Index trades) are now cash-settled.

Credit Events in 2008

The Bear Stearns takeover did not trigger payment on CDS, as its liabilities were taken over by JPMorgan Chase completely (under guarantee from the US Treasury). However, the rescue of Fannie Mae and Freddie Mac did trigger payments under a CDS contract, even though they were deemed 'governorships' rather than a full nationalisation or takeover. Given the nature of the bailout, the liabilities remained priced closed to par, and hence so was the price of the bonds delivered under physical settlement.

The Lehmans bankruptcy triggered payout under the ISDA definitions, as it was a Chapter 11 bankruptcy; the recovery value of its debt was 11% at the dealer auction on 16 September 2008. An added issue was that Lehmans was a big counterparty in CDS and had sold protection on ABS tranches including much sub-prime MBS tranches, so their bankruptcy left many market participants short of credit protection in the one market they most wanted protection in!

RISKS IN CREDIT DEFAULT SWAPS

We now consider some risk exposures that investors take on when trading in credit derivatives.

Unintended Risks in Credit Default Swaps

As credit derivatives can be tailored to meet specific requirements in terms of reference exposure, term to maturity, currency and cash flows, they have enabled market participants to establish exposure to specific entities without the need for them to hold the bond or loan of that entity. This has raised issues of the different risk exposure that this entails compared to the cash equivalent. A Moody's special report highlights the unintended risks of holding credit exposures in the form of default swaps and CLNs.[33] Under certain circumstances, it is possible for CDS to create unintended risk exposure for holders, by exposing them to greater frequency and magnitude of losses compared to that suffered by a holder of the underlying reference credit in cash form.

In a CDS, the payout to a buyer of protection is determined by the occurrence of credit events. The definition of a credit event sets the level of credit risk exposure of the protection seller. A wide definition of credit Event results in a higher level of risk. To reduce the likelihood of disputes, counterparties can adopt the ISDA Credit Derivatives definitions to govern their dealings. The Moody's paper states that the ISDA definitions at the time did not unequivocally separate and isolate credit risk, and in certain circumstances credit derivatives can expose holders to additional risks. The paper suggested that differences in definitions can lead to unintended risks being taken on by protection sellers. Two examples from the paper are cited below as illustration.

Extending Loan Maturity

The bank debt of Conseco, a corporate entity, was restructured in August 2000. The restructuring provisions included deferment of the loan maturity by three months, higher coupon, corporate guarantee and additional covenants. Under the Moody's definition, as lenders received compensation in return for an extension of the debt, the restructuring was not considered to be a 'diminished financial obligation', although Conseco's credit rating was downgraded one notch. However, under the ISDA definition, the extension of the loan maturity meant that the restructuring was considered to be a credit event, and thus triggered payments on default swaps written on Conseco's bank debt. Therefore this was an example of a loss event under ISDA definitions that was not considered by Moody's to be a default.

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[33] Jeffrey Tolk, 'Understanding the Risks in Credit Default Swaps', Moody's Investors Service Special Report, 16 March 2001.

It was the Conseco case that led to the adoption of the modified restructuring ISDA definitions of 2003.

Risks of Synthetic Positions and Cash Positions Compared

Consider two investors in XYZ, one of whom owns bonds issued by XYZ, while the other holds a CLN referenced to XYZ. Following a deterioration in its debt situation, XYZ violates a number of covenants on its bank loans, but its bonds are unaffected. XYZ's bank accelerates the bank loan, but the bonds continue to trade at 85 cents in the dollar, coupons are paid and the bond is redeemed in full at maturity. However, the default swap underlying the CLN cites 'obligation acceleration' (of either bond or loan) as a credit event, so the holder of the CLN receives 85% of par in cash settlement and the CLN is terminated. However, the cash investor receives all the coupons and the par value of the bonds on maturity.

These two examples illustrate how, as CDSs are defined to pay out in the event of a very broad range of definitions of a credit event, portfolio managers may suffer losses as a result of occurrences that are not captured by one or more of the ratings agencies rating of the reference asset. This may result in a potentially greater risk for the portfolio manager, compared to the position were it to actually hold the underlying reference asset. Essentially, therefore, it is important for the range of definitions of a credit event to be fully understood by counterparties, so that holders of default swaps are not taking on greater risk than is intended.

Investors should be aware of the regulatory capital implications of holding the cash versus the synthetic position; CDS is always held in a Trading book and its value is marked-to-market daily. Appendix 2.4 is a summary of the Basel regulatory capital rules.

Measuring Risk for a CDS Contract

Banks calculate a quantitative measure of the risk exposure of their CDS positions. The approach used follows the same value-at-risk principles used for earlier asset class products; namely, it calculates the sensitivity of a contract to variations in market parameters. The main risk measure regards the sensitivity of the CDS to a change in the primary credit curve, and is known as Spread01 or usually 'Credit01'.

Credit01 is a measure of the change in the mark-to-market value of a CDS contract for a 1 bp parallel shift upwards in the credit-risky curve. The precise definition differs, depending on whether one is measuring the risk on a bought or sold protection position. The value of a short credit (buy protection) CDS position increases as credit spreads widen, while the value of a long credit (sell protection) position decreases as credit spreads widen. Generally, the market quotes the Credit01 value of a long credit (sold protection) contract as negative, which matches the sign for a short credit position. Essentially, Credit01 is similar in concept to the 'PVBP' or DV01 (Dollar01) interest rate risk measure for a cash bond holding.

The change in the mark-to-market value is given by:

$$\text{Notional} \times \text{Credit01} \times \Delta\text{Spread}$$

with this value being negative or positive depending on whether the holder is buying or selling protection.

There is also an interest rate sensitivity measure for CDS contracts, although this sensitivity is relatively insignificant unless one is experiencing high market volatility. The risk measure of sensitivity to changes in the interest rate yield curve (the LIBOR curve) is known as IR01 or LIBOR01, and measures the change in value of the contract for a 1 bp upward parallel shift in the LIBOR curve.

A formal expression for Credit01 or CS01 is given in Chapter 9.

The CDS price provides an implicit market view of the expected timing of default. This is another way of looking at the value as a measure of risk. A description of implied market timing to default is given at Appendix 2.5.

IMPACT OF THE 2007–08 CREDIT CRUNCH: NEW CDS CONTRACTS AND THE CDS 'BIG BANG'

One of the impacts of the 2007–08 financial market crisis was that CDS prices rose to hitherto unseen astronomically high levels. The bankruptcy of Lehman Brothers (see the Prologue) highlighted also the issue of counterparty risk for those market participants that had bought protection using CDS.

One response to this was that the markets changed the protocol for quoting CDS contracts traded in the US and Canada, and shortly after in Europe and emerging markets.

The CDS 'Big Bang'

ISDA introduced a new supplement and protocol (the 'Big Bang' protocol) and a new standard North American corporate CDS contract (SNAC) with effect from 8 April 2009. The ISDA supplement applied to new CDS transactions. It established credit determination committees, added auction settlement provisions and created backstop dates for credit and succession events. The Big Bang protocol applies to existing CDS transactions. The ISDA SNAC, also referred to as 100/500, applies to North American names denominated in any currency. These CDS contracts trade with an upfront payment and fixed coupons of either 100 bps for investment-grade reference names and 500 bps for lower rated names. The new contract is referred to as the 'SNAC' or the '100/500' contract.

Investment grade CDS traded with a 100 bps premium are quoted using a flat credit curve. The high-yield names trading at a 500 bps premium are quoted with points upfront. All trades now have a full first coupon with no long or short stub periods. The first accrual start date no longer coincides with the effective date. The effective date was changed to reflect the 'look back' period of 60 days for credit events.[34] The look back periods ensure that offsetting transactions have the same terms and allow positions to be fully hedged.

The ISDA Big Bang protocol applies to existing transactions. It enables market participants to amend outstanding trades so that they can eliminate distinctions between trades entered into before and after 8 April 2009.

The CDS 'Small Bang'

As we noted above, the introduction of the 'standard North American contract' (SNAC) and the new ISDA supplement and protocol were known as the 'CDS Big Bang'. On 22 June 2009 similar changes became effective in Europe, in what was known as the 'Small Bang'. In Europe there are now three different contracts:

- the standard European corporate contract;
- the standard subordinated European insurance contract;
- the standard western European sovereign contract.

There are four standard coupons, which are 25, 100, 500 and 1,000 bps. In addition, fixed coupons of 300 and 750 bps may be used for existing trades.

CDS and Points Upfront

The 2007–08 credit crunch and resulting financial crisis caused the CDS price for many reference names to trade at very high levels; for example, Morgan Stanley traded at 1,300 bps on 10 October 2008 and AIG at 3,500 bps on 16 September 2008. For high-risk reference names, CDS spreads that

[34] The look back period is 90 days for succession credit events.

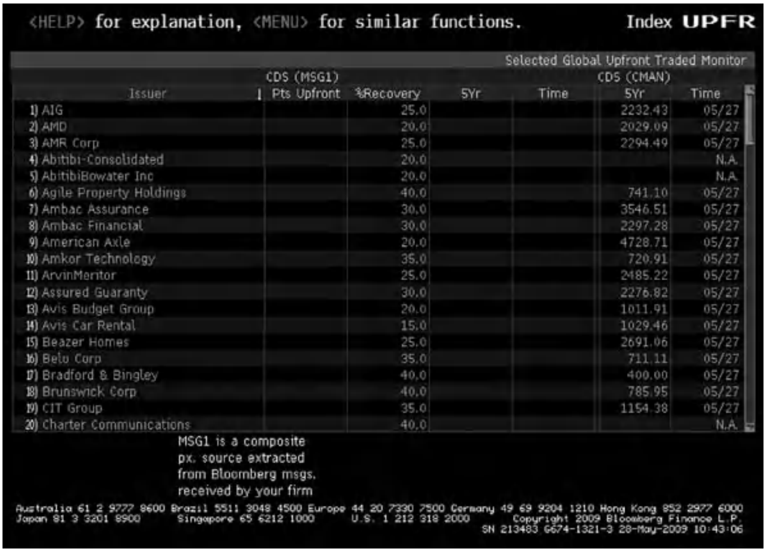
FIGURE 2.51 Bloomberg screen CDSW showing 5-year CDS written on Virgin Media Finance plc Name, traded 28 May 2009, with 'points upfront' valuation of 2.88%.

have widened to a large extent are quoted by market-makers with 'points upfront'. In this case, if a CDS trades with an upfront fee, a market counterparty buying protection must make an initial payment (a percentage of the notional contract value) as well as a running spread of 500 bps.

The Bloomberg screen CDSW can be used to value CDS that are quoted with upfront fees, as shown at Figure 2.51. The trade example here is a 5-year CDS quoted on 28 May 2009 on Virgin Media Finance plc. The CDS premium is 575 bps, and if this is traded in the US market there is now a 'points upfront' fixed fee to be paid on inception. This is shown on the screen as 2.885757%. Note also that the pricing model selected has been changed from the hitherto standard J.P. Morgan model to the 'ISDA standard upfront' model. In the field 'SNAC' the user has selected 'Y' for yes, indicating this contract is being traded in the US market and not in Europe.

Another response to the market that can be observed from Bloomberg screen CDSW concerns the recovery rate parameter. Previously this had defaulted to 40%. For a large number of lower rated names this value has been tailor-set to levels ranging from 5% upwards.

Screen UPFR on Bloomberg shows the recovery rate for selected reference names, now that the market no longer defaults automatically to 40%.



<HELP> for explanation, <MENU> for similar functions. Index UPFR

Selected Global Upfront Traded Monitor

Issuer	CDS (MSG1) Pts Upfront	%Recovery	5Yr	Time	CDS (CMAN) 5Yr	Time
1) AIG		25.0			2232.43	05/27
2) AMD		20.0			2029.09	05/27
3) AMR Corp		25.0			2294.49	05/27
4) Abitibi-Consolidated		20.0				N.A.
5) AbitibiBowater Inc		20.0				N.A.
6) Agile Property Holdings		40.0			741.10	05/27
7) Ambac Assurance		30.0			3546.51	05/27
8) Ambac Financial		30.0			2297.28	05/27
9) American Axle		20.0			4728.71	05/27
10) Amkor Technology		35.0			720.91	05/27
11) ArvinMeritor		25.0			2485.22	05/27
12) Assured Guaranty		30.0			2276.82	05/27
13) Avis Budget Group		20.0			1011.91	05/27
14) Avis Car Rental		15.0			1029.46	05/27
15) Beazer Homes		25.0			2691.06	05/27
16) Belo Corp		35.0			711.11	05/27
17) Bradford & Bingley		40.0			400.00	05/27
18) Brunswick Corp		40.0			785.95	05/27
19) CIT Group		35.0			1154.38	05/27
20) Charter Communications		40.0				N.A.

MSG1 is a composite
px. source extracted
from Bloomberg msgs.
received by your firm

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2009 Bloomberg Finance L.P.
SN 213483 G674-1321-3 28-May-2009 10:43:06

FIGURE 2.52 Bloomberg screen UPFR showing reference name recovery rates. © Bloomberg L.P. Used with permission. Visit www. bloomberg.com

Page 1 of this screen is shown at Figure 2.52. We see that recovery rates for this group of companies range from 15% to 40%.

Further Developments in Standard CDS Contracts

At the time of writing the CDS market was still in a state of flux as it revamped itself following the market crisis. A good flavour of the debate and the changes taking place at the time can be found in Forrester *et al* (2009). In this piece, the authors discuss the Big Bang, described elsewhere in this chapter, by which the protection buyer no longer pays a running premium but instead a fixed coupon and an upfront fee. The upfront fee is equal to the present value of the risk of the reference name over and above the fixed coupon.

Forrester *et al* (*ibid*) also state,

> *. . . after a long saga, 'restructuring' was removed as a credit event for the standard North American CDS contract. This change was part of an effort to have CDS trade in a fashion similar to that of bonds and indices . . . parties may still include restructuring as a credit event if they specifically build it into their documentation, but new standard North American trades only include credit events relating to a payment failure or insolvency of a reference entity.*

For increased market pricing transparency, ISDA distributed the CDS Standard Model, which is based on the JPMorgan CDS pricing model. This is now available to all market participants via an open source licenser. ISDA also publishes the model input parameters, namely recovery rate values and benchmark yield curves.

The focus of efforts during 2009 was the establishment of a centralised clearing house for the CDS market, in order to remove counterparty risk. At the time of writing no global market infrastructure had been established, however in the USA the ICE Trust (a subsidiary of Intercontinental Exchange Inc) became the first clearing centre to receive approval from the Federal Reserve.[35] The criteria for joining ICE Trust included:

- net worth of $5 billion or more;
- credit rating of A or higher.

CDS contracts traded via ICE Trust are treated in the same was as futures on an exchange, that is the clearing house is deemed to be the counterparty to each trade, thus there is a separate trade each to the buyer and seller of the CDS. This also enables ICE Trust to net all CDS positions and make net payments. The daily pricing is provided by the firm MarkIt.

We summarise below the changes made in CDS trading convention after the events of 2007-2008.

Contract structure:	Auction settlement 60-day look-back period for credit events Maintain quarterly rolls (March, June, September, December) Points upfront Standard coupons (100/500), with no requirement to reset coupons at each quarterly roll date as both 100 bps and 500 bps are quoted for the life of the contract
Credit events:	Restructuring no longer a credit event Note that emerging market (EM) CDS contracts retain restructuring as a credit event

QUICK CDS CALCULATOR

Bloomberg has introduced a CDS calculator that does not reference a specific reference name, rather the purpose of the model is to calculate the cash flows or valuation associated with a CDS contract. The screen is QCDS, and it uses the

[35] As stated in Forrester *et al* (2009).

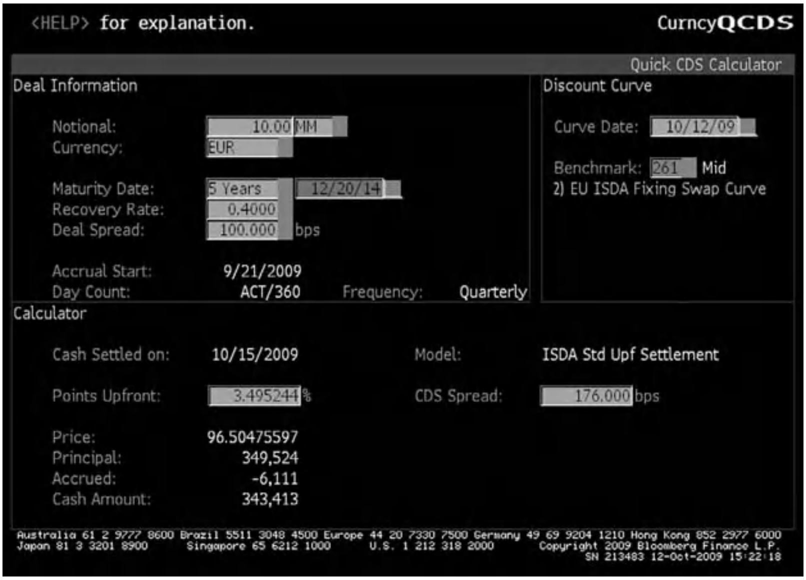


FIGURE 2.53 Bloomberg screen QCDS used to calculate points upfront, 12 October 2009.

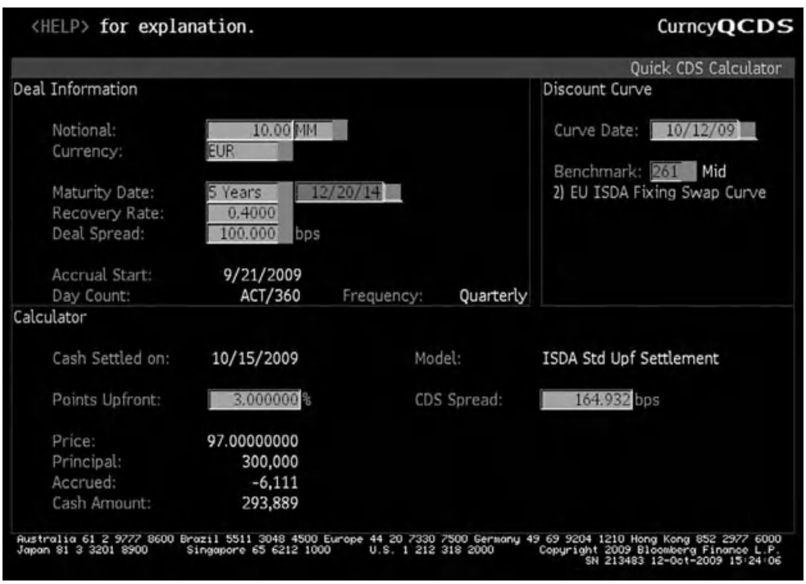


FIGURE 2.54 Change of inputs: calculation.

ISDA standard upfront settlement model and the associated inputs to calculate the cash settlement amount and either the points upfront or the CDS spread.

The screen is shown at Figure 2.53. The user selects the currency, the relevant swap curve, the recovery rate and the deal spread (the fixed running coupon). The example we have shown is for a euro-denominated CDS, hence defaults to the euro swap curve, and is for five years. The user then inputs either the points upfront or the CDS spread, and the screen then calculates the other variable. In Figure 2.53 the 'Deal Spread' is 100 basis points and the CDS spread selected was 176 bps.[36] The calculation indicates the equivalency between the points upfront and the CDS market spread. Figure 2.54 shows that if we input the points upfront at 3.00%, the CDS spread calculated was 164 bps.

CDS INDEX SCREENS

The iTraxx contracts can be viewed in a family of Bloomberg screens using CDX <go>. The breakdown of each iTraxx or CD-X contract can be viewed using GCDS <go>, while screen CDXC can be used to compare the price, volatility and price changes of two index series over time. Figure 2.55 shows the price history for the MarkIt CDX North America series 13 (5-year contract) against the same contract series 12, as at 12 October 2009.

FIGURE 2.55 Bloomberg screen CDXC, for comparing different CDS indices and series.
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[36] Coincidentally, the mid-price CDS spread for Allied Irish Bank 5-year CDS (in EUR) as at 12 October 2009.

APPENDIX 2.1 ISDA 2003 CREDIT DERIVATIVE DEFINITIONS

Bankruptcy

A reference entity voluntarily or involuntarily files for bankruptcy or insolvency protection, or is otherwise unable to pay its debts.

Failure to Pay

This is failure of a reference entity to make due payments greater than a specified payment requirement (commonly $1 million or more), taking into account a pre-specified grace period to prevent accidental triggering of the contract due to administrative errors.

Restructuring and Modified Restructuring

A reference entity agrees to a capital restructuring (such as a change in a loan obligation's seniority), deferral or reduction of loan, change in currency or composition of a material debt obligation such as interest or principal payments. 'Material' is generally considered to be $10 million or more. Market participants may elect an alternative definition of restructuring known as *modified restructuring* to limit the maturity and type of obligations that may be delivered by the protection seller, to reduce the 'cheapest-to-deliver' option.

Obligation Acceleration

Obligations of the reference entity have become due and are payable earlier than they would have been due to default, other than a Failure to Pay.

Obligation Default

Obligations of the reference entity have become capable of being declared due and payable before they otherwise would have due to a default other than a Failure to Pay.

Repudiation/Moratorium

A reference entity or government authority rejects or challenges the validity of the obligation.

APPENDIX 2.2 CDS TERM SHEET

For illustrative purposes, we show here an example of a typical term sheet for a hypothetical single-name CDS transaction. The entity XYZ Bank plc is the CDS market-maker.

XYZ Bank plc
London branch

Draft Terms—Credit Default Swap

1. General Terms

Trade Date	5 Aug 2003
Effective Date	6 Aug 2003
Scheduled Termination Date	30 Jul 2005
Floating Rate Payer (‘Seller’)	XYZ Bank plc, London branch.
Fixed Rate Payer (‘Buyer’)	ABC Investment Bank plc
Calculation Agent	Seller
Calculation Agent City	New York
Business Day	New York
Business Day Convention	Following
Reference Entity	Waterford International Inc
Reference Obligation	Primary Obligor: Waterford International Inc. Maturity: 30 Jun 2020 Coupon: 0% CUSIP/ISIN: 947074AB6/US947074AB67 Original Issue Amount: $910,000,000
Reference Price	100%
All Guarantees	Not Applicable

2. Fixed Payments

Fixed Rate Payer Calculation Amount	$7,000,000
Fixed Rate	0.3% per annum

Fixed Rate Payer Payment Date(s)	30 Oct, 30 Jan, 30 Apr, 30 Jul, starting 30 Oct 2003
Fixed Rate Day Count Fraction	Actual/360

3. Floating Payments

Floating Rate Payer Calculation Amount	$7,000,000
Conditions to Payment	Credit Event Notice (Notifying Parties: Buyer or Seller) Notice of Publicly Available Information: Applicable (Public Source: Standard Public Sources. Specified Number: Two)
Credit Events	Bankruptcy Failure to Pay (Grace Period Extension: Not Applicable. Payment Requirement: $1,000,000)
Obligation(s)	Borrowed Money

4. Settlement Terms

Settlement Method	Physical Settlement
Settlement Currency	The currency in which the Floating Rate Payer Calculation Amount is denominated.
Terms Relating to Physical Settlement	
Physical Settlement Period	The longest of the number of business days for settlement in accordance with the then current market practice of any Deliverable Obligation being Delivered in the Portfolio, as determined by the Calculation Agent, after consultation with the parties, but in no event shall be more than 30 days.
Portfolio	Exclude Accrued Interest
Deliverable Obligations	Bond or Loan
Deliverable Obligation Characteristics	Not Subordinated Specified Currency—Standard Specified Currencies Maximum Maturity: 30 years Not Contingent

	Not Bearer Transferable Assignable Loan Consent Required Loan
Restructuring Maturity Limitation	Not Applicable
Partial Cash Settlement of Loans	Not Applicable
Partial Cash Settlement of Assignable Loans	Not Applicable
Escrow	Applicable

5. Documentation

Confirmation to be prepared by the Seller and agreed to by the Buyer. The definitions and provisions contained in the 2003 ISDA Credit Derivatives Definitions, as published by the International Swaps and Derivatives Association, Inc., as supplemented by the May 2003 Supplement, to the 2003 ISDA Credit Derivatives Definitions (together, the 'Credit Derivatives Definitions'), are incorporated into the Confirmation.

6. Notice and Account Details

Telephone, Telex and/or Facsimile Numbers and Contact Details for Notices	Buyer: Phone: Fax: Seller: A.N. Other Phone: +1 212-xxx-xxxx Fax: +1 212-xxx-xxxx
Account Details of Seller	

7. Risks and Characteristics

Credit Risk. An investor's ability to collect any will depend on the ability of XYZ Bank plc to pay.

Non-Marketability. Swaps are not registered instruments and they do not trade on any exchange. It may be impossible for the transactor in a swap to transfer the obligations under the swap to another holder. Swaps are customised instruments and there is no central source to obtain prices from other dealers.

APPENDIX 2.3 TOTAL RETURN SWAP AND REPO

Repo is short for 'sale and repurchase' agreement, and is a collateralised loan. The legal definition is a sale of a bond by one party (or other collateral) in return for cash, with a simultaneous agreement to buy back that bond at an agreed future date. On the buy-back date, the original sale proceeds are returned together with interest on the amount, this interest being charged at the repo rate.

There are economic similarities between a TRS and a repo transaction. A repo seller does not remove the collateral bond from its balance sheet, and there is no transfer of economic effects, including market and credit risk. In a TRS the total return payer or beneficiary lays off these risks to the swap counterparty. The counterparty desires this economic exposure, but the TRS enables it to achieve this without taking on the associated financing cost. However, both trades are funding transactions, in effect financed purchases of an asset, and in that respect are similar.

Consider a situation where the potential total return receiver owns an asset such as a bond, and requires financing for it (or is about to purchase the asset and requires financing). It could sell the bond to a counterparty that is prepared to be a TRS payer and simultaneously enter into a TRS with this counterparty. This is illustrated in Figure A2.3a. In Figure A2.3a, if Bank A had entered into a classic repo with Bank B, with the repo rate set at LIBOR plus a spread, the repo trade would be economically identical to the bond sale and TRS.[37]

The main difference is that the transaction is governed by the International Swap and Derivatives Association (ISDA) Swap agreement as opposed to a repo agreement. This changes the way the trade is reflected on the bank's balance sheet, and takes it off-balance-sheet. This is one of the main motivations for entering into this type of trade. So the transaction works as follows:

(a) the institution sells the security at its market price;
(b) the institution then executes a swap transaction for a fixed term, exchanging the total return on the security for an agreed rate on the relevant cash amount;
(c) on maturity of the swap the institution repurchases the security at the market price.

In theory each leg of the transaction can be executed separately with different counterparties; in practice, the trade is bundled together and so is economically identical to a repo.

[37] This trade is also common with equity or convertible bonds as underlying assets.

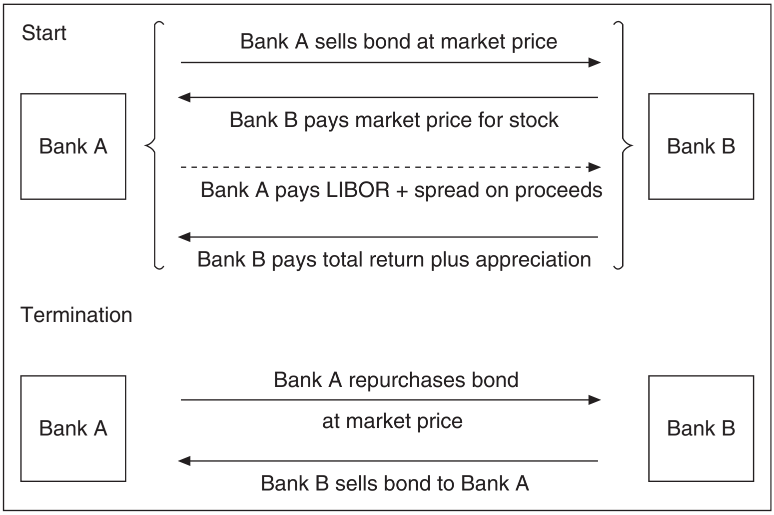

FIGURE A2.3a Repo and TRS.

The similarities between repo and TRS have resulted in repo traders employing the latter to help manage their books. The swaps are used if they offer a cheaper funding rate and if there is a need to remove assets from the balance sheet for the term of the swap. Often TRS are used as financing instruments by equity market-makers. It is unlikely that a repo trader would employ TRS for short-term funding, or longer term funding in high-quality assets such as gilts. However, long-term funding and funding of high-yield or exotic assets may need to be funded via a TRS. In addition, repo desks are exposed to credit risk in the same way that other lending desks are so exposed; a TRS or other credit derivative may be used to reduce this credit exposure where the bank does not wish to physically sell the asset.

TRSs are increasingly used as synthetic repo instruments, most commonly by investors that wish to purchase the credit exposure of an asset without purchasing the asset itself. This is conceptually similar to what happened when interest rate swaps were introduced, which enabled banks and other financial institutions to trade interest rate risk without borrowing or lending cash funds.

Balance Sheet Impact

Under a TRS an asset such as a bond position may be removed from the balance sheet. As we noted earlier, in order to avoid adverse impact on regular internal and external capital and credit exposure reporting a bank may use TRS to reduce the amount of lower quality assets on the balance sheet. This can be done by entering into a short-term TRS with, say, a 2-week term that straddles the reporting date.

Bonds are removed from the balance sheet if they are part of a sale plus TRS transaction. This is because legally, the bank selling the asset is not required to repurchase bonds from the swap counterparty, nor is the total return payer obliged to sell the bonds back to the counterparty (or indeed sell the bonds at all on maturity of the TRS). This does not occur under a classic repo or sell/buy-back, which remain balance sheet transactions.

APPENDIX 2.4 BASEL REGULATORY CAPITAL TREATMENT AND CREDIT DERIVATIVES

All banking activity is subject to regulatory capital treatment, as defined in the Bank for International Settlements (BIS) Basel capital accord of 1988. The Basel rules are described in Choudhry (2007).

The Basel rules define banking activity in terms of the Banking book and the Trading book. Banking book activity would include traditional bank lending such as loans to corporates, while the Trading book is where investment banking operations such as market making and derivatives trading is concentrated. All banks are required to put up regulatory capital against all their banking and trading book operations.

Approaches to Credit Risk

Basel II rules can be implemented under three alternative approaches: the standardised, foundation IRB and advanced IRB approaches. Briefly, these can be described as follows:

- *standardised approach:* the most straightforward to apply, with risk weights being assigned according to asset class or formal credit ratings. The assets are described as residential mortgages, corporate loans and so on;
- *foundation IRB:* under foundation IRB, the capital calculation is made after the bank itself sets default probabilities for each class of assets. The bank assigns probabilities of default (PD) to each asset class, or each asset in accordance with credit rating; using Basel II guidelines it then sets the loss-given-default (LGD), exposure-at default (EAD) and maturity (M) parameters. These inputs are then used to calculate risk-weights for each asset class using the Basel II capital calculation

formula. Foundation IRB may be used as a stepping-stone before implementation of the advanced IRB methodology, or retained as a calculation method in its own right;
- *advanced IRB:* under advanced IRB, a bank will calculate risk weights using its own parameters, which are arrived at from its own default data and internal models.

Under the IRB approach the banks may use their own data, significantly including data for PD, LGD and EAD. Their own model can be used to calculate risk-weights, which is then adjusted by a scaling factor. In practice this means a scaling factor of 1.06 will be applied. Note that a bank must adopt the same approach for both its banking book and its trading book.

The majority of banks, especially those outside Europe, employ the standardised approach. Smaller banks with extensive retail and mortgage business are also expected to adopt the standardised approach.

Only the largest banks are expected to adopt the advanced IRB approach, which requires significant investment in internal systems. Banks that do wish to implement the advanced IRB approach must seek supervisory approval of their systems and models from their national regulator.

The IRB Approach

The basic IRB framework is that banks must hold sufficient reserves to cover *expected loss* EL, or otherwise face a capital penalty. The EL portion of risk-weighted assets is part of total eligible capital provision; and shortage in eligible provisions will be deducted in a proportion of 50% from Tier 1 capital and 50% from Tier 2 capital. So the definition of Tier 1 and Tier 2 capital has changed under Basel II; the final framework withdraws the inclusion of general loan loss reserves in Tier 2 capital and excludes expected credit losses from required capital.

The building blocks of the IRB approach remain as when first described; namely, the statistical measures of individual asset credit risk levels. This incorporates:

- probability of default (PD); that is, the measure of probability that the obligor defaults over a specified time horizon;
- loss-given-default (LGD); that is, the amount that a bank expects to incur in the event of default. A cash amount measure per asset, showing VaR in the event of default;
- exposure-at-default (EAD); that is, bank guarantees, credit lines and liquidity lines, which are the forecast amount of how much a borrower will draw upon in the event of default;

- remaining maturity (M) of an asset; that is, on the basis that an asset with a longer remaining term-to-maturity will have a higher probability of experiencing default or another such credit event compared to an asset of shorter maturity.

Under the advanced IRB approach a bank is allowed to calculate their own capital requirement using its own internal measures of PD, LGD, EAD and M. These will be calculated by the bank's internal model using historical data on each asset, plus asset-specific data. The calculation method itself is described in Basel II; however, a bank will supply its own internal data on the assets. This includes the confidence level: the IRB formula is calculated based on a 99.9% confidence level and a 1-year time horizon. This means there is a 99.9% probability that the minimum amount of regulatory capital held by a bank will cover its economic losses over the next 12 months. Put simply, that means that statistically there is only a one in 1,000 chance that a bank's losses would erode completely its capital base, assuming that this was kept at the regulatory minimum level.

The economic losses covered by the IRB-calculated amount represent, in effect, a bank's *unexpected loss* or UL. That is, they do not represent what a bank would expect to lose, which is what EL is. The EL amount, where it is calculated by a bank, must be covered by reserves.

Standardised Basel II risk weights, which are the ones driven by credit rating, are shown at Table A2.4a.

TABLE A2.4a Basel II capital requirement risk weights, percentage weightings.

	Credit rating						
Asset	**AAA to AA**	**A+ to A−**	**BBB+ to BBB−**	**BB+ to B−**	**B+ to B−**	**Below B−**	**Unrated**
Sovereign	0%	20%	50%	100%	100%	150%	100%
Banks –							
option 1[(1)]	0%	20%	50%	100%	100%	150%	100%
option 2[(2)]							
< 3 months	20%	20%	20%	50%	50%	150%	20%
> 3 months	20%	50%	50%	100%	100%	150%	50%
Corporates	20%	50%	100%	100%	150%	150%	100%

[(1)]Based, on the risk-weighting of the sovereign in which the bank is incorporated.
[(2)]Based on the assessment of the individual bank.
Source: BIS.

Retail assets are described somewhat differently under the IRB approaches compared to sovereign or corporate assets. There is only one IRB approach; that is, we do not have separate foundation and advanced approaches. A bank adopting the IRB method for retail assets may use its own internal PD, LGD and EAD values. Unlike for large corporates and sovereigns, where there is a wealth of historical and other published data, this may prove problematic for retail assets. A bank would need sufficient statistical data for each retail borrower, which may not be available.

Credit Derivatives

Credit derivatives are classed as a 'credit risk mitigation' tool. Basel I allowed for such instruments, but only explicitly named collateral and bank guarantees. Exposures backed by collateral are risk-weighted at the risk weight of the collateral, be it cash, sovereign bonds or other suitable securities. Exposures backed by a bank guarantee are risk-weighted at 20% if the bank is an OECD bank. Credit derivatives are treated as implicit guarantees under Basel I, so an exposure backed by a CDS is risk-weighted at the level of the entity that is selling protection. This would be 20% for an OECD bank. If there is a currency mismatch between the exposure and the denomination of swap, this is taken to be an 8% reduction in protection. Exposures protected by a basket CDS are risk-weighted according to the type of instrument it is; for example, in a first-to-default (FtD) CDS, only one asset in the basket is recognised as being under protection, and the bank can nominate which one this is and which receives the 20% weighting. The remaining assets would be weighted as if they had no credit risk mitigation treatment.

Basel II explicitly identifies a larger number of credit risk mitigation instruments, and these include credit derivatives. In addition to collateral and guarantees, they include:

- netting agreements;
- third-party guarantees;
- the buying of credit protection using credit derivatives.

This is very relevant for credit derivative capital treatment.

Standardised and IRB Approach Under the standardised approach of Basel II, if an asset is protected with a credit derivative its risk-weight is deemed to be equal to the risk-weight of the credit protection seller. This is identical treatment to that under Basel I. For capital charge purposes then, there is an advantage to obtaining credit protection only from counterparties whose risk-weight is lower than the asset being protected; this may well be a majority of cases with regard to corporate and developing economy sovereign assets. The BIS document states that the credit events protected under the credit derivative must include failure to pay, bankruptcy and restructuring. These are all included under standard ISDA credit derivative documentation. If the contract excludes restructuring, then the level of capital charge relief is reduced. The foundation IRB approach to treating credit derivatives is similar to the standardised approach. The PD value that is used in the calculation will be that of the entity that is providing the credit risk protection. Under the advanced IRB approach, a bank's own PD and LGD values can be adjusted to account for the CDS protection.

Selling Protection Via CDS The Basel II capital treatment of a CDS contract used to sell protection assumes it is a cash instrument. Thus, capital must be allocated to the position as if it were a cash asset in the name of the reference entity. This is the same principle as Basel I, although now of course the reference entity rating is the key factor. For example, under Basel I selling protection on an A-rated corporate entity would attract a 100% risk-weighting, whereas under standardised Basel II the risk-weight would be 50%. Under the foundation IRB this weighting would be lower still.

An instrument is recognised as a credit risk mitigation tool if it is transacted under standard documentation that can be enforced in all legal jurisdictions. The procedure is slightly different, depending on what type of risk mitigation tool is used; however, certain factors are common to all three types. The most important of these is the maturity mismatch. A hedging tool of different maturity to the exposure is only considered if the maturity of the latter is one year or more. The BIS prescribes an adjustment factor that reduces the amount considered to be under protection for all hedges that do not match the exposure maturity.

Credit Derivatives and Synthetic Securitisation

The use of credit derivatives in a structured finance transaction produces a synthetic securitisation, in which the credit risk transfer of a pool of assets is achieved via the credit derivatives rather than a 'true sale' of the assets to a specially incorporated legal entity. For a synthetic CDO, the Basel II rules prescribe separate approaches for originators and investors.

The risk-weights to use for synthetic CDO note tranches are shown in Table A2.4b.

TABLE A2.4b Standardised approach for synthetic CDO tranches: risk weights %.

Tranche rating	Investment banks	Originating banks
AAA to AA−	20	20
A+ to A−	50	50
BBB+ to BBB−	100	100
BB+ to BB−	350	Deduction from capital
B+ and below	Deduction from capital	Deduction from capital
Unrated	Deduction from capital	Deduction from capital

Source: BIS.

IRB Approach When calculating the capital charge for CDO note assets, banks have less freedom to use their own internal data, even under the IRB approach. This stands it apart from other asset classes. An originating bank must nevertheless apply the IRB approach if it is using this same approach to assign risk-weights for the underlying assets of the CDO. If the tranche is rated, then the bank must apply the RBA approach; if not, then the SF calculation method will apply. If neither of these methods can be used, then the CDO asset must be deducted from capital. The RBA approach is essentially identical to that described earlier for ABS assets.

Basel II and Securitisation

Securitisation is important as a tool and technique in asset–liability management (ALM). We surmise a number of actions that banks can be expected to take with regard to both originating and investing in securitisation notes. For instance, the different treatment of assets such as residential mortgages and credit cards compared to Basel I means that there is less incentive to securitise them, compared with, say, lower rated corporate loans. From an ALM strategy perspective, the way securitisation deals are structured can also be expected to change, as the cost of investing in the junior notes and sub-investment-graded notes in an ABS deal will be higher in many cases. So we may observe that for many ABS deals the capital structure on the liability side will change to reflect this. The capital calculation approach adopted will also influence securitisation. Larger banks with more sophisticated or diverse asset portfolios are expected to adopt the IRB approach, which produces more favourable treatment for higher rated assets. Banks using the IRB method may have less incentive to securitise high-quality assets or invest in anything other than the senior tranche in an ABS deal. Smaller banks would be expected to adopt the standardised approach, which paradoxically creates a greater incentive to hold lower rated ABS tranches in some cases.

Change from Basel I to Basel II

A direct result of the original Basel accord, albeit an unplanned one, was the widespread adoption of securitisation as a balance sheet management tool among banks. This reflected the blanket coverage of the rules to a wide range of assets held on bank balance sheets, of widely varying credit quality. Basel I created a strong incentive to reduce regulatory capital charges by removing exposures, particularly higher quality ones, from balance sheets by securitising them. In order to help place the deal in the market, originators often retained the 'first-loss' or equity tranche of the structure, which meant that the highest risk part of the asset pool was retained by the bank. The somewhat ironic result of such a procedure is that, while the regulatory capital requirement would have been reduced, the economic risk to the bank would not have been. This was one of the main areas of complaint on the original accord, that it did not align closely enough the regulatory capital requirement to actual economic risk exposure of a bank's asset pool. Basel II has addressed this issue, and even in the standardised approach it manages to produce less of a 'shotgun' approach to risk capital calculations compared to Basel I. The IRB approach attempts to align regulatory capital with economic risk closer still. The main impact of this should be to reduce the incentive to securitise assets, especially higher quality ones. In addition, Basel II carries a high capital charge for securitised assets where the junior tranche is retained by the bank, so the deal economics in a securitisation will no longer be as attractive as before if the first-loss piece is retained. As we noted above, though, a significant influence on whether securitisation should be undertaken will be whether the standardised or IRB approach is adopted. For instance, the capital charge against investment in an AA-rated ABS tranche is higher for a standardised bank than an IRB bank. Table A2.4c, which is reproduced with the kind permission of Fitch Ratings Ltd, shows the difference in capital charges between the two approaches in a securitisation issue. The figures are for banks that invest in ABS tranches.

One further significant impact of Basel II is the new distinction it introduces between investment-grade and sub-investment-grade assets. The increased capital charge that results once one moves into a sub-investment grade rating is pronounced. This has the effect of creating a wall of higher charges across just one notch in rating; for example, from Table A2.4b we observe that under the RBA method a BBB– note tranche attracts a 8%

TABLE A2.4c Basel II risk-weights under securitisation: standardised versus IRB approach (%).

External rating	Standardised securitisation charges(1)	Basel II IRB securitised(2)	IRB vs standardised securitisation charges
AAA	1.60	0.56	(65)
AA	1.60	0.64	(60)
A	4	0.96	(76)
BBB+	8	2.80	(65)
BBB	8	4.80	(40)
BBB−	8	8	0
BB+	28	20	(29)
BB	28	34	21
BB−	28	52	86
B	Full deduction	Full deduction	NA
CCC+	Full deduction	Full deduction	NA

Source: © 2005 Fitch Ratings Ltd. Used with permission.
(1)Applies to investing standardised banks only; originating standardised banks are required to deduct non-investment-grade tranches. Rated BB+ and below out of capital.
(2)For positions rated BBB and above, the most favourable ratings-based approach (RBA) charges available for granular and senior positions are used in this comparison, given the severe stress scenarios and conservative enhance me tit levels needed to achieve an investment-grade rating.
IRB—internal ratings based
NA—not applicable

charge, whereas a note rated one notch lower at BB+ requires more than double this amount of capital (20%). This sudden steep increase will have an impact on the amount of lower rated assets held on the balance sheet; at the same time, it gives banks an incentive to minimise the number and size of un-rated tranches. In practice usually only the equity tranche is un-rated, so to reduce the regulatory capital charge to the lowest possible amount this note piece will need to be as small as possible. Balanced against this is the need for the equity piece to be of sufficient size such that it provides sufficient credit enhancement and protection for the tranches lying above it, as required by the rating agencies. Under Basel II not only will banks be penalised if they retain an un-rated securitisation note and/or the equity notes, other banks have no incentive to hold these as investments. Hence, banks can be expected to market such notes to non-bank investors not subject to Basel II regulation, such as hedge funds.

APPENDIX 2.5 MARKET-IMPLIED TIMING OF DEFAULT FROM CDS PRICES

The premium payable on a CDS contract is an explicit valuation of default risk.[38] Given that the CDS has a specified fixed term to maturity, it is possible by applying breakeven analysis to extract a market-implied timing of default for the reference credit in question. This is done by calculating the amount of time that has to elapse before the premium income on the CDS equals the recovery value. By definition therefore, we require an assumed recovery rate to perform this calculation.

When a credit reference shows signs of distress the CDS market begins to reflect this by marking higher the price of a CDS written on that name. This implies the timing of the default event. For instance, assume that recent market sentiment concerning ABC plc suggests that it is about to be downgraded to sub-investment grade status, and that default is now a high possibility. As a result, 5-year quarterly in arrears CDS for ABC plc rises in price and is now quoted at 2,300 bps. The recovery rate is expected to be 30% of the company value in the event of default occurring. Given this information, it is possible to get an approximate idea of when the market anticipates a default.

The calculation is shown at Figure A2.5a on page 159, an Excel spreadsheet used to obtain the breakeven point value. Cell H10 establishes the difference between the recovery amount and the time-weighted premium income. In this case the time weighting is quarterly, which is common for most CDS contracts. Initially, this value will not be equal to zero. To establish the (undiscounted) breakeven point, we apply the 'Goal Seek' function. We set the difference in H10 to zero by changing the value in cell D12. Cell D13 converts the number of periods back into years.

In our example, we have a 5-year CDS of £20 million trading at 2,300 bps spread. £4.6 million would be paid each year for default protection. Assuming a 30% recovery rate, the recovery in the event of default is expected to be £6 million. Ignoring the necessary discounting process, the £6 million will be received as premium in approximately 1.3 years. If this calculation is correct, then selling protection via the CDS will bring in premium income until the default occurs. Figure A.2.5b shows the Excel formulae used in Figure A2.5a on page 159.

This type of trading has occurred in a number of lower rated market sectors. Default timing risk can be seen as a means of achieving diversification of premium income within a portfolio.

[38] More accurately, credit event risk, since certain situations short of full default also constitute a credit event under which the CDS contract is terminated and is a payout made by the protection seller.

A1	B	C	D	E	F	G	H
2		Principal	£20,000,000				
3		Recovery rate	30%				
4				CDS	bps		
5	Maturity	5	Year	quote	2,300	0.23	
6		1	Year				£4,600,000
7	Payment frequency	0.25	Year				£1,150,000
8							
9			Recovery				£6,000,000
10							£0
11			Without discounting				
12			5.217391304	periods			
13			1.3043478	Years breakeven			
14							
15	To obtain the implied price of default						
16	Set G9 = 0 by changing C11						
17	Use 'Goal Seek' function						

FIGURE A2.5a Default timing calculation, five-year CDS.

A1	B	C	D	E	F	G	H
2		Principal	£20,000,000				
3		Recovery rate	30%				
4				CDS	bps		
5	Maturity	5	Year	quote	2,300	=F5/10000	
6		1	Year				=D2*G5
7	Payment frequency	0.25	Year				=H6*C7
8							
9			Recovery				£6,000,000
10							=H9-H7*D12
11			Without discounting				
12			5.217391304	periods			
13			=C7 * D12	Years breakeven			
14							
15	To obtain the implied price of default						
16	Set G9 = 0 by changing C11						
17	Use 'Goal Seek' function						

FIGURE A2.5b Excel spreadsheet formulae used in Figure A2.5a.

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Structured Credit Products: Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

CHAPTER 3

Credit Derivatives II: Funded Instruments

We have noted that credit derivative instruments exist in funded and unfunded variants. The previous chapter looked at unfunded credit derivatives. In this chapter we consider funded credit derivatives, by which we mean principally the credit-linked note (CLN) and also some versions of total return swaps (TRS).

CREDIT-LINKED NOTES

CLNs are a form of credit derivative. They are also, in all their forms, bond instruments for which an investor pays cash upfront, in order to receive a periodic coupon and, on maturity or termination, all or part of its initial purchase price back. That makes CLNs virtually identical to cash bonds. The key difference is that the return on the CLN is explicitly linked to the credit performance of the reference security or reference entity. Like all credit derivatives, CLNs are associated with a reference entity, credit events and cash or physical settlement.

CLNs are funded credit derivatives. The *buyer* of the note is the investor, who is the *credit protection seller* and is making an upfront payment to the protection buyer when it buys the note. Thus, the *credit protection buyer* is the *issuer* of the note. If no credit event occurs during the life of the note, the par redemption value of the note is paid to the investor on maturity. If a credit event does occur, then on maturity, a value less than par will be paid to the investor. This value will be reduced by the nominal value of the reference asset that the CLN is linked to. The exact process will differ according to whether cash settlement or physical settlement has been specified for the note. We will consider this later.[1]

As with credit default swaps (CDSs), CLNs are used in structured products, in various combinations, and their flexibility has been behind the growth and wide application of the synthetic collateralised debt obligation (CDO) and other credit hybrid products.

Description of CLNs

CLNs exist in a number of forms, but all of them contain a link between the return they pay and the credit-related performance of the underlying asset. A standard CLN is a security, issued directly by a financial or corporate entity or by a special purpose legal entity (SPV or SPE), which has an interest payment and fixed maturity structure similar to a vanilla bond. The performance of the note, however, including the maturity value, is linked to the performance of a specified underlying asset or assets as well as that of the issuing entity. Notes are usually issued at par. The notes are often used by borrowers to hedge against credit risk, and by investors to enhance the yield received on their holdings. Hence, the issuer of the note is the credit protection buyer and the buyer of the note is the credit protection seller.[2]

Essentially CLNs are hybrid instruments that combine a pure credit risk exposure with a vanilla bond. The CLN pays regular coupons; however, the credit derivative element is usually set to allow the issuer to decrease the principal amount, and/or the coupon interest, if a specified credit event occurs.

Figure 3.1 on page 165 shows Bloomberg screen SND and their definition of the CLN. We also show an earlier page from the same screen, Figure 3.2 on page 165, which indicates that a CLN is also viewed as a *structured note*.

[1]In an era before fancy terminology, a bank would make a loan to a corporate, in return for which the bank would receive interest payments on the loan up until the loan maturity date, upon which the original loan would be repaid in full ('par'). During the life of the loan, if the borrower ('obligor') experiences any financial difficulty or downturn in corporate performance, it may not be able to service the loan interest, or may default on the loan repayment. The bank lender has taken on an exposure to the credit performance of the obligor. The original funded credit derivative . . . ?!

[2]Some market participants think of CLNs as being issued only by SPVs or as part of structured products. However, as we illustrate in the example in this chapter they are also issued by corporations.

10 Page N219 n Corp **SND**

Page 11/ 12

Credit Linked Notes (CLN): A hybrid debt security that offers investors a synthetic credit exposure to a specified Reference Entity or basket of Reference Entities. This credit exposure can be gained through a variety of methods including (but not limited to): a credit default swap, a credit spread swap, a total return swap, or as a repackaged note where the issuer passes through the risk of an underlying credit to the noteholder in exchange for an enhanced return. For example, a note might provide for its principal repayment to be reduced below par in the event that a reference obligation defaults.

20) Example: EC771465 <CORP> DES. A note that is linked to the credit of Sodexho Alliance SA. Following a credit event on the underlying reference obligation, this note will be redeemed early at less than par.

Repackaged Notes: A debt instrument secured by an underlying asset where the cashflows of that asset are reprofiled through a derivative contract while the credit risk is passed through to the investor of the Repackaged Note.

21) Example: EC785183 <CORP> DES. A note that is secured by Roche Holdings convertible notes and a swap agreement. Following an event of default on all or part of the underlying, this note will be redeemed early at an amount based on the underlying.

Page <FWD> for FFIEC 034 Structured Note Call Reporting Revision

FIGURE 3.1 Bloomberg screen SND: definition of credit-linked note.

Page N219 n Corp **SND**

Page 2/ 12

Structured Note – Definition

The use of the term **structured note** is imprecise among market participants. Bloomberg appreciates the sensitivity to the identification of any bond as such, since special treatment is mandated for **structured notes** by various U.S. banking regulations. It is for precisely this reason that Bloomberg has elected to use the Structured note definition as employed by U.S. banking regulations.

Structured notes are hybrid securities combining a fixed-income instrument with a series of derivative components. As a result, the bond's coupon, average life, and/or redemption value can become exposed to the forward movement in various indices, equity prices, foreign exchange rates, mortgage-backed security prepayment speeds, etc. When combined with the nature of the options typically embedded within these structures--including complex call features, caps, and/or floors--exotic payoff scenarios and random cashflows can be expected. Excluded from this category are fixed-income securities that are issued by sovereign governments, where the structure is considered to be standard domestic convention.

Page <FWRD> for Structured Note product types

FIGURE 3.2 Bloomberg screen SND: definition of structured note.

As with CDSs, CLNs may be specified under cash settlement or physical settlement. Specifically:

- under cash settlement, if a credit event has occurred, on termination the protection seller receives the difference between the value of the initial purchase proceeds and the value of the reference asset at the time of the credit event;
- under physical settlement, on occurrence of a credit event, the note is terminated. At maturity, the protection buyer delivers the reference asset or an asset among a list of deliverable assets, and the protection seller receives the value of the original purchase proceeds minus the value of the asset that has been delivered.

Figure 3.3 illustrates a cash-settled CLN.

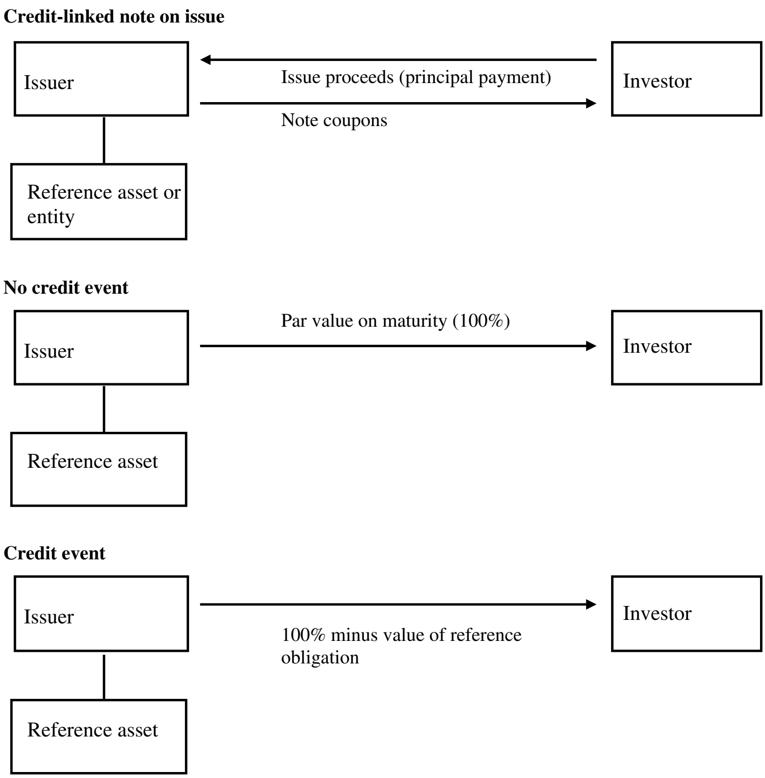


FIGURE 3.3 Credit-linked note settlement.

CLNs may be issued directly by a financial or corporate entity or via a special purpose vehicle (SPV). They have been issued with the form of credit-linking by taking on one or more of a number of different guises. For instance, a CLN may have its return performance linked to the issuer's, or a specified reference entity's, credit rating, risk exposure, financial performance or circumstance of default. The return of a CLN is linked to the performance of the reference asset. CLNs are described in some texts as being 'collateralised' with the reference security, but this is incorrect. The reference security may not be owned by the issuer of the CLN, so it could not possibly be described as being 'collateral' for the CLN.[3]

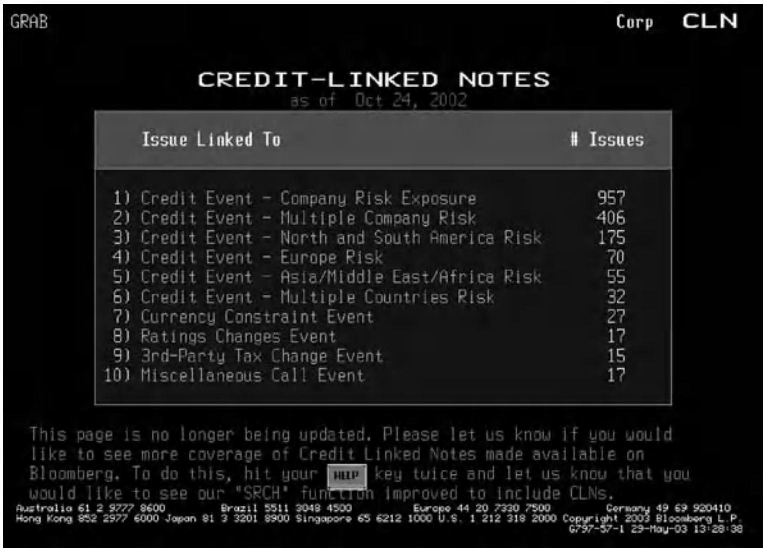
In some texts a CLN is described as being the equivalent of a risk-free bond and a short position in a CDS. While this description is not incorrect, we cannot see the point of stating it. A CLN is a bond with a return that is comprised of principal and/or interest payments. It is/are linked to the credit performance of a linked reference asset or reference entity, which may be the issuer. The investor in the note is selling credit protection on the reference asset or entity.

Certain market practitioners suggest that only bonds issued by an SPV that references a third-party security can be a CLN. For example, a note issued by an SPV whose return is linked to the fortunes of a named entity, to a pool of assets or to a structured finance security. The author does not agree with this limited definition, as clearly a bond whose return is adjusted on change of issuer credit rating (see Figures 3.6 and 3.7 on page 170) is a CLN. However, the reader needs to be aware of this distinction, as it impacts the possible settlement type. A CLN issued by the issuer who is also the reference entity will only be cash-settled on occurrence of a credit event. A CLN issued by an SPV that references a third-party name may also be physically settled, in theory at least.

Figure 3.4 shows Bloomberg screen CLN and a list of the various types of CLN issue that have been made.

Figure 3.5 shows a page accessed from Bloomberg screen 'CLN', which is a list of CLNs that have had their coupon affected by a change in the reference entity's credit rating, as at October 2002.

[3]Beware of this sort of jargon being used by bankers or capital market lawyers, or even in some textbooks. The proceeds of a CLN issue may be invested in collateral, as part of a synthetic CDO structured product (see Chapter 13), but, in its plain vanilla form it is not collateralised by anything. This is as silly as saying that a bond issued by a corporate cannot be a CLN (because it has not been issued by an SPV), even though the bond may, for example, have its coupon payment linked to the credit rating of the issuer or another reference entity.



GRAB Corp CLN

CREDIT-LINKED NOTES
as of Oct 24, 2002

Issue Linked To	# Issues
1) Credit Event – Company Risk Exposure	957
2) Credit Event – Multiple Company Risk	406
3) Credit Event – North and South America Risk	175
4) Credit Event – Europe Risk	70
5) Credit Event – Asia/Middle East/Africa Risk	55
6) Credit Event – Multiple Countries Risk	32
7) Currency Constraint Event	27
8) Ratings Changes Event	17
9) 3rd-Party Tax Change Event	15
10) Miscellaneous Call Event	17

This page is no longer being updated. Please let us know if you would like to see more coverage of Credit Linked Notes made available on Bloomberg. To do this, hit your HELP key twice and let us know that you would like to see our "SRCH" function improved to include CLNs.

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2003 Bloomberg L.P.
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FIGURE 3.4 Bloomberg screen CLN.
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GRAB Corp CLN

Page 1/ 1

RATINGS CHANGES EVENT

	Issuer	Settle Date	Cpn	Crncy	Maturity Date	Rating Changes Exposure
1)	BHFBK	04/28/1998	6.25	DEM	04/28/2006	Govt of Ukraine
2)	BSPIR	03/21/2000	7.00	EUR	02/20/2010	B-Spires
3)	CATTLE	10/21/1999	8.63	GBP	12/07/2007	Cattle PLC
4)	CNTCNZ	09/14/2000	FRN	AUD	09/14/2007	Contact Energy
5)	CNTCNZ	09/14/2000	FRN	USD	09/14/2007	Contact Energy
6)	HI	11/13/1997	FRN	USD	11/13/2013	Household Fin Co
7)	IFCTF	08/04/1997	7.88	USD	08/04/2002	Indust Fin Corp
8)	IFCTF	08/04/1997	7.75	USD	08/04/2007	Indust Fin Corp
9)	KPN	06/13/2000	FRN	EUR	06/13/2002	KPN NV
10)	KPN	06/13/2000	FRN	EUR	06/13/2002	KPN NV
11)	KPN	06/13/2000	6.05	EUR	06/13/2003	KPN NV
12)	METALF	07/25/2000	6.75	EUR	07/25/2005	MetallGesell Fin
13)	METALF	07/25/2000	6.75	EUR	07/25/2005	MetallGesell Fin
14)	OSTDRA	02/16/2000	Var	EUR	02/16/2007	Oester Draukraft
15)	SIRSTR	06/25/1998	FRN	USD	10/06/2006	Bk Tokyo-Mitsub
16)	SOWLN	03/26/1998	6.89	GBP	03/26/2008	Southern Water
17)	SPIRES	01/26/1998	FRN	DEM	10/24/2007	Greece

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
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FIGURE 3.5 Bloomberg screen showing a sample of CLNs impacted by change in reference entity credit rating, October 2002.
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Example Illustrations

CLNs come in a variety of forms. For example, consider a bank issuer of credit cards that wants to fund its credit card loan portfolio via an issue of debt. The bank is rated as AA–. In order to reduce the credit risk of the loans, it issues a 2-year CLN. The principal amount of the bond is 100% (par) as usual, and it pays a coupon of 7.50%, which is 200 bps above the 2-year benchmark. The equivalent spread for a vanilla bond issued by a bank of this rating would be around 120 bps. With the CLN though, if the incidence of bad debt among credit card holders exceeds 10%, then the terms state that note holders will only receive $85 per $100 nominal. The credit card issuer has, in effect, purchased a credit option that lowers its liability in the event that it suffers from a specified credit event, which in this case is an above-expected incidence of bad debts. The credit card bank has issued the CLN to reduce its credit exposure, in the form of this particular type of credit insurance. If the incidence of bad debts is low, the note is redeemed at par. However, if there is a high incidence of such debt, the bank will only have to repay a part of its loan liability. In this example, the reference assets linked to the CLN is the credit card loan portfolio.

Investors may wish to purchase the CLN because the coupon paid on it will be above what the credit card bank would pay on a vanilla bond it issued, and higher than other comparable investments in the market. In addition, such notes are usually priced below par on issue. Assuming that the notes are eventually redeemed at par, investors will also have realised a substantial capital gain.

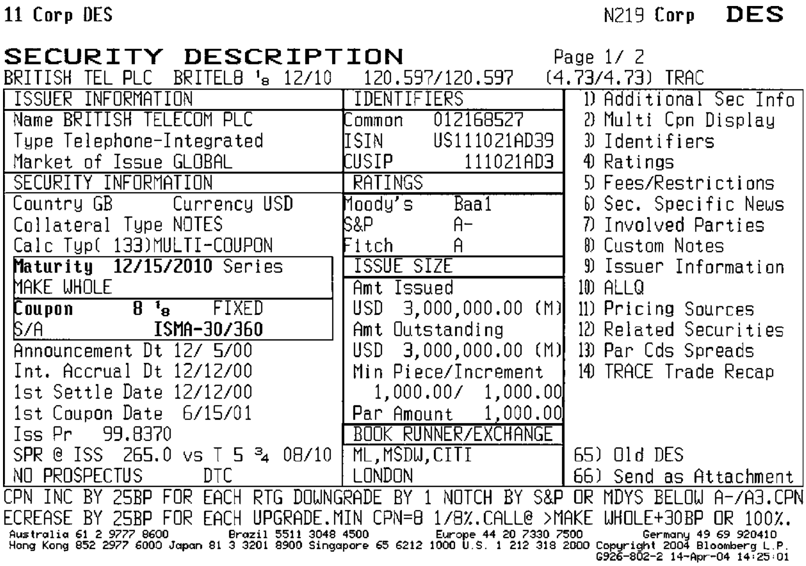
The majority of CLNs are issued directly by banks and corporates, in the same way as conventional bonds.

An example of such a bond is shown in Figure 3.6. This shows Bloomberg screen DES for a CLN issued by British Telecom, the 8.125% note due in December 2010. The terms of this note state that the coupon will increase by 25 bps for each 1-notch rating downgrade below A–/A3 suffered by the issuer during the life of the note. The coupon will decrease by 25 bps for each ratings upgrade, with a minimum coupon set at 8.125%. In other words, this note allows investors to take on a credit play on the fortunes of the issuer.

Figure 3.7 shows Bloomberg screen YA for this note, as at 12 May 2003. We can see that a rating downgrade meant that the coupon on the note changed to 8.375%.

Figure 3.8 on page 171 is the Bloomberg DES page for a US dollar-denominated CLN issued directly by Household Finance Corporation.[4] Like the British Telecom bond, this is a CLN with its return linked to the

[4]HFC was subsequently acquired by HSBC.


11 Corp DES N219 Corp DES

SECURITY DESCRIPTION Page 1/ 2
BRITISH TEL PLC BRITEL8 ⅛ 12/10 120.597/120.597 (4.73/4.73) TRAC

ISSUER INFORMATION	IDENTIFIERS	
Name BRITISH TELECOM PLC	Common 012168527	1) Additional Sec Info
Type Telephone-Integrated	ISIN US111021AD39	2) Multi Cpn Display
Market of Issue GLOBAL	CUSIP 111021AD3	3) Identifiers
SECURITY INFORMATION	RATINGS	4) Ratings
Country GB Currency USD	Moody's Baa1	5) Fees/Restrictions
Collateral Type NOTES	S&P A-	6) Sec. Specific News
Calc Typ(133)MULTI-COUPON	Fitch A	7) Involved Parties
Maturity 12/15/2010 Series	ISSUE SIZE	8) Custom Notes
MAKE WHOLE	Amt Issued	9) Issuer Information
Coupon 8 ⅛ FIXED	USD 3,000,000.00 (M)	10) ALLQ
S/A ISMA-30/360	Amt Outstanding	11) Pricing Sources
Announcement Dt 12/ 5/00	USD 3,000,000.00 (M)	12) Related Securities
Int. Accrual Dt 12/12/00	Min Piece/Increment	13) Par Cds Spreads
1st Settle Date 12/12/00	1,000.00/ 1,000.00	14) TRACE Trade Recap
1st Coupon Date 6/15/01	Par Amount 1,000.00	
Iss Pr 99.8370	BOOK RUNNER/EXCHANGE	
SPR @ ISS 265.0 vs T 5 ¾ 08/10	ML,MSDW,CITI	65) Old DES
NO PROSPECTUS DTC	LONDON	66) Send as Attachment

CPN INC BY 25BP FOR EACH RTG DOWNGRADE BY 1 NOTCH BY S&P OR MDYS BELOW A-/A3.CPN
ECREASE BY 25BP FOR EACH UPGRADE.MIN CPN=8 1/8%.CALL@ >MAKE WHOLE+30BP OR 100%.
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
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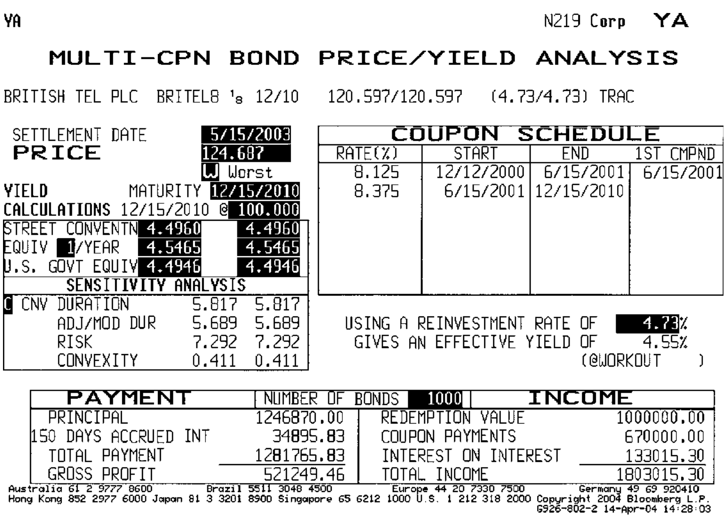
FIGURE 3.6 Bloomberg screen DES for British Telecom plc 8.125% 2010 credit-linked note issued on 5 December 2000.


YA N219 Corp YA

MULTI-CPN BOND PRICE/YIELD ANALYSIS

BRITISH TEL PLC BRITEL8 ⅛ 12/10 120.597/120.597 (4.73/4.73) TRAC

SETTLEMENT DATE 5/15/2003
PRICE 124.687
W Worst
YIELD MATURITY 12/15/2010
CALCULATIONS 12/15/2010 @ 100.000

STREET CONVENTN	4.4960	4.4960
EQUIV 1/YEAR	4.5465	4.5465
U.S. GOVT EQUIV	4.4946	4.4946
SENSITIVITY ANALYSIS		
C CNV DURATION	5.817	5.817
ADJ/MOD DUR	5.689	5.689
RISK	7.292	7.292
CONVEXITY	0.411	0.411

COUPON SCHEDULE

RATE(%)	START	END	1ST CMPND
8.125	12/12/2000	6/15/2001	6/15/2001
8.375	6/15/2001	12/15/2010	

USING A REINVESTMENT RATE OF 4.73%
GIVES AN EFFECTIVE YIELD OF 4.55%
(@WORKOUT)

PAYMENT	NUMBER OF BONDS 1000	INCOME	
PRINCIPAL	1246870.00	REDEMPTION VALUE	1000000.00
150 DAYS ACCRUED INT	34895.83	COUPON PAYMENTS	670000.00
TOTAL PAYMENT	1281765.83	INTEREST ON INTEREST	133015.30
GROSS PROFIT	521249.46	TOTAL INCOME	1803015.30

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2004 Bloomberg L.P.
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FIGURE 3.7 Bloomberg screen YA for British Telecom CLN, as at 12 May 2003.

FIGURE 3.8 Bloomberg screen DES for Household Finance Corporation CLN.
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credit risk of the issuer, but in a different way. The coupon of the HFC bond was issued as floating USD-LIBOR, but in the event of the bond not being called from November 2001, the coupon would be changed to the issuer's 2-year 'credit spread' over a fixed rate of 5.9%. In fact, the issuer called the bond with effect from the coupon change date. Figure 3.9 on page 172 shows the Bloomberg screen YA for the bond and how its coupon remained the same as at the first issue until the call date.

Another type of credit-linking is illustrated in Figure 3.10 on page 172. This is a Japanese Yen-denominated bond issued by Alpha-Sires, which is a medium-term note (MTN) program vehicle set up by Merrill Lynch. The note itself is linked to the credit quality of Ford Motor Credit. In the event of a default of the reference name, the note will be called immediately. Figure 3.11 on page 173 shows the rate fixing for this note as at the last coupon date. The screen snapshot was taken on 6 June 2003.

CLNs AND STRUCTURED PRODUCTS

As with other credit derivatives, CLNs are used as part of synthetic securitisation structures and structured products. We introduce this use here, while a detailed description of these products is given in Chapter 15.

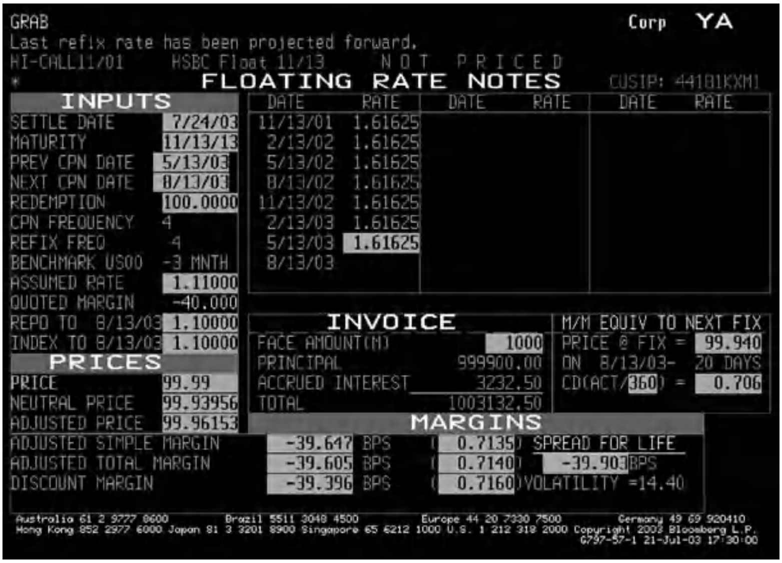

FIGURE 3.9 Bloomberg screen YA for Household Finance Corporation CLN, showing bond (Screen as at 21 July 2003).

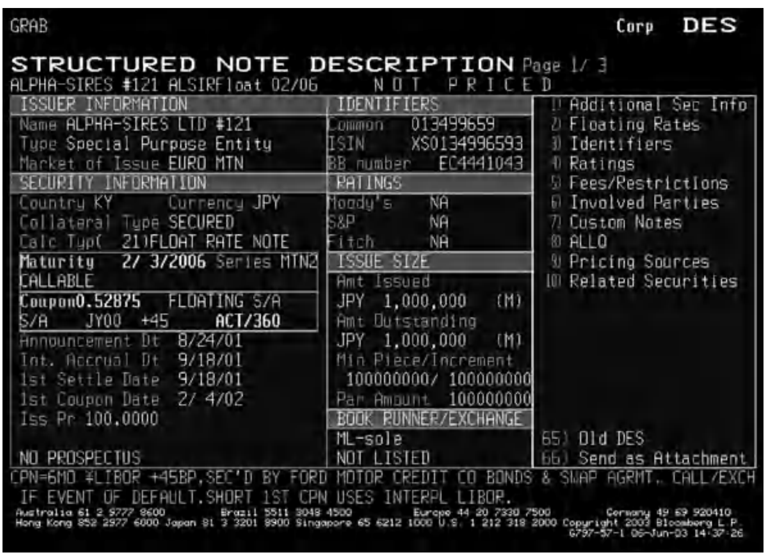

FIGURE 3.10 Bloomberg screen DES for Ford Motor credit-referenced linked CLN issued by Alpha-Sires MTN Program.

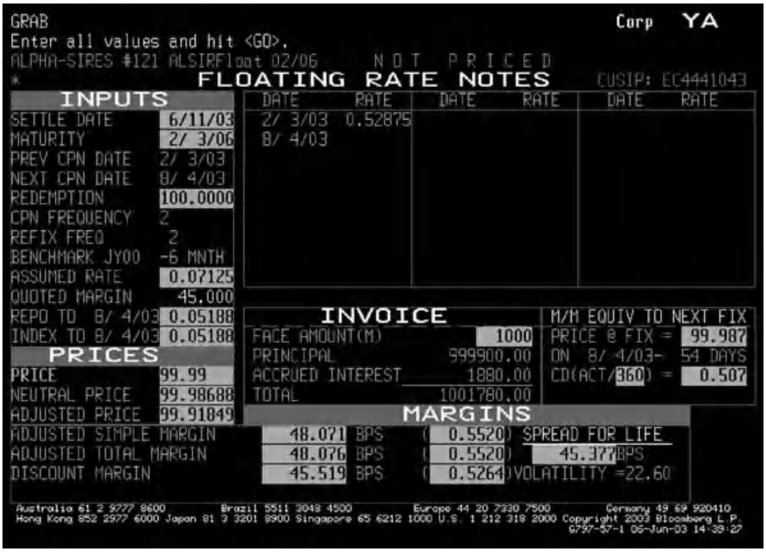

FIGURE 3.11 Bloomberg screen YA for Ford Motor credit-linked CLN as at 6 June 2003.

Simple Structure

Structured products such as synthetic collateralised debt obligations (CDOs) may combine both CLNs and CDSs, to meet issuer and investor requirements. For example, Figure 3.12 shows a credit structure designed to provide a higher return for an investor on comparable risk to the cash market. An issuing entity is set up in the form of an SPV, which issues CLNs to the market. The structure is engineered so that the SPV has a neutral position on a reference asset. It has bought protection on a single reference name by issuing a funded credit derivative, the CLN, and simultaneously sold protection on this name by selling a CDS on this name. The proceeds of the CLN are invested in risk-free collateral such as T-bills or a Treasury bank account. The coupon on the CLN will be a spread over

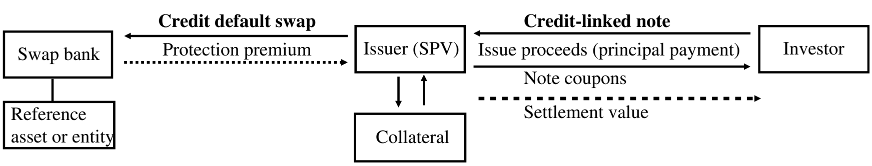

FIGURE 3.12 CLN and CDS structure on single reference name.

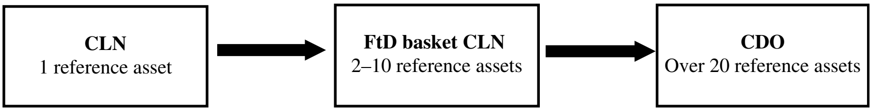

FIGURE 3.13 Progression CLN development.

LIBOR. It is backed by the collateral account and the fee generated by the SPV in selling protection with the CDS. Investors in the CLN have exposure to the reference asset or entity, and the repayment of the note is linked to the performance of the reference entity. If a credit event occurs, the maturity date of the CLN is brought forward and the note is settled as par minus the value of the reference asset or entity.

The First-to-Default CLN

A standard CLN is issued in reference to one specific bond or loan. An investor purchasing such a note is writing credit protection on a specific reference credit. A CLN that is linked to more than one reference credit is known as a *basket credit-linked note*. A development of the CLN as a structured product is the first-to-default (FtD) CLN, which is a CLN that is linked to a basket of reference assets. The investor in the CLN is selling protection on the first credit to default.[5] Figure 3.13 shows this progression in the development of CLNs as structured products, with the *fully funded synthetic* collateralised debt obligation (CDO) being the vehicle that uses CLNs tied to a large basket of reference assets.

An FtD CLN is a funded credit derivative in which the investor sells protection on one reference entity in a basket of assets, whichever is the first to default. The return on the CLN is a multiple of the average spread of the basket. The CLN will mature early on occurrence of a credit event relating to any of the reference assets. Note that settlement can be either of the following:

- physical settlement: with the defaulted asset(s) being delivered to the note holder;
- cash settlement: in which the CLN issuer pays redemption proceeds to the note holder calculated as (principal amount multiplied by the reference asset recovery value).[6]

[5] 'Default' here means a credit event as defined in the ISDA definitions.

[6] In practice, it is not the 'recovery value' that is used, but the market value of the reference asset at the time the credit event is verified. Recovery of a defaulted asset follows a legal process of administration and/or liquidation that can take years, the final recovery value may not be known with certainty for some time.

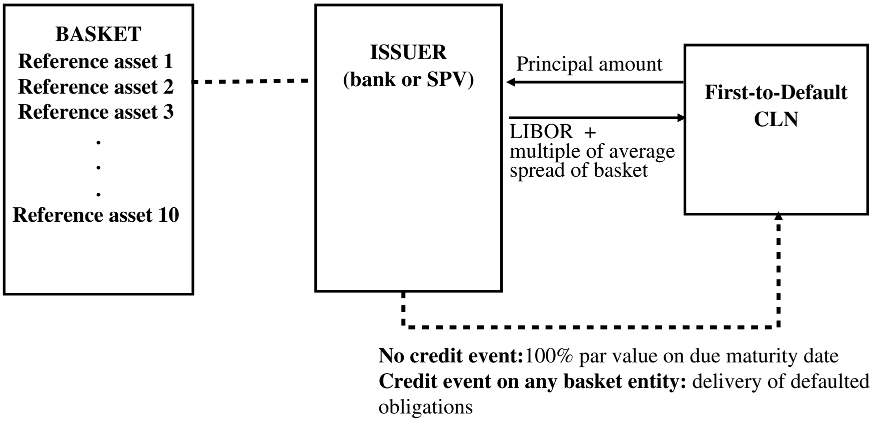

FIGURE 3.14 CLN structure.

Figure 3.14 shows a generic FtD credit-linked note.

To illustrate, let us consider an FtD CLN issued at par with a term to maturity of five years and linked to a basket of five reference assets with a face value (issued nominal amount) of $10 million. An investor purchasing this note will pay $10 million to the issuer. If no credit event occurs during the life of the note, the investor will receive the face value of the note on maturity. If a credit event occurs on any of the assets in the basket, the note will redeem early and the issuer will deliver a deliverable obligation of the reference entity, or a portfolio of such obligations, for a $10 million nominal amount. An FtD CLN carries a similar amount of risk exposure on default to a standard CLN; namely, the recovery rate of the defaulted credit. However, its risk exposure prior to default is theoretically lower than a standard CLN, as it can reduce default probability through diversification. The investor can obtain exposure to a basket of reference entities that differ by industrial sector and by credit rating.

The matrix in Figure 3.15 illustrates how an investor can select a credit mix in the basket that diversifies risk exposure across a wide range, in theory at least. We show a hypothetical mix of reference assets to which an issued FtD could be linked. The precise selection of names will reflect investors' own risk/return profile requirements. We say 'in theory' because the 2007–08 crash showed how diversifying across assets can actually concentrate risk in a bear market. Our hypothetical mix that we selected in 2004, shown at Figure 3.15, would not have done very well in 2008.

The FtD CLN creates a synthetic credit entity that features a note return with enhanced spread. Investors receive a spread over LIBOR that is the average return of all the reference assets in the basket. This structure serves

AAA							
Aa1							
Aa2				SunAlliance			
Aa3		RBoS					
A1							
A2							Powergen
A3	Ford					British Telecom	
Baa1			Philips		News Intl		
Baa2							
Baa3							

FIGURE 3.15 Diversified credit exposure to basket of reference assets: hypothetical reference asset mix, 2004.

to diversify credit risk exposure while benefiting from a higher average return. If the pool of reference assets is sufficiently large, the structure becomes similar to a *single-tranche CDO*. This is considered in Chapter 13.

PRINCIPAL PROTECTED STRUCTURES

Principal protected structures are instruments that were designed to meet investor demand for products that offered an element of capital guarantee. Because they offer an exposure to credit risk, and can be used to transfer credit risk exposure, they may be designated as a form of credit derivative. As the cost of a principal protected structure is paid upfront on issue, we discuss them here as part of 'funded' credit derivatives.

Certain investors desire to hold highly rated or investment-grade rated assets, but in a form that guarantees at least their initial investment on maturity. That is, the purchase price of par is not at risk during the term of the investment. This guarantee is structured into the investment instrument in the credit derivatives market, in the form of a principal protected CLN. The note is issued usually by an SPV that has been set up by the structuring investment bank. In essence the principal protected note is a funded credit derivative and is a form of CLN. The typical structure is that of a 100% principal protected note with an embedded CDS. The swap is linked to a specified reference credit. On occurrence of a credit event, the note stops paying coupons, but is redeemed at par on the original stated maturity date. Any type of credit derivative, such as a basket CDS, can be embedded into a principal protected note. So another type of structure is one where the coupons of the principal protected note are linked to the risk on a CDO mezzanine or equity tranche. Any default results in a decrease or termination of the remaining coupons. On maturity the par value is paid back to the investor.

FUNDED TOTAL RETURN SWAP

As we saw in Chapter 2, the total return swap (TRS) is an unfunded credit derivative. However, TRS can also be traded in funded form, where an upfront payment is made in return for the 'total return' of the reference asset. This makes the funded TRS similar to the synthetic repo discussed in Appendix 2.3.

A variation of the generic TRS is a funded credit derivative that has been used in structured credit products such as synthetic collateralised debt obligations (CDO).[7] An example of this is the Jazz I CDO B.V., which was a vehicle that could trade in cash bonds as well as CDSs and TRSs. It was called a hybrid CDO for this reason. In the *Jazz* structure, the TRS is a funded credit derivative because the market price of the reference asset is paid upfront by the *Jazz* vehicle to the swap counterparty. In return, the swap counterparty pays the principal and interest on the reference asset to the Jazz CDO. The Jazz CDO has therefore purchased the reference asset synthetically, and paid upfront the purchase price. The TRS in this case is physically settled. On occurrence of a predefined credit event, the swap counterparty delivers the asset to the CDO and the TRS is terminated. Because these are funded credit derivatives, a liquidity facility is needed by the vehicle, which it will draw on whenever it purchases a TRS. This facility is provided by the arranging bank to the structure, which in this case was Deutsche Bank AG.

The TRS arrangement in the *Jazz* structure is shown in Figure 3.16. The Jazz I CDO is discussed in detail in Chapter 13.

[7] These are covered in Chapter 13.

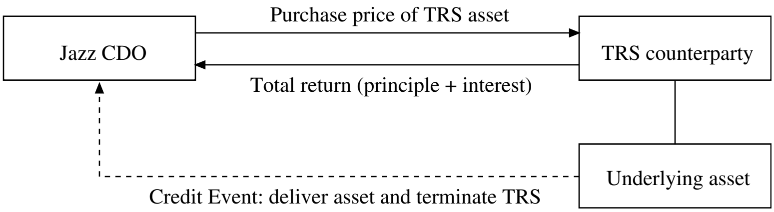

FIGURE 3.16 TRS as used in Jazz 1 CDO B.V.

THE PORTFOLIO CLN

To conclude this chapter, we produce here for illustrative purposes the term sheet that relates to a hypothetical Portfolio CLN. This is a note issued by an SPV that references a basket of 50 different corporate bonds. Readers will be able to get a flavour of the market's description of these products from this term sheet, and the list of the reference portfolio that is detailed within it. There is also a description of the return of the CLN and how it is linked to the performance of the bonds in the basket. For space reasons we have removed the schedule of reference securities, which was reproduced in the first edition of this book.

STATIC PORTFOLIO CLN

Indicative Terms and Conditions

For illustrative purposes we show here a sample term sheet for a hypothetical CLN that has been issued by an hypothetical Jersey SPV ('Golden Claw Funding Limited'). The CLN is referenced to a static tranche of a 7-year portfolio of 50 (synthetic) assets and pays a quarterly coupon of EURIBOR plus 2.2% on an Act/360 basis.

Issuer	Golden Claw Funding Limited an SPV incorporated in Jersey
Format	Bearer Medium Term Notes
Trade Date	11 December 2003
Issue Date	8 January 2004
Scheduled Maturity Date	20 March 2011
Scheduled Credit Observation End Date	3 Business Days prior to the Scheduled Maturity Date
Principal Amount	€100,000,000

Issue Price	100%
Reference Entity	Each of the Reference Entities specified in the Schedule and any Successors of any of them
Loss Threshold	Implicit Portfolio Size multiplied by the Lower Boundary
Lower Boundary	5.95%
Upper Boundary	6.95%
Tranche Size	Upper Boundary minus Lower Boundary
Implicit Portfolio Size	Principal Amount divided by Tranche Size
Combined Collateral	1. €100,000,000 of Erste Europaische Pfandbrief Und Kommunalkredit-bank AG • % bonds due 20 March 2011, ISIN [to be confirmed] (the 'Collateral Securities') 2. A swap agreement with the Swap Counterparty comprising an Asset Swap element and a Credit Swap element (the 'Swap Agreement')
Interest Rate	3-month EURIBOR + 220 bps
Interest Payment Dates	Quarterly on 20 March, 20 June, 20 September and 20 December each year, starting with a long first coupon on 20 March 2004, Act/360, following
Interest Amount and Accrual of Interest	**Interest Bearing Amount ∗ Interest Rate ∗ Day Count Fraction** 1. Interest Amount shall be determined by the Calculation Agent on the Payment Observation Date based on the Interest Bearing Amount as at that Payment Observation Date and shall be payable to the Note holders on the relevant Interest Payment Date 2. For the avoidance of doubt, Interest Amounts shall not be calculated on a weighted average basis 3. No Interest shall accrue after the Scheduled Maturity Date
Interest Bearing Amount	Principal Amount less the Notional Reduction Amount

Notional Reduction Amount	On any date, an amount determined by the Calculation Agent equal to: (1) the aggregate of the Implicit Credit Positions of all Non-determined Reference Entities existing on such date **plus** (2) Accumulated Loss calculated as of such date **Minus** (3) Implicit Portfolio Size multiplied by Lower Boundary, Subject to a maximum of the Principal Amount and a minimum of zero.
Non-determined Reference Entity	On any date, any Reference Entity in respect of which: (a) a Credit Event has occurred on or prior to, or (b) if a Potential Failure to Pay is Applicable, a Potential Failure to Pay exists on, that date and no Price Determination Date has occurred in respect thereof
Implicit Credit Position	With respect to any Reference Entity means the Implicit Portfolio Size multiplied by the Credit Position
Accumulated Loss	Aggregate of all Triggered Reference Entity Losses
Triggered Reference Entity	Each Reference Entity in respect of which a Credit Event has occurred and a Final Price has been determined
Triggered Reference Entity Loss	With respect to any Triggered Reference Entity means: the Implicit Portfolio Size multiplied by the Credit Position multiplied by the Credit Swap Loss
Credit Swap Loss	The difference between 100% and the Final Price of the Reference Obligation of the Triggered Reference Entity, as determined by the Calculation Agent
Additional Interest Payment Loss	If any Non-determined Reference Entities exist on the Payment Observation Date relating to an Interest Payment Date, the Deferral Number of Business

	Days following the Price Determination Date in respect of each such Reference Entity
Price Determination Date	In respect of a Reference Entity the date on which either (i) the Final Price is determined in relation to a Credit Event or (ii) if Potential Failure to Pay is Applicable, a Potential Failure to Pay has been cured
Payment Observation Date	The Observation Day Number of Business Days prior to each Interest Payment Date (including the Scheduled Maturity Date)
Redemption Amount	Provided no Early Redemption Event ('Credit Event') has occurred, the Notes will redeem on the Scheduled Maturity Date at the Interest Bearing Amount calculated as of the Payment Observation Date preceding the Scheduled Maturity Date (including in the Notional Reduction Amount the Implicit Credit Positions of all the Non-determined Reference Entities) If on such day any Non-determined Reference Entities exist, then on the Additional Instalment Date in respect of any such Reference Entity, a further instalment of principal shall be payable, which shall equal: 1. The Interest Bearing Amount calculated in respect of the final Interest Payment Date on the Price Determination Date in respect of the relevant Reference Entity **Minus** 2. Either (a) the Interest Bearing Amount calculated in respect of the final Interest Payment Date on the last preceding Price Determination Date in respect of another Reference Entity that was a Non-determined Reference Entity on the

	Payment Observation Date or (b), if no such Price Determination Date has occurred, the Interest Bearing Amount calculated in respect of such last Interest Payment Date prior to the Scheduled Maturity Date, subject to a minimum of zero. Subject to a minimum of zero. Notwithstanding the foregoing, where on any Payment Observation Date on which no Non-determined Reference entities exist, the Interest Bearing Amount is zero, the Notes will redeem on the related Interest Payment Date and both the Redemption Amount and Interest Amount due on such day shall be zero.
Redemption following Early Redemption Events	Notwithstanding any other provision, if an Early Redemption Event (including default by the issuer of the Collateral Securities and tax events) occurs the Collateral Securities will be liquidated and the Notes will redeem on the Early Redemption Date at the Early Redemption Amount
The Early Redemption Amount	The liquidation proceeds of the Collateral Securities plus or minus the mark-to-market values of the Swap Agreement as determined by the Calculation Agent *For the avoidance of doubt, the mark-to-market value of the Swap Agreement shall take into account any amounts due to be paid to the Swap Counterparty as a result of the occurrence of one or more Credit Events*
Calculation Agent/Swap Counterparty	XYZ Bank plc
Final Price	As determined by the Calculation Agent, in accordance with the Valuation Method on the basis of the Relevant Quotations (exclusive of any

	accrued interest and expressed as a percentage) for the relevant Reference Obligation as determined on the Valuation Date by the Calculation Agent. Final Price may be determined after the Valuation Date as more fully described in the final documentation
Potential Failure to Pay	Applicable
Valuation Method	Market
Valuation Time	Any time determined in the sole discretion of the Calculation Agent on the Valuation Date
Quotation Amount	Any amount not greater than the Credit Position multiplied by the Implicit Portfolio Size, as selected in the sole discretion of the Calculation Agent
Relevant Quotation	Bid
Additional Specified Currencies	None
Additional Public Sources	None
Denominations	€50,000
Business Days	Target
Listing	Application for listing will be made to an EU exchange after the Issue Date
Rating	Yes
Governing Law	English
Selling Restrictions	Investors are required to inform themselves of, and comply with, the restrictions on sales of the Notes set out in the Programme Documents which include: US, UK and the jurisdiction of the Issuer

Defined Terms

The terms of the Notes are based on the definitions and provisions contained in the 2000 ISDA Definitions and the 2003 ISDA Credit Derivatives Definitions as supplemented by the May 2003 Supplement (as published by the International Swaps and Derivatives Association, Inc.) (the 'Definitions'), subject to amendment as set out herein and in the Credit Provisions Annex (the 'Credit Annex') attached. In the event of any inconsistency between the Definitions, the Credit Annex and this term sheet will govern.

Structured Credit Products:Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

CHAPTER 4

Credit Analysis and Relative Value Measurement

Credit analysis is concerned with issuer-specific considerations (as opposed to macro considerations). This will include a quantitative analysis and a qualitative analysis that results in the assignment of an internal credit rating. Investors sometimes substitute the credit rating given by a third-party company such as Moody's or S&P. The qualitative factors to consider include those both internal and exogenous to the company.

In this chapter, we consider the process of credit analysis, as this is important for investors to be familiar with. We then look at measuring credit relative value.

CREDIT ANALYSIS

When ratings agencies were first set up the primary focus of credit analysis was on the default risk of the bond, or the probability that the investor would not receive the interest payments and the principal repayment as they fell due. Although this is still important, credit analysts now also consider overall macroeconomic conditions, as well as the chance that an issuer will have its rating changed during the life of the bond. There are differences in approach, depending on which industry or market sector the issuing company is part of.

In this section we review the main issues of concern to a credit analyst when rating bond issues. Analysts usually adopt a 'top-down' approach, or a 'big picture' approach, and concentrate on the macro issues first before looking at the issuer-specific points in detail. The process therefore involves reviewing the issuer's industry, before looking at its financial and balance sheet strength, and finally the legal provisions concerning the bond issue. There are also detail differences in analysis depending on which industry the issuer is in.

The Issuer Industry

In the first instance the credit analysis process of a specific issue will review the issuer's industry. This is in order to place the subsequent company analysis in context. For example, a company that has recorded growth rates of 10% each year may appear to be a quality performer, but not if its industry has been experiencing average growth rates of 30%. Generally, the industry analysis will review the following issues:

- *Economic cycle.* The business cycle of the industry and its correlation with the overall business cycle are key indicators. That is, how closely does the industry follow the rate of growth of its country's GNP? Certain industries such as the electricity and food retail sectors are more resistant to recession than others. Other sectors are closely tied to changes in population and birth patterns, such as residential homes, while the financial services industry is influenced by the overall health of the economy, as well as by the level of interest rates. As well as the correlation with macro-factors, credit analysts review traditional financial indicators in context; for example, the issuing company's *earnings per share* (EPS) against the growth rate of its industry.
- *Growth prospects.* This review is of the issuer industry's general prospects. A company operating within what is considered a high-growth industry is generally deemed to have better credit quality expectations than one operating in a low-growth environment. A scenario of anticipated growth in the industry has implications for the issuing company; for example, the extent to which the company will be able cope with capacity demands and the financing of excess capacity. A fast-growth industry also attracts new entrants, which will lead to over-supply, intensified competition and reduced margins. A slow-growth industry has implications for diversification, so that a company deemed to have plans for diversifying when operating in stagnant markets will be marked up.
- *Competition.* A review of the intensity of competitive forces within an industry, and the extent of pricing and over- or under-capacity, is an essential ingredient of credit analysis. Competition is now regarded as a global phenomenon and well-rated companies are judged able to compete successfully on a global basis while concentrating on the highest growth regions. Competition within a particular industry is related to that industry's structure and has implications for pricing flexibility. The type of market—for example, monopoly, oligopoly and so on—also influences pricing policy and relative margins. Another issue arises if there is obvious overcapacity in an industry; this has been exemplified

in the past in the airline industry and financial services (of some countries) when overcapacity often leads to intense price competition and price wars. This is frequently damaging for the industry as a whole, as all companies suffer losses and financial deterioration in the attempt to maintain or grow market share.

- *Supply sources.* The availability of suppliers in an industry influences a company's financial wellbeing. Monopoly sources of supply are considered a restrictive element and have negative implications. A vertically integrated company that is able to supply its own raw materials is less susceptible to economic conditions that might affect suppliers or leave it hostage to price rises. A company that is not self-sufficient in its factors of production, but is nevertheless in strong enough a position to pass on its costs, is in a good position.
- *Research and development.* A broad assessment of the growth prospects of a company must also include a review of its research and development (R&D) position. In certain industries, such as telecommunications, media and information technology, a heavy investment in R&D is essential simply in order to maintain market share. In a high-technology field it is common for products to obsolesce very quickly, therefore it is essential to maintain high R&D spending. In the short term, however, a company with a low level of research expenditure may actually post above-average (relative to the industry) profits because it is operating at higher margins. This is not considered a healthy strategy for the long term, though. Evaluating the R&D input of a company is not necessarily a straightforward issue of comparing ratios, however, as it is also important to assess correctly the direction of technology. That is, a successful company needs not only to invest a sufficient amount in R&D, it must also be correct in its assessment of the direction the industry is heading, technology-wise. A heavy investment in developing Betamax videos, for example, would not have assisted a company in the early 1980s.
- *Level of regulation.* The degree of regulation in an industry, its direction and its effect on the profitability of a company are relevant in a credit analysis. A highly regulated industry such as power generation, production of medicines or (in certain countries) telecommunications can have a restrictive influence on company profits. On the other hand, if the government has announced a policy of deregulating an industry, this is considered a positive development for companies in that industry.
- *Labour relations.* An industry with a highly unionised labour force or generally tense labour relations is viewed unfavourably compared to one with stable labour relations. Credit analysts will consider historic patterns of, say, strikes and production days lost to industrial action.

The status of labour relations is also more influential in a highly labour-intensive industry than one that is more automated for example.

- *Political climate*. The investment industry adopts an increasingly global outlook and the emergence of sizeable tradable debt markets in, for example, 'emerging' countries means that ratings agencies frequently must analyse the general political and economic climate in which an industry is operating. Failure to foresee certain political developments can have far-reaching effects for investors; for example in Indonesia when that country experienced a change of government foreign investors lost funds as several local banks went bankrupt.

FINANCIAL ANALYSIS

The traditional approach to credit analysis concentrated heavily on financial analysis. The more modern approach involves a review of the industry the company is operating in first, discussed above, before considering financial considerations. Generally, the financial analysis of the issuer is conducted in three phases, namely:

- the ratio analysis for the bonds;
- analysing the company's return on capital;
- non-financial factors such as management expertise and the extent of overseas operations.

Ratio analysis

In themselves ratios do not present very much insight, although there are various norms that can be applied. Generally, ratio analysis is compared to the levels prevalent in the industry, as well as historical values, in an effort to place the analysis in context and compare the company with those in its peer group. The ratios that can be considered are:

- pre-tax interest cover, the level of cover for interest charges in current pre-tax income;
- fixed interest charge level;
- *leverage*, which is commonly defined as the ratio of long-term debt as a percentage of the total capitalisation;
- level of leverage compared to industry average;
- nature of debt, whether fixed- or floating-rate, short- or long-term;

TABLE 4.1 S&P ratio benchmarks, 1997.

Credit Rating	Pre-Tax Interest Cover	Leverage	Cash Flow
AAA	17.99	13.2	97.5
AA	9.74	19.7	8.5
A	5.35	33.2	43.8
BBB	2.91	44.8	29.9

Source: S&P.

- cash flow, which is the ratio of cash flow as a percentage of total debt. Cash flow itself is usually defined as net income from continuing operations, plus depreciation and taxes, while debt is taken to be long-term debt;
- net assets, as a percentage of total debt. The liquidity of the assets—meaning the ease with which they can be turned into cash—is taken into account when assessing the net asset ratio.

The ratings agencies maintain benchmarks that are used to assign ratings, and these are monitored and if necessary modified to allow for changes in the economic climate. For example, Standard & Poor's guidelines for pre-tax interest cover, leverage level and cash flow in 1997 are shown in Table 4.1. A pre-tax cover of above 9.00, for example, was consistent with a double-A rating.

Other ratios that are considered include:

- intangibles; that is, the portion of intangibles relative to the asset side of a balance sheet;
- unfunded pension liabilities; generally a fully funded pension is not seen as necessary; however, an unfunded liability that is over 10% of net assets would be viewed as a negative point;
- age and condition of plant;
- working capital.

Return on equity

There is a range of performance measures used in the market that are connected with return on equity (generally, the analysis concentrates on return on capital, or more recently return on risk-adjusted capital or RORAC). In analysing measures of return, analysts seek to determine trends in historical performance and comparisons with peer group companies. Different companies also emphasise different target returns in their objectives, usually an expression of their corporate philosophy, so it is common for companies in the same industry to have different return ratios. The range of ratios used by the credit ratings agencies is shown below. Note that 'EBIT' is 'earnings before interest and tax'.

$$\text{Return on net assets} = \frac{\text{Profit}}{\text{Net assets}} \times 100$$

$$\text{Return on sales} = \frac{\text{Profit}}{\text{Sales turnover}} \times 100$$

$$\text{Return on equity} = (\text{Return on net assets} \times \text{Gearing}) \times 100$$

$$\text{Pre-tax interest cover} = \frac{\text{Pre-tax income from continuing operations}}{\text{Gross interest}}$$

$$\text{EBIT interest cover} = \frac{\text{Pre-tax income from continuing operations} + \text{Interest expense}}{\text{Gross interest}}$$

$$\text{Long-term debt as \% of capitalisation} = \frac{\text{Long-term debt}}{\text{Long-term debt} + \text{Equity}} \times 100$$

$$\text{Funds flow as \% of debt} = \frac{\text{Funds from operations}}{\text{Total debt}} \times 100$$

$$\text{Free cash flow as \% of debt} = \frac{\text{Free cash flow}}{\text{Total debt}} \times 100$$

The agencies make available data that may be consulted by the public; for example, default rates, recovery rates and so on.

Non-financial factors

The non-financial element of a company credit analysis has assumed a more important role in recent years, especially with regard to companies in exotic or emerging markets. Credit analysts review the non-financial factors relevant to the specific company after they have completed the financial and ratio analysis. These include the strength and competence of senior management, and the degree of exposure to overseas markets. The depth of overseas exposure is not always apparent from documents such as the annual report, and analysts sometimes need to conduct further research to determine this. Companies with considerable overseas exposure, such as petroleum companies, also need to be reviewed with respect to the political situation in their operating locations. A bank such as Standard Chartered, for example, has significant exposure to more exotic currencies in Asian, Middle-Eastern and African countries, and so is more at risk from additional market movements than a bank with almost exclusively domestic operations. The global, integrated nature of the bond markets also means that the foreign exchange exposure of a company must be evaluated and assessed for risk. The quality of management is a subjective, qualitative factor that can be reviewed in a number of ways. A personal familiarity with senior directors, acquired over a period of time, may help in the assessment. A broad breadth of experience, diversity of age and strong internal competition for those aspiring to very senior roles is considered positive. A company that had been founded by one individual, and in which there were no clear plans of 'succession', might be marked down.

INDUSTRY-SPECIFIC ANALYSIS

Specific industries will be subject to review that is more relevant to the particular nature of the operations of the companies within them. In this section we briefly consider two separate industries: power generation, water and certain other public service companies (or utilities); and financial companies.

Utility Companies

The industry for power generation, water supply and until recently telecommunications has a tradition of being highly regulated. Until the mid-1980s, utility companies were public-sector companies, and the first privatisation of such a company was for British Telecom in 1984. In certain European countries, utility companies are still nationalised companies, and their debt trades virtually as government debt. Credit analysis for utility companies therefore emphasises non-financial factors such as the depth of regulation and the direction in which regulation is heading; for example, towards an easing or tightening. Even in a privatised industry, for example, new government regulation maybe targeted only at the utility sector. In May 1997, the Labour government in the UK imposed a 'windfall tax' on several privatised utility companies shortly after being elected.

Another consideration concerns government direction on how the companies may operate, such as restrictions on where a power generation company may purchase coal from. In some countries, such as Germany, coal must be bought from the country's own domestic coal industry only, which imposes costs on the generating company that it would escape if it were free to purchase coal from other, lower cost producers. The financial analysis of a utility company essentially follows the pattern we described earlier.

Financial Sector Companies

The financial sector encompasses a large and diverse group of companies. They conduct an intermediary function in that they are a conduit for funds between borrowers and lenders of capital. At its simplest, financial service companies such as banks may earn profit by taking the spread between funds lent and borrowed. In analysing a financial sector company the credit analyst will consider the type of customer base served by the company; for example, how much of a bank's lending is to the wholesale sector, how much is retail and so on. The financial strength and prospects of its customer base are important elements of a bank's credit rating.

Financial analysis of banks and securities houses is concerned (in addition to the factors discussed above) with the asset quality of the institution; for example, the extent of diversification of a bank's lending book. Diversification can be across customer base as well as geographically. A loan book that is heavily concentrated in one sector is considered to be a negative factor in the overall credit assessment of the bank. A credit analyst will be concerned with the level of loans compared with levels in peer companies and the risk involved with this type of lending. For example, the expected frequency of bad loans from direct unsecured retail customer loans is higher than for retail customer loans secured by a second mortgage on a property. The higher lending rate charged for the former is designed to compensate for this higher lending risk.

There is a range of financial ratios that can be used to assess a bank's asset quality. These include:

- loss reserves/net charge-off level;
- net losses/average level of receivables;
- non-performing loans/average level of receivables.

However, unlike the more 'concrete' financial ratios given earlier, there is a higher subjective element with these ratios as banks themselves will designate which loans are non-performing and those loans against which have been assigned charges. Nevertheless, these ratios are useful indicators and may be used to identify trends across the sector as well. The loss reserves/net charge-off ratio is perhaps the most useful as it indicates the level of 'cushion' that a bank has; a falling ratio suggests that the bank may not be adding sufficient reserves to cover for future charge-offs. This trend, if continued, may then result in a future increase in the reserves and therefore a decrease in earnings levels as the expense of the reserves increase.

The leverage ratio is particularly important for financial sector companies, as the industry and business itself are highly leveraged. Banks and securities companies are therefore permitted a significantly higher leverage level than other companies. For example, in a diversified banking group with a high level of asset quality, a leverage ratio of 20:1 or even higher is considered satisfactory by ratings agencies. Another important measure for financial companies is *liquidity*. Due to the nature of the industry and the capital structure of banks, liquidity or, more accurately, the lack of liquidity is the primary reason behind banking failures. A bank that is unable to raise funds sufficiently quickly to meet demand will most probably fail, and certainly so if external support is not provided. An inability to raise funds may arise due to internal factors, such as a deterioration in earnings or a very poorly performing loan book, connected perhaps with a downgrade in credit rating, or from external factors such as a major structural fault in the money markets. This latter was exactly what happened to Northern Rock in 2007.

For credit analysis purposes the traditional liquidity measures are:

- cash;
- cash equivalents;
- level of receivables under one year/level of short-term liabilities.

A higher ratio indicates a greater safety cushion. A further consideration is the extent of lines of credit from other banks in the market. Other measures of strength for financial companies are *asset coverage*, the bank's earnings record including *earnings per share* (profit attributable to shareholders/number of shares in issue) and finally, the size of the institution. There is an element of thought which states that a very large institution, measured by asset size, cannot go bankrupt. This type of thinking can lead to complacency however, and it did not prevent several large Japanese banks from getting into financial difficulty in the 1990s.[1] It was also plainly no defence against the problems suffered by Citigroup and Royal Bank of Scotland in 2008.

RELATIVE VALUE ANALYSIS: BOND SPREADS

Investors measure the perceived market value, or relative value, of a corporate bond by measuring its yield spread relative to a designated benchmark. This is the spread over the benchmark that gives the yield of the corporate bond. A key measure of relative value of a corporate bond is its swap spread. This is the basis point spread over the interest rate swap curve, and

[1] In fact, the Japanese government gave an implicit guarantee for the largest 20 'city' banks at one stage, shortly after the collapse of Yamaichi Securities in 1997.

is a measure of the credit risk of the bond. In its simplest form, the swap spread can be measured as the difference between the yield-to-maturity of the bond and the interest rate given by a straight-line interpolation of the swap curve. In practice, traders use the asset swap spread and the Z-spread as the main measures of relative value. The government bond spread is also used. In addition, now that the market in synthetic corporate credit is well established, using credit derivatives and CDS, investors consider the cash-CDS spread as well, which is known as the *basis*.

The spread that is selected is an indication of the relative value of the bond, and a measure of its credit risk. The greater the perceived risk, the greater the spread should be. This is best illustrated by the credit structure of interest rates, which will (generally) show AAA– and AA-rated bonds trading at the lowest spreads and BBB–, BB– and lower-rated bonds trading at the highest spreads. Bond spreads are the most commonly used indication of the risk-return profile of a bond. In this section we consider the Treasury spread, asset swap spread, Z-spread and basis.

Swap Spread and Treasury Spread

A bond's swap spread is a measure of the credit risk of that bond, relative to the interest-rate swaps market. Because the swaps market is traded by banks, this risk is effectively the inter-bank market, so the credit risk of the bond over-and-above bank risk is given by its spread over swaps. This is a simple calculation to make, and is the yield of the bond minus the swap rate for the appropriate maturity swap. Figure 4.1 shows Bloomberg page IRSB for GBP as at 10 August 2005. This shows the GBP swap curve on the left-hand side. The right-hand side of the screen shows the swap rates' spread over UK gilts. It is the spread over these swap rates that would provide the simplest relative value measure for corporate bonds denominated in GBP. If the bond has an odd maturity, say 5.5 years, we would interpolate between the 5-year and 6-year swap rates.

The spread over swaps is sometimes called the *I-spread*. It has a simple relationship to swaps and Treasury yields, shown here in the equation for corporate bond yield,

$$Y = I + S + T$$

where

- Y is the yield on the corporate bond
- I is the I-spread or spread over swap
- S is the swap spread
- T is the yield on the Treasury security (or an interpolated yield).

GRAB Govt **IRSB**

British Pound

Ticker	TIME	Bid	Ask	Change	Open	High	Low	Prev Cls
GBP Swap Rates								
2) 1 YR	11:22	4.4940	4.5030	--	4.4980	4.5005	4.4870	4.4980
3) 18 MO	11:22	4.3925	4.4225	-.0087	4.4150	4.4175	4.3950	4.4163
4) 2 YR	11:16	4.4070	4.4150	-.0055	4.4150	4.4225	4.3975	4.4175
5) 3 YR	11:23	4.4110	4.4360	.0006	4.4225	4.4275	4.4000	4.4238
6) 4 YR	11:23	4.4160	4.4150	.0118	4.4250	4.4615	4.4085	4.4263
7) 5 YR	11:23	4.4230	4.4240	-.0127	4.4350	4.4370	4.4125	4.4363
8) 6 YR	11:23	4.4240	4.4625	-.0030	4.4500	4.4550	4.4233	4.4513
9) 7 YR	11:23	4.4440	4.4620	-.0157	4.4600	4.4590	4.4355	4.4638
10) 8 YR	11:23	4.4520	4.4590	-.0158	4.4675	4.4750	4.4422	4.4713
11) 9 YR	11:23	4.4680	4.4630	-.0157	4.4725	4.4800	4.4478	4.4763
12) 10 YR	11:23	4.4610	4.4640	-.0128	4.4750	4.4840	4.4550	4.4763
13) 12 YR	11:23	4.4610	4.4640	.0138	4.4750	4.4750	4.4585	4.4763
14) 15 YR	11:23	4.4620	4.4850	-.0128	4.4650	4.4735	4.4335	4.4663
15) 20 YR	11:23	4.4210	4.4230	-.0118	4.4325	4.5250	4.3912	4.4338
16) 25 YR	11:21	4.3175	4.4475	-.0125	4.3975	4.4357	4.3763	4.3963
17) 30 YR	11:21	4.3430	4.3650	-.0078	4.3550	4.4600	4.3225	4.3688

Page 1

Ticker	TIME	Bid	Ask	Change	Open	High	Low	Prev Cls
GBP Swap Spread								
19) 1 YR	11:22	33.80	36.80	+2.10	31.40	33.80	29.90	31.7000
20) 2 YR	11:21	29.50	33.50	+1.00	28.00	32.25	28.50	30.5000
21) 3 YR	11:21	31.00	35.00	+.75	30.75	33.25	30.00	32.2500
22) 4 YR	11:23	30.50	35.60	+.50	30.50	33.25	30.00	32.5000
23) 5 YR	11:14	26.50	36.00	-4.50	30.50	30.50	28.50	33.0000
24) 6 YR	11:23	32.75	37.75	+.50	32.50	35.50	32.50	34.7500
25) 7 YR	11:23	32.00	37.00	+.50	32.00	34.75	32.00	34.0000
26) 8 YR	11:21	31.00	36.00	+.50	30.75	33.75	30.75	33.0000
27) 9 YR	11:21	29.75	34.75	+.50	29.75	32.50	29.75	31.7500
28) 10 YR	8:05	29.75	34.75	+.25	32.25	32.50	32.25	32.0000
29) 15 YR	11:21	22.75	31.75	+.25	27.25	28.00	27.00	27.0000
30) 20 YR	11:21	19.00	32.00	+.13	25.50	26.00	25.25	25.3750
31) 30 YR	11:23	14.75	27.50	+.25	21.00	21.50	20.63	20.8750
For UK Govt Yield Curve, Click on any Tickers above & Select IYC1 I22								
For GBP Swap Curve, Click on any Tickers above & Select IYC1 I55								

Page 2

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2005 Bloomberg L.P.
2 22-Sep-05 11:23:44

FIGURE 4.1 Bloomberg page IRSB for pounds sterling, showing GBP swap rates and swap spread over UK gilts.
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In other words, the swap rate itself is given by $T + S$.

The I-spread is sometimes used to compare a cash bond with its equivalent CDS price, but for straightforward relative value, analysis is usually dropped in favour of the asset swap spread, which we look at later in this section.

The basic relative value measure is the Treasury spread or government bond spread. This is simply the spread of the bond yield over the yield of the appropriate government bond. Again, an interpolated yield may need to be used to obtain the right Treasury rate to use. The bond spread is given by:

$$BS = Y - T.$$

Using an interpolated yield is not strictly accurate because yield curves are smooth in shape and so straight-line interpolation will produce slight errors. The method is still commonly used though.

Asset Swap Spread

An asset swap is a package that combines an interest rate swap with a cash bond, the effect of the combined package being to transform the interest rate basis of the bond. Typically, a fixed-rate bond will be combined with an interest-rate swap in which the bondholder pays fixed coupon and receives floating coupon. The floating-coupon will be a spread over LIBOR. The spread is the asset swap spread and is a function of the credit risk of the bond over and above inter-bank credit risk.[2] Asset swaps may be transacted at par or at the bond's market price. This means that the asset swap value is made up of the difference between the bond's market price and par, as well as the difference between the bond coupon and the swap fixed rate.

The zero-coupon curve is used in the asset swap valuation. This curve is derived from the swap curve, so it is the implied zero-coupon curve. The asset swap spread is the spread that equates the difference between the present value of the bond's cash flows, calculated using the swap zero rates, and the market price of the bond. This spread is a function of the bond's market price and yield, its cash flows and the implied zero-coupon interest rates.[3]

Figure 4.2 shows the Bloomberg screen ASW for a GBP-denominated bond, GKN Holdings 7% 2012, as at 10 August 2005. We see that the asset

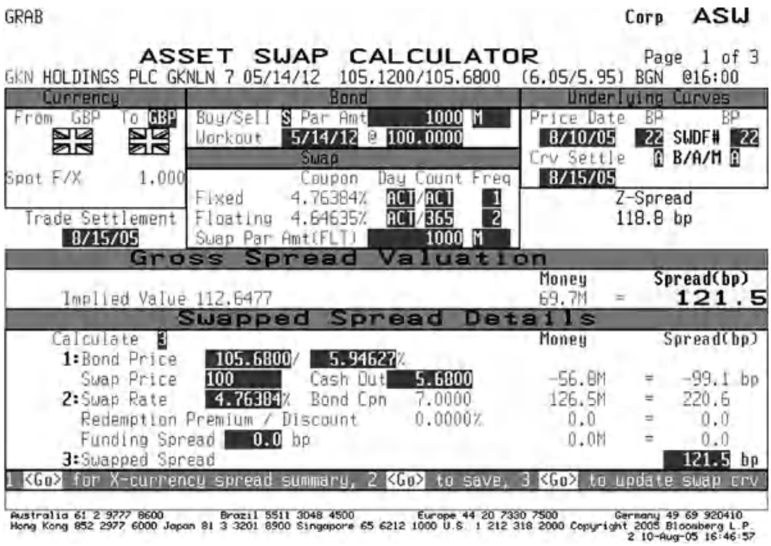

FIGURE 4.2 Bloomberg page ASW for GKN Bond, 10 August 2005.
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[2]This is because in the inter-bank market, two banks transacting an interest-rate swap will be paying/receiving the fixed rate and receiving/paying LIBOR-flat. See also the author's 'Learning Curve' article on asset swaps available on www.yield curve.com

[3]Bloomberg refers to this spread as the Gross Spread.

swap spread is 121.5 bps. This is the spread over LIBOR that will be received if the bond is purchased in an asset-swap package. In essence the asset swap spread measures a difference between the market price of the bond and the value of the bond when cash flows have been valued using zero-coupon rates. The asset swap spread can therefore be regarded as the coupon of an annuity in the swap market that equals this difference.

Z-spread

The conventional approach for analysing an asset swap uses the bond's yield-to-maturity (YTM) in calculating the spread. The assumptions implicit in the YTM calculation (see Choudhry 2001, Chapter 6) make this spread problematic for relative value analysis, so market practitioners use what is termed the Z-spread instead. The Z-spread uses the zero-coupon yield curve to calculate spread, so it is a more realistic, and effective, spread to use. The zero-coupon curve used in the calculation is derived from the interest-rate swap curve.

Put simply, the Z-spread is the basis point spread that would need to be added to the implied spot yield curve such that the discounted cash flows of the bond are equal to its present value (its current market price). Each bond cash flow is discounted by the relevant spot rate for its maturity term. How does this differ from the conventional asset swap spread? Essentially, in its use of zero-coupon rates when assigning a value to a bond. Each cash flow is discounted using its own particular zero-coupon rate. The price of a bond's price at any time can be taken to be the market's value of the bond's cash flows. Using the Z-spread we can quantify what the swap market thinks of this value; that is, by how much the conventional spread differs from the Z-spread. Both spreads can be viewed as the coupon of a swap market annuity of equivalent credit risk of the bond being valued.

In practice the Z-spread, especially for shorter dated bonds and for better credit-quality bonds, does not differ greatly from the conventional asset-swap spread. The Z-spread is usually the higher spread of the two, following the logic of spot rates, but not always. If it differs greatly, then the bond can be considered to be mispriced. Figure 4.3 on page 198 uses the Bloomberg screen YAS for the same bond shown in Figure 4.2, as at the same date. It shows a number of spreads for the bond. The main spread of 151.00 bps is the spread over the government yield curve. This is an interpolated spread, as can be seen lower down the screen, with the appropriate benchmark bind identified. We see that the asset swap spread is 121.6 bps, while the Z-spread is 118.8 bps. When undertaking relative value analysis—for instance, if making comparisons against cash funding

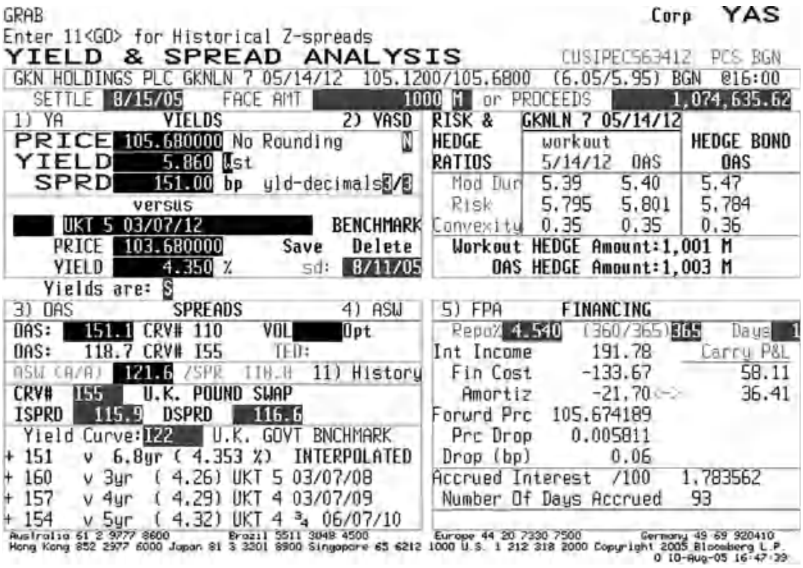

FIGURE 4.3 Bloomberg page YAS for GKN bond, 10 August 2005.
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rates or the same company name CDS—it would be this lower spread that would be used.[4]

The same screen can be used to check spread history. This is shown at Figure 4.4, the Z-spread graph for the GKN bond for the six months prior to our calculation date.

Z-spread is closely related to the bond price, as shown by equation (4.1),

$$P = \sum_{i=1}^{n} \left[\frac{C_i + M_i}{(1 + ((Z + S_i + T_i)/m))^i} \right] \tag{4.1}$$

where n is the number of interest periods until maturity
P is the bond price
C is the coupon
M is the redemption payment (so bond cash flow is all C plus M)
Z is the Z-spread
m is the frequency of coupon payments.

In effect this is the standard bond price equation with the discount rate adjusted by whatever the Z-spread is; it is an iterative calculation. The

[4] On the date in question the 10-year CDS for this reference entity was quoted as 96.8 bps, which is an example of a negative basis, in this case of −22 bps.

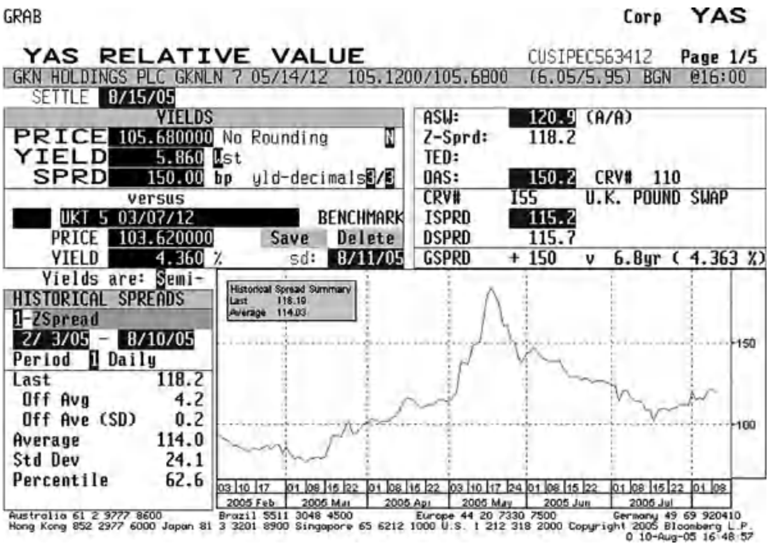


FIGURE 4.4 Bloomberg page YAS for GKN bond, 10 August 2005 showing Z-spread history.

appropriate maturity swap rate is used, which is the essential difference between the I-spread and the Z-spread. This is deemed to be more accurate, because the entire swap curve is taken into account rather than just one point on it. In practice though, as we have seen in the example above, there is often little difference between the two spreads.

To reiterate then, using the correct Z-spread, the sum of the bond's discounted cash flows will be equal to the current price of the bond.

We illustrate the Z-spread calculation at Figure 4.5 on page 200 and 201. This is done using a hypothetical bond, the XYZ plc 5% of June 2008, a 3-year bond at the time of the calculation. Market rates for swaps, Treasury and CDS are also shown. We require the spread over the swaps curve that equates the present values of the cash flows to the current market price. The cash flows are discounted using the appropriate swap rate for each cash flow maturity. With a bond yield of 5.635 %, we see that the I-spread is 43.5 bps, while the Z-spread is 19.4 bps. In practice the difference between these two spreads is rarely this large.

For the readers' benefit we also show the Excel formula in Figure 4.5. This shows how the Z-spread is calculated; for ease of illustration we have assumed that the calculation takes place for value on a coupon date, so that we have precisely an even period to maturity.

A1	B	C	D	E	F	G	H	I
2	**Issuer**		**XYZ plc**					
3	Settlement date		6/1/05					
4	Maturity date		6/1/08					
5	Coupon		5%	**YIELD**	**0.05635**			
6	Price		98.95	[Cell formula =YIELD(C4,C5,C6,C7,C8,C9,C10)]				
7	Par		100					
8	Semi-annual coupon		2	**PRICE**	**98.95000**			
9	act/act		1	[Cell formula =PRICE(C4,C5,C6,C6,C8,C9,C10)]				
10								
11	Bond yield		5.635%					
12	Sovereign bond yield		4.880%					
13	Swap rate (S)		5.200%					
14								
15	3-year CDS price		28 bps					
16								
17	**Treasury spread**							
18	5.635 – 4.88		55 bps					
19								
20	**I-spread**							
21	5.635 – 5.20		43.5 bps					
22								
23	**Z-spread (Z)**		19.4 bps	0.00194				
24	The Z-spread is found using iteration							
25								

FIGURE 4.5 Calculating the Z-spread, hypothetical 5% 2008 bond issued by XYZ plc.

26								**Sum of PVs**
27	Cash flow date	12/1/05	6/1/06	12/1/06	6/1/07	12/1/07	6/1/08	
28	Cash flow maturity (years)	0.50	1.00	1.50	2.00	2.50	3.00	
29	0.5-year swap rate (S)	4.31%	4.84%	4.99%	5.09%	5.18%	5.20%	
30	Cash flow (CF)	2.50	2.50	2.50	2.50	2.50	102.50	
31	Discount factor	0.97797598	0.951498751	0.926103469	0.900947692	0.875835752	0.852419659	
32	(DF calculation)	1/(1+(S+Z)/2)^1	1/(1+(S+Z)/2)^2	1/(1+(S+Z)/2)^3	1/(1+(S+Z)/2)^4	1/(1+(S+Z)/2)^5	1/(1+(S+Z)/2)^6	
33	CF present value (PV)	2.445	2.379	2.315	2.252	2.190	87.373	**98.95**
34								
35								
36								
37	A Z-spread of 19.4 basis points gives us the current bond price so is the correct one							
38	Using this value, the sum of all the discounted cashflows is equal to the market price							
39								
40	**CDS Basis**							
41	28 – 19.4	8.6 bps						
42	The basis is positive in this example							

FIGURE 4.5 (*Continued*)

REFERENCE

Choudhry, M., *The Bond and Money Markets*, Oxford: Butterworth Heinemann, 2001.

Structured Credit Products:Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

CHAPTER 5

Credit Derivatives III: Applications

As derivative instruments are over-the-counter (OTC) contracts, credit derivatives are very flexible products with a wide range of applications. It was their introduction that enabled synthetic structured products to be developed, which are now a major part of the debt capital markets. In Part II of this book we look in detail at synthetic securitisation, in this chapter we present an overview of some basic applications.

MANAGING CREDIT RISK

Credit derivatives were introduced initially as tools to hedge credit risk exposure, by providing insurance against losses suffered due to 'credit events'. At market inception in 1994, commercial banks were using them to protect against losses on their corporate loan books. The principle behind credit derivatives is straightforward and this makes them useful equally for both protection buyers and sellers. For instance, while commercial banks were offloading their loan book risk, investors who may have previously been unable to gain exposure to this sector (because of the lack of a 'market' in bank loans) could now take it on synthetically. The flexibility of credit derivatives provides users with a number of advantages precisely because they are OTC products and can be designed to meet specific user requirements.

We focus on credit derivatives as instruments that may be used to manage risk exposure inherent in a corporate or non-AAA sovereign bond portfolio. They may also be used to manage the credit risk of commercial loan books. The intense competition among commercial banks, combined with rapid disintermediation, has meant that banks have been forced to evaluate their lending policy, with a view to improving profitability and return on capital. The use of credit derivatives assists banks with restructuring their businesses, because they allow banks to repackage and transfer credit risk, while retaining assets on balance sheet (when required) and thus maintain client relationships. As the instruments isolate certain aspects of credit risk from the underlying loan or bond and transfer them to another entity, it becomes possible to separate the ownership and management of credit risk from the other features of ownership associated with the assets in question. This means that illiquid assets such as bank loans, and illiquid bonds, can have their credit risk exposures transferred and the bank owning the assets can protect against credit loss even if it cannot transfer the physical assets themselves.

The same principles apply to the credit risk exposures of portfolio managers. For fixed income portfolio managers, some of the advantages of credit derivatives include the following:

- they can be tailor-made to meet the specific requirements of the entity buying the risk protection, as opposed to the liquidity or term of the underlying reference asset;
- they can be 'sold short' without risk of a liquidity or delivery squeeze, as it is a specific credit risk that is being traded. In the cash market it is not possible to 'sell short' a bank loan, for example, but a credit derivative can be used to establish synthetically the economic effect of such a position;
- as they theoretically isolate credit risk from other factors such as client relationships and interest rate risk, credit derivatives introduce a formal pricing mechanism to price credit issues only. This means a market can develop in credit only, allowing more efficient pricing, and it becomes possible to model a term structure of credit rates;
- they are off-balance sheet instruments[1] and as such incorporate tremendous flexibility and leverage, exactly like other financial derivatives. For example, bank loans are not particularly attractive investments for certain investors because of the administration required in managing and servicing a loan portfolio. However, an exposure to bank loans and their associated return can be achieved by, say, a total return swap (TRS) while simultaneously avoiding the administrative costs of actually owning the assets. Hence, credit derivatives allow investors access to specific credits while allowing banks access to further distribution for bank loan credit risk.

[1]When credit derivatives are embedded in certain fixed income products, such as structured notes and credit-linked notes, they are then off-balance sheet, but part of a structure that may have on-balance sheet elements.

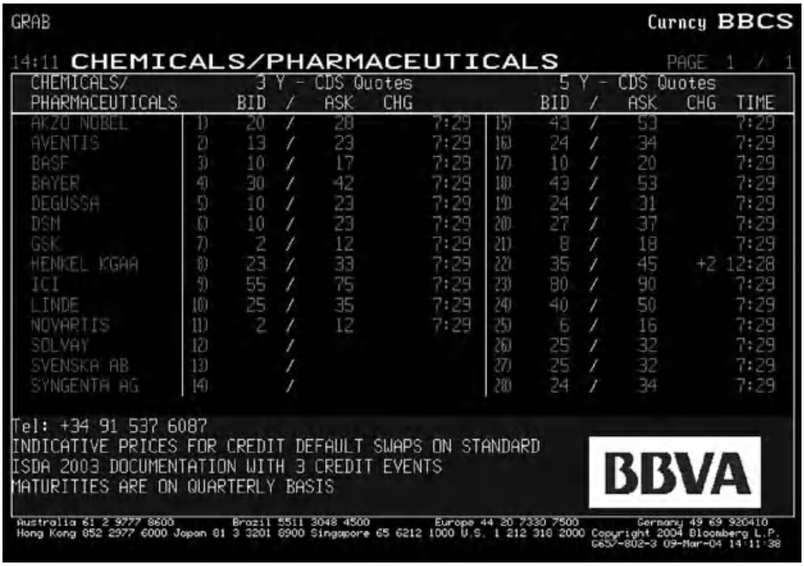
Thus, credit derivatives can be an important instrument for bond portfolio managers as well as commercial banks, who wish to increase the liquidity of their portfolios, gain from the relative value arising from credit pricing anomalies and enhance portfolio returns. Some key applications are summarised below.

BASIC USE OF CREDIT DERIVATIVES BY BANKS

Banks were the first users of credit derivatives. The market developed as banks sought to protect themselves from loss due to default on portfolios of mainly illiquid assets, such as corporate loans and emerging-market syndicated loans. While securitisation was a well-used technique to move credit risk off the balance sheet, often this caused relationship problems with obligors, who would feel that their close relationship with their banker was being compromised if the loans were sold off the bank's balance sheet. Banks would therefore buy protection on the loan book using credit default swaps (CDSs), enabling them to hedge their credit exposure while maintaining banking relationships. The loan would be maintained on the balance sheet, but would be fully protected by the CDSs.

To illustrate, consider Figure 5.1, which is a Bloomberg description page for a loan in the name of Haarman & Reimer, a chemicals company rated

FIGURE 5.1 Haarman & Reimer loan description.



GRAB Curncy BBCS

14:11 CHEMICALS/PHARMACEUTICALS PAGE 1 / 1

CHEMICALS/ PHARMACEUTICALS		3 Y - CDS Quotes BID	/	ASK	CHG			5 Y - CDS Quotes BID	/	ASK	CHG	TIME
AKZO NOBEL	1)	20	/	28		7:29	15)	43	/	53		7:29
AVENTIS	2)	13	/	23		7:29	16)	24	/	34		7:29
BASF	3)	10	/	17		7:29	17)	10	/	20		7:29
BAYER	4)	30	/	42		7:29	18)	43	/	53		7:29
DEGUSSA	5)	10	/	23		7:29	19)	24	/	31		7:29
DSM	6)	10	/	23		7:29	20)	27	/	37		7:29
GSK	7)	2	/	12		7:29	21)	8	/	18		7:29
HENKEL KGAA	8)	23	/	33		7:29	22)	35	/	45	+2	12:28
ICI	9)	55	/	75		7:29	23)	80	/	90		7:29
LINDE	10)	25	/	35		7:29	24)	40	/	50		7:29
NOVARTIS	11)	2	/	12		7:29	25)	6	/	16		7:29
SOLVAY	12)		/				26)	25	/	32		7:29
SVENSKA AB	13)		/				27)	25	/	32		7:29
SYNGENTA AG	14)		/				28)	24	/	34		7:29

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G657-802-3 09-Mar-04 14:11:38

FIGURE 5.2 Chemicals sector CDS prices for Banco Bilbao Vizcaya, 9 March 2004. © Bloomberg L.P. and BBVA. Used with permission. Visit www.bloomberg.com

A3 by Moody's. We see that this loan pays 225 bps over LIBOR. Figure 5.2 shows the CDS prices page for A3-rated Chemicals entities: Akzo Nobel is trading at 28 bps (to buy protection) as at 9 March 2004. A bank holding this loan can protect against default by purchasing this credit protection, and the relationship manager does not need to divulge this to the obligor.

The other major use by banks of credit derivatives is as a product offering for clients. The CDS market has developed exactly as the market did in interest-rate swaps, with banks offering two-way prices to customers and other banks as part of their product portfolio. Most commercial banks now offer this service, as they do in interest-rate swaps. In this role banks are both buyers and sellers of credit protection. Their net position will reflect their overall view on the market as well the other side of their customer business.

Diversifying the Credit Portfolio

A bank or portfolio manager may wish to take on credit exposure by providing credit protection on assets that it already owns, in return for a fee. This enhances income on their portfolio. They may sell credit derivatives to enable non-financial counterparties to gain credit exposures, if these clients do not wish to purchase the assets directly. In this respect, the bank or asset manager performs a credit intermediation role.

Reducing Credit Exposure

A bank can reduce credit exposure either for an individual loan or a sectoral concentration, by buying protection via a CDS. This may be desirable for assets in their portfolio that cannot be sold for client relationship or tax reasons. For fixed income managers, a particular asset or collection of assets may be viewed as favourable holdings in the long-term, but at risk from short-term downward price movements. In this instance, a sale would not fit in with long-term objectives; however, short-term credit protection can be obtained via a credit swap.

Acting as a Credit Derivatives Market Maker

A financial entity may wish to set itself up as a market maker in credit derivatives. In this case, it may or may not hold the reference assets directly, and depending on its appetite for risk and the liquidity of the market, it can offset derivative contracts as and when required.

APPLICATIONS OF TRSs

There are a number of reasons why portfolio managers may wish to enter into TRS arrangements. One of these is to reduce or remove credit risk. By using TRSs as a credit derivative instrument, a party can remove exposure to an asset without having to sell it. In a vanilla TRS, the total return payer retains rights to the reference asset, although in some cases servicing and voting rights may be transferred. The total return receiver gains an exposure to the reference asset without having to pay out the cash proceeds that would be required to purchase it. As the maturity of the swap rarely matches that of the asset, the swap receiver may gain from the positive funding or *carry* that derives from being able to roll over short-term funding of a longer term asset.[2] The total return payer, on the other hand, benefits from protection against market and credit risk for a specified period of time, without having to liquidate the asset itself. On maturity of the swap, the total return payer may reinvest the asset if it continues to own it, or it may sell the asset in the open market. Thus the instrument may be considered a synthetic repo. A TRS agreement entered into as a credit derivative is a means by which banks can take on unfunded off-balance sheet credit exposure. Higher rated banks that have access to LIBID funding can benefit by funding on-balance sheet assets that are credit protected through a credit

[2]This assumes a positively sloping yield curve.

derivative such as a TRS, assuming the net spread of asset income over credit protection premium is positive.

A TRS conducted as a synthetic repo is usually undertaken to effect the temporary removal of assets from the balance sheet. This may be desired for a number of reasons; for example, if the institution is due to be analysed by credit rating agencies or if the annual external audit is due shortly. Another reason a bank may wish to temporarily remove lower credit-quality assets from its balance sheet is if it is in danger of breaching capital limits in between the quarterly return periods. In this case, as the return period approaches, lower quality assets may be removed from the balance sheet by means of a TRS, which is set to mature after the return period has passed.

We look now at some more applications of TRS instruments.

Capital Structure Arbitrage

A capital structure arbitrage describes an arrangement whereby investors exploit mispricing between the yields received on two different loans by the same issuer. For example, assume that the reference entity has both a commercial bank loan and a subordinated bond issue outstanding, but that the former pays LIBOR plus 330 bps, while the latter pays LIBOR plus 315 bps. An investor enters into a TRS in which it effectively is purchasing the bank loan and selling short the bond. The nominal amounts will be at a ratio, for argument's sake let us say 1.25:1, as the bonds will be more price-sensitive to changes in credit status than the loans.

This trade is illustrated in Figure 5.3 The investor receives the 'total return' on the bank loan, while simultaneously paying the return on the bond in addition to LIBOR plus 30 bps, which is the price of the TRS. The swap generates a net spread of 67.5 bps, given by $[(330 \times 1.25) - (315 + 30)]$.

Another type of capital structure arbitrage involves trading the CDS against the equity of the same company.

In general, such a trade would involve 'going long' the asset that was viewed as cheap and shorting the asset that was viewed as expensive. Therefore if we believed that a company's equity was in some way underpriced, say against its peer group, and its CDS price was overpriced, then we would buy the equity and buy protection in the same-name CDS contract.

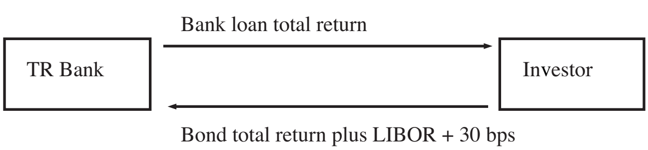

FIGURE 5.3 Total return swap in capital structure arbitrage.

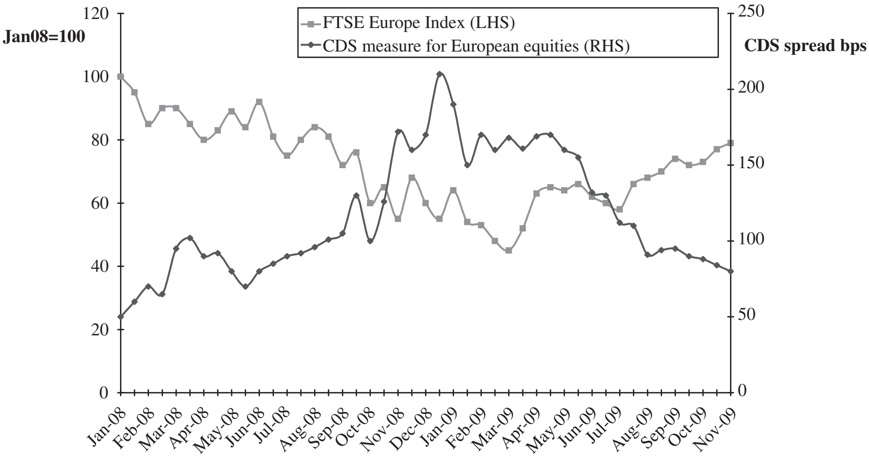

FIGURE 5.4 European equity index and CDS level, 2008-2009
Source: Bloomberg L.P.

An example of such a trade opportunity arose in the last quarter of 2009. Equity levels worldwide had risen since their lows of March that year, and as expected credit spreads had also tightened during this period. Figure 5.4 shows the level of the FTSE Europe Index during 2008-2009, alongside an equity-weighted CDS spread for the same index. We observe that the CDS price has fallen back down to its level at the time just before the Lehman collapse in September 2008, whereas the equity index had still to recover to that level. This suggested that equities still had further upside, relative to credit spreads. A potential trade would therefore be to acquire an exposure to the equity index, perhaps via an exchange-traded future, and buy protection on this same basket via a CDS basket trade.

The trade can also be put on for an individual name. A comparison can be made between a company share's dividend yield and its implied credit yield; where there is a positive gap then this represents a potential arbitrage trade. The gap implies that the equity has further upside potential.

The implied credit yield is calculated as follows:

$$\text{Implied credit yield} = \text{5-year CDS spread} - \text{5-year swap rate.}$$

The dividend yield of a listed equity is easily obtained from media sources. Thus we have the capital structure 'gap' as follows:

$$\text{Gap} = \text{Dividend yield} - \text{Implied credit yield.}$$

TABLE 5.1 Sample of European equities with dividend yields above respective implied credit yield, October 2009.

Name	Dividend yield (%)	CDS spread (bps)	Implied credit yield (%)	Gap
Swisscom	6.1	74.1	2.4	3.7
BP plc	6.5	43	3.7	2.8
Telefonica S.A.	6.0	83.3	3.5	2.5
E.ON AG	5.4	61.8	3.3	2.1
Vodaphone Group plc	6.0	65.9	3.9	2.1
National Grid plc	6.3	103.5	4.3	2.0
Mediobanca	4.9	51.4	3.2	1.7
Unilever NV	3.9	30.2	3.0	0.9

Source: Bloomberg L.P., FTSE

Table 5.1 shows a sample of equity names as at October 2009 and the dividend gap at the time.

Where the gap is positive, this indicates a potential arbitrage of:

- buying the equity;
- buying protection in the same-name CDS.

The trade can be done as cash equivalents or on a VaR-adjusted equivalent level. In theory there will be a gain as the equity price rises and the CDS spread widens. The risk of the transaction is of course that the prices do not go in this direction, as well as mark-to-market risk.

Synthetic Repo

TRSs are increasingly used as synthetic repo instruments, most commonly by investors that wish to purchase the credit exposure of an asset without purchasing the asset itself. This is conceptually similar to what happened when interest rate swaps were introduced, which enabled banks and other financial institutions to trade interest rate risk without borrowing or lending cash funds.

Under a TRS, an asset such as a bond position may be removed from the balance sheet. As stated previously, a bank may use TRSs to reduce the amount of lower quality assets on the balance sheet in order to avoid an adverse impact on regular internal and external capital and credit exposure reporting. This can be done by entering into a short-term TRS with, say, a two-week term that straddles the reporting date. Bonds are removed from the balance sheet if they are part of a sale plus TRS transaction. This is because, legally, the bank selling the asset is not required to repurchase bonds from the swap counterparty, nor is the total return payer obliged to sell the bonds back to the counterparty (or indeed sell the bonds at all on maturity of the TRS).

Let us assume then, that a portfolio manager believes that a particular bond that it does not hold is about to decline in price. To reflect this view, the portfolio manager may do one of the following:

Sell the bond in the market and cover the resulting short position in repo: The cash flow out is the coupon on the bond, with capital gain if the bond falls in price. Assume that the repo rate is floating, say LIBOR plus a spread. The manager must be aware of the funding costs of the trade, so that unless the bond can be covered in repo at *general collateral* rates,[3] the funding will be at a loss. The yield on the bond must also be lower than the LIBOR plus spread received in the repo.

As an alternative, enter into a TRS: the portfolio manager pays the total return on the bond and receives LIBOR plus a spread. If the bond yield exceeds the LIBOR spread, the funding will be negative; however, the trade will gain if the trader's view is proved correct and the bond falls in price by a sufficient amount. If the breakeven funding cost (which the bond must exceed as it falls in value) is lower in the TRS, this method will be used rather than the repo approach. This is more likely if the bond is special.

THE TRS AS OFF-BALANCE SHEET FUNDING TOOL

The TRS may be used as a funding tool, as a means of securing off-balance sheet financing for assets held, for example, on a market-making book. It is most commonly used in this capacity by broker-dealers and securities houses that have little or no access to unsecured or LIBOR-flat funding. When used for this purpose the TRS is similar to a repo transaction, although there are detail differences. Often a TRS approach is used instead of classic repo when

[3] That is, the bond cannot be *special*. A bond is special when the repo rate payable on it is significantly (say, 20–30 bps or more) below the *general collateral* repo rate, so that covering a short position in the bond entails paying a substantial funding premium.

the assets that require funding are less liquid or indeed not really tradable. These can include lower rated bonds; illiquid bonds such as certain ABS, MBS and CDO securities; and assets such as hedge fund interests.

Bonds that are taken on by the TRS provider must be acceptable to it in terms of credit quality. If no independent price source is available the TRS provider may insist on pricing the assets itself.

As a funding tool the TRS is transacted as follows:

- the broker-dealer swaps out a bond or basket of bonds that it owns to the TRS counterparty (usually a bank), who pays the market price for the security or securities;
- the maturity of the TRS can be for anything from one week to one year or even longer. For longer dated contracts, a weekly or monthly re-set is usually employed, so that the TRS is re-priced and cash flows are exchanged each week or month;
- the funds that are passed over by the TRS counterparty to the broker-dealer have the economic effect of being a loan to cover the financing of the underlying bonds. This loan is charged at LIBOR plus a spread;
- at the maturity of the TRS, the broker-dealer will owe interest on funds to the swap counterparty, while the swap counterparty will owe the market performance of the bonds to the broker-dealer if they have increased in price. The two cash flows are netted out;
- for a longer dated TRS that is re-set at weekly or monthly intervals, the broker-dealer will owe the loan interest plus any decrease in basket value to the swap counterparty at the re-set date. The swap counterparty will owe any increase in value.

By entering into this transaction the broker-dealer obtains LIBOR-based funding for a pool of assets it already owns, while the swap counterparty earns LIBOR plus a spread on funds that are in effect secured by a pool of assets. This transaction takes the original assets off the balance sheet of the broker-dealer during the term of the trade, which might also be desirable.

The broker-dealer can add or remove bonds from or to the basket at each re-set date. When this happens the swap counterparty re-values the basket and will hand over more funds or receive back funds as required. Bonds are removed from the basket if they have been sold by the broker-dealer, while new acquisitions can be funded by being placed in the TRS basket.

We illustrate a funding TRS trade using an example. Table 5.2 shows a portfolio of five hypothetical convertible bonds on the balance sheet of a broker-dealer. The spreadsheet also shows market prices. This portfolio has

TABLE 5.2 Spreadsheet showing basket of hypothetical bonds used in TRS funding trade.

Market rates	
EUR/USD FX rate	1.266550
US$ 1W LIBOR	1.4055

Name	Currency	Nominal value	Price	Accrued	Amount	FX rate	ISIN/CUSIP code	Market price	Accrued Interest
ABC Telecom	EUR	16,000,000	111.671%	0.8169%	22,795,534.57	1.2666		111.6713875	0.81693989
XYZ Bank	USD	17,000,000	128.113%	1.7472%	22,076,259.03	1.0000		128.113125	1.74722222
XTC Utility	EUR	45,000,000	102.334%	0.3135%	58,845,000.00	1.2666		102.3337875	0.31352459
SPG Corporation	EUR	30,000,000	100.32500		30,000,325.00	1.2666		100.325	0
Watty Exploited	USD	15,000,000	114.997%	0.7594%	17,363,503.13	1.0000		114.9973125	0.759375
					151,080,621.72				

Payments		
Interest ($)		
Rate	0.000000%	
Principle	151,080,000.00	
Interest payable	+0.00	
Performance ($)		
New portfolio value	151,080,621.72	
Old portfolio value	n/a	
Performance payment	n/a	
Net payment ($)		
Broker-dealer receives from swap counterparty	+0.00	
New loan		
Portfolio additions ($)	0.00	
New loan amount ($)	151,080,621.72	
New interest rate	1.141250%	1w LIBOR + 7 bps

TABLE 5.3 Spreadsheet showing basket of bonds at TRS re-set date plus performance and interest payments due from each TRS counterparty.

EUR/USD	**1.2431**								
Bond	**Curr**	**Nominal value**	**Price**	**Accrued**	**Amount**	**FX**	**ISIN/ CUSIP**	**Market price**	**Accrued**
ABC Telecom	EUR	16,000,000	111.5000%	0.78%	22,331,239	1.2431		111.5	0.77595628
XYZ Bank	USD	17,000,000	125.0000%	1.58%	21,518,931	1		125	1.58194444
XTC Utility	EUR	45,000,000	113.0000000%	0.28%	63,369,825	1.2431		113	0.28278689
SPG Corporation	EUR	30,000,000	100.75		30,225,000	1.2431		100.75	
Watty Exploited	USD	15,000,000	113.0620%	0.63%	17,053,518.2	1		113.0619965	0.628125
					154,498,511.95				

Payments

Interest		
Rate	1.14125%	1W LIBOR + 7bps
Amount	151,080,000.00	151,113,526.12
Interest payable	**33,526.12**	

Performance				
Old portfolio value	151,080,000.00		Old portfolio value:	+151,080,951.67 US$
New portfolio value	154,498,511.95		Interest rate:	1.14125%
Performance payment	**−3,418,511.95**		Interest payable by broker-dealer	+33,526.33 US$
Swap ctpy pays	**−3,384,985.83**	[if negative, swap counterparty pays, if positive, broker-dealer pays	New portfolio value:	+154,498,511 US$
			Performance:	3,418,511 US$
New loan				
Additions	-		Net payment	
New loan amount	**154,498,511.95**			
New interest rate	**1.14875%**			

been swapped out to a TRS provider in a 6-month, 1-week re-set TRS contract. The TRS bank has paid over the combined market value of the portfolio at a lending rate of 1.141250%. This represents 1-week LIBOR plus 7 bps. We assume the broker-dealer usually funds at above this level, hence the attraction of this TRS contract.

We see from Table 5.3 that the portfolio has a current market value of $151,080,000. This value is lent to the broker-dealer in return for the bonds.

One week later the TRS is re-set. We see from Table 5.3 that the portfolio has increased in market value since the last re-set. Therefore the swap counterparty pays this difference over to the broker-dealer. This payment is netted out with the interest payment due from the broker-dealer to the swap counterparty. The interest payment is shown as $34,510.

Table 5.4 shows the basket after the addition of a new bond, and the resultant change in portfolio value.

APPLICATIONS FOR PORTFOLIO MANAGERS

Credit derivatives have allowed market participants to separate and disaggregate credit risk, and therefore to trade this risk in a secondary market. Initially, portfolio managers used them to reduce credit exposure; subsequently, they have been used in the management of portfolios to enhance portfolio yields and in the structuring of synthetic collateralised debt obligations. We summarise portfolio managers' main uses of credit derivatives below.

Enhancing Portfolio Returns

Asset managers can derive premium income by trading credit exposures in the form of derivatives issued with synthetic structured notes. The multi-tranching aspect of structured products enables specific credit exposures (credit spreads and outright default), and their expectations, to be sold to specific areas of demand. By using structured notes such as credit-linked notes (CLNs), tied to the assets in the reference pool of the portfolio manager, the trading of credit exposures is crystallised as added yield on the asset manager's fixed income portfolio. In this way, the portfolio manager has enabled other market participants to gain an exposure to the credit risk of a pool of assets, but not to any other aspects of the portfolio, and without the need to hold the physical assets themselves.

TABLE 5.4 TRS basket value after addition of new bond.

EUR/USD	**1.228**								
Name	**Curr**	**Nominal value**	**Price**	**Accrued**	**Amount**	**FX**	**Isin/ CUSIP**	**Price**	**Accrued**
ABC Telecom	EUR	16,000,000	111.5000%	0.78%	22,331,239	1.2431		111.5	0.775956
XYZ Bank	USD	17,000,000	125.0000%	1.58%	21,518,931	1		125	1.581944
XTC Utility	EUR	45,000,000	113.0000000%	0.28%	63,369,825	1.2431		113	0.282787
SPG Corporation	EUR	30,000,000	100.75		30,225,000	1.2431		100.75	
Watty Exploited	USD	15,000,000	113.0620%	0.00628125	17,053,518	1		113.062	0.628125
Lloyd Cole Funding	USD	15,000,000	112.0923%	0.57%	16,899,628.1	1		112.0923	0.571875
					171,398,140.07				
Payments									
Interest									
Rate	1.14875%	1W LIBOR + 7bps							
Amount	154,498,511.95								
Interest payable	34,510.03								
Performance									
Old portfolio value	154,498,511.95								
New portfolio value	171,398,140.07								
Performance payment	−16,899,628.13								
Swap ctpy pays	−16,865,118.09								
New loan									
Additions	16,899,628.13								
New loan amount	171,398,140.07								
New interest rate	1.22750%								

Reducing Credit Exposure

Let us consider a portfolio manager that holds a large portfolio of bonds issued by a particular sector (say, utilities) and they believe that spreads in this sector will widen in the short term. Previously, in order to reduce its credit exposure, it would have to sell bonds; however, this may crystallise a mark-to-market loss and may conflict with its long-term investment strategy. An alternative approach would be to enter into a CDS, purchasing protection for the short term. If spreads do widen, these swaps will increase in value and may be sold at a profit in the secondary market. Alternatively, the portfolio manager may enter into TRSs on the desired credits. It pays the counterparty the total return on the reference assets, in return for LIBOR. This transfers the credit exposure of the bonds to the counterparty for the term of the swap, in return for the credit exposure of the counterparty.

Let us consider now the case of a portfolio manager wishing to mitigate credit risk from a growing portfolio (say, one that has just been launched). Figure 5.5 shows an example of an unhedged credit exposure to a hypothetical credit-risky portfolio. It illustrates the manager's expectation of credit risk building up to $250 million as the portfolio is built up, and then declining to a more stable level as the credits become more established. A 3-year CDS entered into shortly after provides protection on half of the notional exposure, shown as the broken line. The net exposure to credit events has been reduced by a significant margin.

Credit Switches and Zero-Cost Credit Exposure

Protection buyers utilising CDSs must pay premium in return for transferring their credit risk exposure. An alternative approach for an asset manager

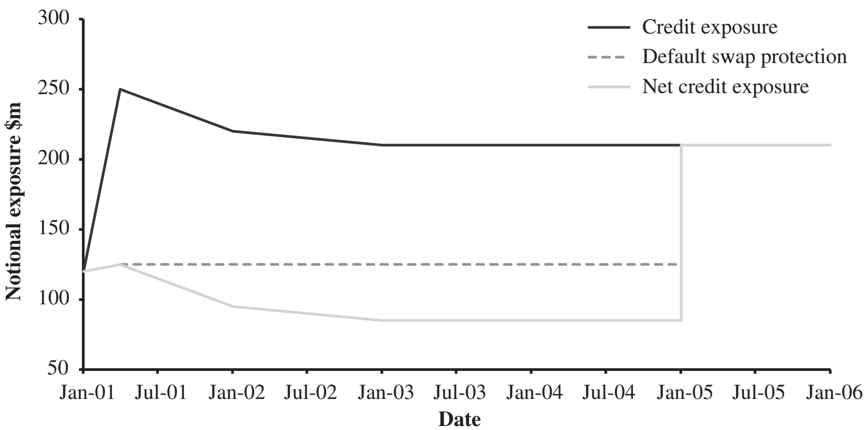

FIGURE 5.5 Reducing credit exposure.

involves the use of credit switches for specific sectors of the portfolio. In a credit switch, the portfolio manager purchases credit protection on one reference asset or pool of assets, and simultaneously sells protection on another asset or pool of assets.[4] So, for example, the portfolio manager would purchase protection for a particular fund and sell protection on another. Typically, the entire transaction would be undertaken with one investment bank, which would price the structure so that the net cash flows would be zero. This has the effect of synthetically diversifying the credit exposure of the portfolio manager, enabling it to gain and/or reduce exposure to sectors it desires.

Exposure to Market Sectors

Investors can use credit derivatives to gain exposure to sectors for which they do not wish a cash market exposure. This can be achieved with an *index* swap, which is similar to a TRS, with one counterparty paying a total return that is linked to an external reference index. The other party pays a LIBOR-linked coupon or the total return of another index. Indices that are used may include the government bond index, a high-yield index or a technology stocks index. Assume that an investor believes that the bank loan market will outperform the mortgage-backed bond sector and in order to reflect this view the investor enters into an index swap in which they pay the total return of the mortgage index and receive the total return of the bank loan index.

Another possibility is synthetic exposure to foreign currency and money markets. Again we assume that an investor has a particular view on an emerging market currency. The investor can purchase a short-term (say 1-year) domestic coupon-bearing note, with the principal redemption linked to a currency factor. This factor is based on the ratio of the spot value of the foreign currency on issue of the note to the value on maturity. Such currency-linked notes can also be structured so that they provide an exposure to sovereign credit risk. The downside of currency-linked notes is that if the exchange rate goes the other way, the note will have a zero return; in effect, a negative return once the investor's funding costs have been taken into account.

Credit Spreads

Credit derivatives can be used to trade credit spreads. Let us assume that an investor has negative views on a certain emerging market government bond credit spread relative to UK gilts. The simplest way to reflect this view would be to go long a CDS on the sovereign, paying X bps. Assuming that

[4]A pool of assets would be concentrated on one sector, such as utility company bonds.

the investor's view is correct and the sovereign bonds decrease in price as their credit spread widens, the premium payable on the credit swap will increase. The investor's swap can then be sold into the market at this higher premium.

CREDIT DERIVATIVES AND RELATIVE VALUE TRADING

The existence of a liquid market in credit derivatives means that they are a viable and in some cases attractive alternative to cash market assets for investors. In some cases it is possible to exploit relative value opportunities in credit markets more efficiently by using credit derivatives, or by using a mix of cash and synthetic assets. We highlight here some approaches to credit market investment using credit derivatives. A multi-strategy investment fund will have greater freedom and flexibility to consider these applications than a more traditional long-only fund; however, all credit market investment requires an expertise in credit analysis and selection, irrespective of the approach being employed.

Chapter 4 considered credit analysis and how investors could measure relative value. We provide here an outline of some relative value strategies.

Relative Value Trading Strategies

The following strategies can be employed using either CDSs or cash bonds and loans, or a combination of both cash and synthetic. In some cases a specific strategy will be easier to implement using CDS.

Credit Selection This is the traditional strategy that relies on picking names that are expected to 'outperform' the market. In fund management terms, one selects a diversified portfolio of credits, which ensures that systemic market risk (beta) is hedged away, while the performance of the fund generates excess return or 'alpha'. Names that are expected to outperform are trading at levels that are 'cheap' to their industry or sector class, in relative value terms. This is measured by the asset swap spread or ASW, as we observed earlier.

The fund manager selects a minimum of 10 or 12 credit-risky names that are expected to outperform other names in their sector. That is, the ASW spread for any particular name is *relatively* high compared to the sector or industry norm. Alternatively, the spread may be viewed to be higher than what the fund manager deems to be appropriate given the credit risk represented by that name. Once a name is selected, the fund manager will decide on the type of asset class (bond, loan or CDS) and its tenor. The modified duration of the asset is also relevant to the analysis because the longer the duration the more sensitive to changes in credit spreads and base interest rates the asset will be. The portfolio is hedged for currency and interest-rate risk using FX and IR derivatives. The 'credit risk' of the portfolio can be hedged using the iTraxx (or CD-X) index.

The other side of credit selection is to short names that are deemed to be 'dear' or expensive. This is problematic in the cash market, as bonds have to be short-covered, and virtually impossible in the loan market. However, it is straightforward to short a name using CDS. So in this instance, the fund manager would run a portfolio of short credits, and hedge this using sold protection in the relevant iTraxx index.

Credit Pair Trade In this strategy the fund manager runs a position in two different credits that attempts to exploit the spread differential between the two. As it is a relative value position, one name is put on long and the other short.[5] A pair-wise spread trade can be put on as a 'credit carry trade' that attempts to exploit a stable spread, and a 'credit directional trade' where one expects the spread to widen or narrow. Generally, the pair of credits will be names from the same industrial sector.

Consider Figure 5.6, which shows the CDS spread history between Ryanair and EasyJet during 2007–2008. If we expect this spread to remain

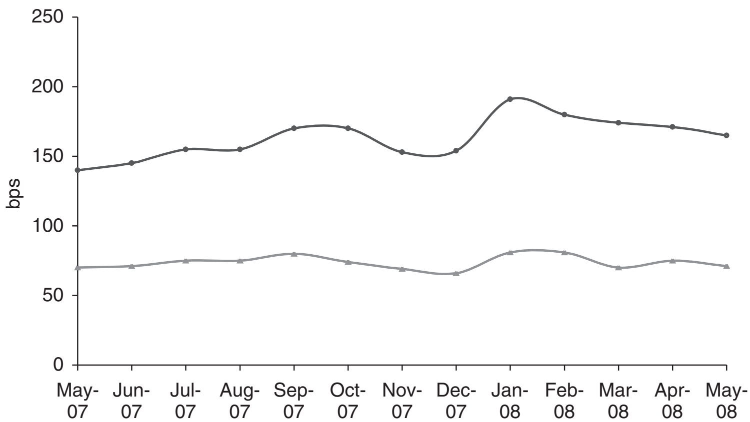

FIGURE 5.6 Ryanair versus EasyJet Air 5-year CDS 2007–2008.
Spreads source: Bloomberg L.P.

[5]It is possible to put this trade on in the same name, using different obligations of that name. However, such a trade is more akin to an arbitrage basis trade than a true credit relative value trade.

stable, we would buy the higher spread and sell the lower spread. This can be done using cash bonds or asset swaps, but is more straightforward using CDS. If the spread remains stable, then the trade generates the long spread minus the short spread as 'carry' during the time the trade is maintained. The downside risk is if Ryanair experiences a credit event, or if its CDS spread widens more than EasyJet's, which will create negative mark-to-market P&L. If no credit event occurs, then we have locked in the spread differential at trade inception. If Ryanair's spread to EasyJet reduces, then this produces positive mark-to-market.

Basket Credit Structure Trade In theory, a basket CDS should price at the same value as the average CDS spread of the individual constituent names, assuming each name is equally weighted. In practice, there will be a difference between the theoretical price and the actual price, which can be exploited by putting on a basket credit structure. In this strategy, the investor sells protection in the basket CDS, typically a first-to-default (FtD) basket, and buys protection on each of the individual reference names in the basket.

For example, consider Figure 5.7, which shows the snapshot P&L profile for an FtD basket trade in five telecoms names, listed in Table 5.5. The investor has credit event exposure to each of the five names, although only to the first credit event. This exposure is hedged via the single-name CDS. The notional amount of the single-name CDS is a function of the delta given by each name CS01, although there is also a correlation factor to consider. The investor should assume high pair-wise correlation given that all the names are from the same sector; that is, the trade is long correlation.

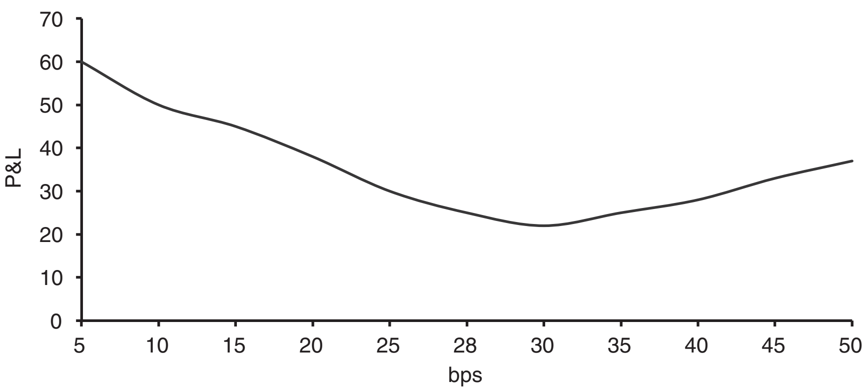

FIGURE 5.7 Credit Basket Trade P&L Profile.

TABLE 5.5 FtD basket trade and single-name CDS hedging.

Sell protection	Buy protection	Notional	Spread	CS01
FtD basket		10,000,000	461	–5,759
	British Telecom	4,800,000	201	1,158
	Vodaphone	5,100,000	188	1,286
	Telefonica	4,900,000	191	1,149
	Deutsche Telecom	5,000,000	174	1,300

This trade would only be put on if it generated positive carry at the start; in this example there is 277 bps positive carry based on the average spread of the five names. With the notional amounts set to produce a net zero CS01, so that the trade is credit-directional neutral, we see that produced an initial positive carry of just under $31,000.00.

From Figure 5.7 we see that the P&L profile is positive irrespective of the average spread of the five names, and a reduction in average spread increases the net profit. This is because such a reduction in the basket will not be matched to the same degree in the single-name CDS price—but this is a safe assumption only in a stable market environment.

In other words, this trade carries catastrophe risk. The net positive spread of the basket vis-à-vis the single names is the return demanded by an investor for assuming that the correlation value for the names is correct. If it changes, the trade will lose money. The trade carries high jump-to-default risk, the risk that one of the names suffers an almost instant deteriorating credit position, or suffers default almost overnight. As its name suggests, jump-to-default is the risk that a credit suffers a credit event without showing any sign, so that its CDS price does not worsen noticeably beforehand. This is a risk to the investor because delta hedging depends on the single-name CDS positions being adjusted as their CDS spread (and thus their CS01) changes. If there is a credit event in a specific name without there being a worsening of its spread, the delta hedge in place at the time of default will be insufficient.

Credit Correlation Trade A common trade strategy before the August 2007 'credit crunch' was the correlation trade. As we note elsewhere in this book, default correlation is a statistic that cannot actually be observed in the market, hence a trade that targets correlation is relying on a model approach. The standard one-factor Gaussian copula approach to valuing CDOs (see Chapter 13) calculates a correlation sensitivity for each tranche, and so using its analysis we can put on relative value positions that exploit these sensitivities. However, when the market valuation departs materially from model valuation, the rationale and indeed the logic behind this type of trading breaks down. This is why, following the 2007 credit crunch and the disappearance of the secondary market in synthetic CDO note tranches, this type of trading desk was closed down in most banks.

An example of this trade is as follows:

- Sell protection on a CDO junior mezzanine tranche.
- Buy protection on the senior or super-senior tranche.

Such a trade will generate profit in a positive economic environment, but is at risk of capital loss as soon as defaults start to occur. In other words, it is essentially a bull market trade that is only protected in a catastrophe insurance situation.

The investor may wish to put the trade on using iTraxx index tranches for liquidity reasons. This is shown in Figure 5.8. In this example, the investor sells protection on the mezzanine tranche and buys protection on the main tranche. The trade should generate profit in a widening spread environment while minimising losses in a spread-tightening environment. The trade is net 'long correlation', and following the logic of the Gaussian copula approach, as spreads widen correlation will increase. This produces a trade profit. The trade is also 'long convexity', in that the increase in profit is greater than the loss for any given change in correlation.

The notional amount of each tranche to transact is a function of the trade delta. This is the change in price of each tranche for a given change in

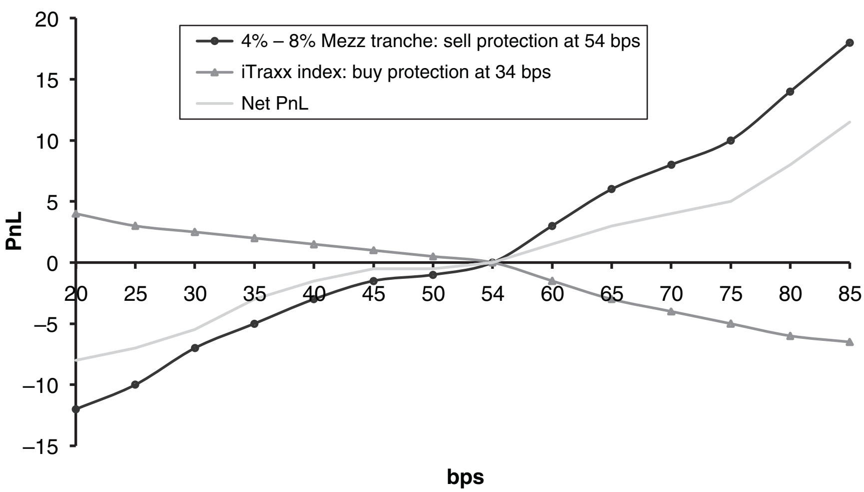

FIGURE 5.8 Credit correlation trade.
Source: Author's notes.

credit spreads. The value of delta fluctuates and so the tranche notionals will need to be rebalanced periodically as the delta dictates.

Assuming a 'CS01' delta of 0.5, the trade mechanics would be:

- Sell protection in $2 million of iTraxx Mezzanine trance at 54 bps.
- Buy protection in $1 million of iTraxx main index at 34 bps.

There is a positive carry on this trade because of our assumed CS01 value, which means invest in a greater notional of the Mezzanine trance. This may not necessarily be the case, but the trade is unlikely to be put on if (irrespective of the CS01 value) it produces a negative value.

BOND VALUATION FROM CDS PRICES: BLOOMBERG SCREEN VCDS

Bloomberg subscribers can use screen VCDS to obtain a CDS-price implied bond valuation, which can be compared to the actual market-observed asset swap price for a bond. This can then be used as a measure of relative value.

Figure 5.9 shows this page used to value the 9.125% of 2030 Eurobond issued by British Telecom plc as at 10 September 2008. This takes the CDS

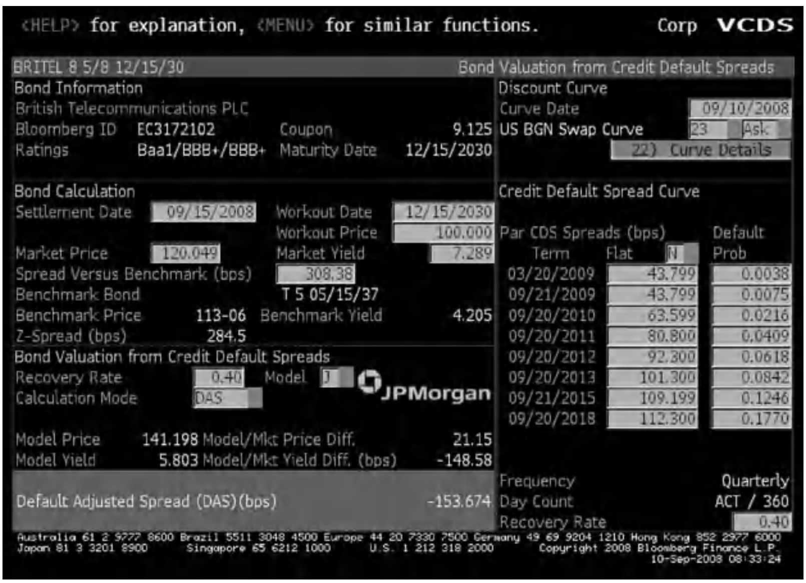

FIGURE 5.9 Bloomberg page VCDS used to value BritTel 9.125% 2030 as at 10 September 2008.

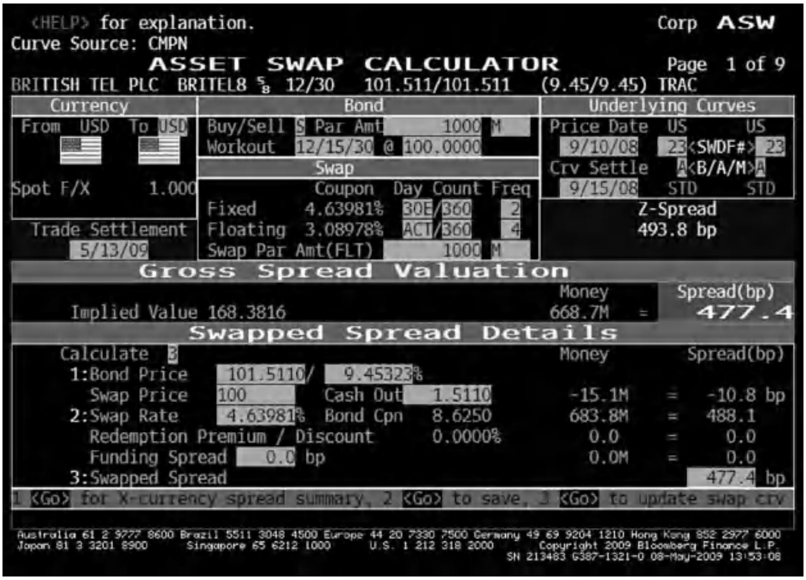

FIGURE 5.10 Asset swap calculator.
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curve for the same reference name and implies a fair value that is 153 bps below the market value (see Figure 5.10).

CHAPTER 6

Credit Derivatives Pricing and Valuation[1]

In this chapter we look at the various approaches used in the pricing and valuation of credit derivatives. We consider generic techniques and compare prices obtained using different pricing models. We also present an intuitive look at pricing to illustrate the basic concept behind pricing a credit default swap (CDS).

INTRODUCTION

The pricing of credit derivatives should aim to provide a 'fair value' for the credit derivative instrument. In the sections below, we discuss the pricing models currently used in the industry. The effective use of pricing models requires an understanding of the models' assumptions, the key pricing parameters and a clear understanding of the limitations of a pricing model. Issues to consider when carrying out credit derivative pricing include:

- implementation and selection of appropriate modelling techniques;
- parameter estimation;
- quality and quantity of data to support parameters and calibration;
- calibration to market instruments for risky debt.

For credit derivative contracts in which the payout is on credit events other than default, the modelling of the credit evolutionary path is critical. If, however, a credit derivative contract does not payout on intermediate stages between the current state and default, then the important factor is

[1] This chapter was co-authored with Richard Pereira. The views and opinions contained herein represent those of the authors in their individual private capacity.

the probability of default from the current state. An introduction to default probabilities is given at Appendix 6.1.

Before continuing with this chapter, you may wish to look at the section that discusses the asset swap pricing method, part of our discussion on the *basis*, in Chapter 9. This was commonly used at the inception of the credit derivatives market, but is rarely used today due to the inherent differences between asset swaps and other credit derivatives. In the following chapter, we look specifically at CDS pricing.

We now consider a number of pricing models as used in the credit derivative markets.

PRICING MODELS

Pricing models for credit derivatives fall into two classes:

- structural models;
- reduced form models.

We discuss these models below.

Structural Models

Structural models are characterised by modelling the firm's value in order to provide the probability of corporate default. The Black–Scholes–Merton option pricing framework is the foundation of the structural model approach. The default event is assumed to occur when the firm's assets fall below the book value of the debt.

Merton applied option pricing techniques to the valuation of corporate debt.[2] By extension, the pricing of credit derivatives based on corporate debt may, in some circumstances, be treated as an option on debt (which is therefore analogous to an option on an option model).

Merton models have the following features:

- default events occur predictably when a firm has insufficient assets to pay its debt;
- a firm's assets evolve randomly. The probability of corporate default is determined using Black–Scholes–Merton option pricing theory.

[2] Merton, R. C., 'On the Pricing of Corporate Debt: The Risk Structure of Interest Rates', *Journal of Finance*, 1974, pp. 449–470.

Some practitioners argue that Merton models are more appropriate than reduced form models when pricing default swaps on high yield bonds, due to the higher correlation of high yield bonds with the underlying equity of the issuer firm.

The constraint of structural models is that the behaviour of the value of assets and the parameters used to describe the process for the value of the firm's assets are not directly observable and the method does not consider the underlying market information for credit instruments.

Reduced form Models

Reduced form models are a form of no-arbitrage model. These models can be fitted to the current term structure of risky bonds to generate no arbitrage prices. In this way, the pricing of credit derivatives using these models is consistent with the market data on the credit risky bonds traded in the market. These models allow the default process to be separated from the asset value and are more commonly used to price credit derivatives.

Some of the key features of reduced form models include:

- complete and arbitrage-free credit market conditions are assumed;
- recovery rate is an input into the pricing model;
- credit spread data to estimate the risk neutral probabilities is used;
- transition probabilities from credit agencies can be accommodated in some of these models. The formation of the risk neutral transition matrix from the historical transition matrix is a key step;
- default can take place randomly over time and the default probability can be determined using the risk neutral transition matrix.

When implementing reduced form models it is necessary to consider issues such as the illiquidity of the underlying credit risky assets. Liquidity is often assumed to be present when we develop pricing models. However, in practice there may be problems when calibrating a model to illiquid positions, and in such cases the resulting pricing framework may be unstable and provide the user with spurious results. Another issue is the relevance of using historical credit transition data, in order to project future credit migration probabilities. In practice it is worthwhile reviewing the sensitivity of price to the historical credit transition data when using the model.

The key reduced form models that provide a detailed modelling of default risk include those presented by Jarrow, Lando and Turnbull (1997);[3]

[3] Jarrow, R. and Lando, D., 'A Markov Model for the Term Structure of Credit Spreads', *Review of Financial Studies*, Volume 10, 1997, pp. 481–523.

Das and Tufano (1996);[4] and Duffie and Singleton (1995).[5] We consider these models in this section.

Jarrow, Lando and Turnbull (JLT) Model

This model focuses on modelling default and credit migration. Its data and assumptions include the use of:

- a statistical rating transition matrix which is based on historic data;
- risky bond prices from the market used in the calibration process;
- a constant recovery rate assumption. The recovery amount is assumed to be received at the maturity of the bond;
- a credit spread assumption for each rating level.

It also assumes that there is no correlation between interest rates and credit rating migration.

The statistical transition matrix is adjusted by calibrating the expected risky bond values to the market values for risky bonds. The adjusted matrix is referred to as the risk neutral transition matrix. The risk neutral transition matrix is key to the pricing of several credit derivatives.

The JLT model allows the pricing of default swaps, as the risk neutral transition matrix can be used to determine the probability of default. The JLT model is sensitive to the level of the recovery rate assumption and the statistical rating matrix. It has a number of advantages, as the model is based on credit migration, it allows the pricing of derivatives for which the payout depends on such credit migration. In addition, the default probability can be explicitly determined and may be used in the pricing of CDSs.

The disadvantages of the model include the fact that it depends on the selected historical transition matrix. The applicability of this matrix to future periods needs to be considered carefully; for example, whether or not it adequately describes future credit migration patterns. In addition, it assumes all securities with the same credit rating have the same spread, which is restrictive. For this reason, the spread levels chosen in the model are a key assumption in the pricing model. Finally, the constant recovery rate is another practical constraint, as in practice the level of recovery will vary.

[4] Sanjiv Das and Tufano, P., 'Pricing Credit Sensitive Debt when Interest Rate, Credit Ratings and Credit Spreads Are Stochastic', *Journal of Financial Engineering*, 1996.

[5] Duffie, D. and K. Singleton, 'Modelling Term Structures of Defaultable Bonds', *Review of Financial Studies*, 1997.

The Das–Tufano Model

The Das–Tufano (DT) model is an extension of the JLT model. The model aims to produce the risk neutral transition matrix in a similar way to the JLT model; however, this model uses stochastic recovery rates. The final risk neutral transition matrix should be computed from the observable term structures. The stochastic recovery rates introduce more variability in the spread volatility. Spreads are a function of factors that may not only be dependent on the rating level of the credit, as in practice credit spreads may change even though credit ratings have not changed. Therefore, to some extent, the DT model introduces this additional variability into the risk neutral transition matrix.

Various credit derivatives may be priced using this model. For example, CDSs, total return swaps (TRSs) and credit spread options. The pricing of these products requires the generation of the appropriate credit dependent cash flows at each node on a lattice of possible outcomes. The fair value may be determined by discounting the probability weighted cash flows. The probability of the outcomes is determined by reference to the risk neutral transition matrix.

The Duffie–Singleton Model

The Duffie–Singleton model approach considers the three components of risk for a credit risky product; namely, the risk-free rate, the hazard rate and the recovery rate.

The *hazard rate* characterises the instantaneous probability of default of the credit risky underlying exposure. As each of the components above may not be static over time, a pricing model may assume a process for each of these components of risk. The process may be implemented using a lattice approach for each component. The constraint on the lattice formation is that this lattice framework should agree to the market pricing of credit risky debt. Here we demonstrate that the credit spread is related to risk of default (as represented by the hazard rate) and the level of recovery of the bond. Let us assume that a zero-coupon risky bond maturing in a small time element Δt,

where

λ is the annualised hazard rate
φ is the recovery value
r is the risk-free rate
s is the credit spread

and where its price P is given by:

$$P = e^{-r\Delta t}((1 - \lambda\Delta t) + (\lambda\Delta t)\varphi) \tag{6.1}$$

Alternatively, P may be expressed as:

$$P \cong e^{-\Delta t(r+\lambda(1-\varphi))} \tag{6.2}$$

However, as the usual form for a risky zero-coupon bond is:

$$P = e^{-\Delta t(r+s)} \tag{6.3}$$

Therefore we have shown that:

$$\mathrm{S} \cong \lambda(1 - \varphi). \tag{6.4}$$

This implies that the credit spread is closely related to the hazard rate (that is, the likelihood of default) and the recovery rate.

This relationship between the credit spread, the hazard rate and recovery rate is intuitively appealing. The credit spread is perceived to be the extra yield (or return) that the investor requires for the credit risk assumed. For example:

- as the hazard rate (or instantaneous probability of default) rises, the credit spread increases;
- as the recovery rate decreases, the credit spread increases.

A 'hazard rate' function may be determined from the term structure of credit. The hazard rate function has its foundation in statistics and may be linked to the instantaneous default probability.

The hazard rate function ($\lambda(s)$) can then be used to derive a probability function for the survival function $\mathrm{S}(t)$:

$$S(t) = \exp^{-\int_0^t \lambda(s)ds} \tag{6.5}$$

The hazard rate function may be determined by using the prices of risky bonds. The lattice for the evolution of the hazard rate should be consistent with the hazard rate function implied from market data. An issue when performing this calibration is the volume of relevant data available for the credit.

Recovery Rates

The recovery rate usually takes the form of the percentage of the par value of the security recovered by the investor.

The key elements of the recovery rate include the:

- level of the recovery rate;
- uncertainty of the recovery rate based on current conditions specific to the reference credit;
- time interval between default and the recovery value being realised.

Generally, recovery rates are related to the seniority of the debt. Therefore if the seniority of debt changes, the recovery value of the debt may change. Also recovery rates exhibit significant volatility.

CREDIT SPREAD MODELLING

Although spreads may be viewed as a function of default risk and recovery risk, spread models do not attempt to break down the spread into its default risk and recovery risk components.

The pricing of credit derivatives that payout according to the level of the credit spread require that the credit spread process is adequately modelled. In order to achieve this, a stochastic process for the distribution of outcomes for the credit spread is an important consideration.

An example of the stochastic process for modelling credit spreads, which may be assumed, includes a mean reverting process such as:

$$ds = k(\mu - s)dt + \sigma s dw \tag{6.6}$$

where

- ds is the change in the value of the spread over an element of time (dt)
- dt is the element of time over which the change in spread is modelled
- s is the credit spread
- k is the rate of mean reversion
- μ is the mean level of the spread
- dw is Wiener increment (sometimes written dW, dZ or dz)
- σ is the volatility of the credit spread.

In this model, when s rises above a mean level of the spread, the drift term $(\mu - s)$ will become negative and the spread process will drift towards (revert) to the mean level. The rate of this drift towards the mean is dependent on k the rate of mean reversion.

The pricing of a European spread option requires the distribution of the credit spread at the maturity (T) of the option. The choice of model affects the probability assigned to each outcome. The mean reversion factor reflects the historic economic features over time of credit spreads, to revert to the average spreads after larger than expected movements away from the average spread.

Therefore the European option price may be reflected as:

$$\text{Option price} = E\left[e^{-rT}(\text{Payoff}(s,\ X))\right] = e^{-rT}\int_{0}^{\infty} f(s,\ X)p(s)ds \qquad (6.7)$$

where

X is the strike price of the spread option
$p(s)$ is the probability function of the credit spread
$E[\ ]$ denotes the expected value
$f(s, X)$ is the payoff function at maturity of the credit spread.

More complex models for the credit spread process may take into account factors such as the term structure of credit and possible correlation between the spread process and the interest process.

The pricing of a spread option is dependent on the underlying process. For example, let us compare the pricing results for a spread option model including mean reversion to the pricing results from a standard Black–Scholes model in Tables 6.1 and 6.2.

Tables 6.1 and 6.2 illustrate the sensitivity of the pricing of a spread option to changes to the underlying process. Comparing Tables 6.1 to 6.2 illustrates the impact of time to expiry increasing by six months. In a mean reversion model, the mean level and the rate of mean reversion are important parameters that may significantly affect the probability distribution of outcomes for the credit spread, and hence the price.

CREDIT SPREAD PRODUCTS

Forward Starting CDS

The forward starting CDS is a key building block for products that reference the future level of the CDS spread. We determine the forward CDS spread by considering the term structure of CDS spreads and the risky annuity level for the relevant maturities.

TABLE 6.1 Comparison of model results (1).

Expiry in 6 months Risk-free rate = 10% Strike = 70 bps Credit spread = 60 bps Volatility = 20%	**Mean reversion model price**	**Standard Black–Scholes price**	**% difference between standard Black–Scholes and mean reversion model price**
Mean level = 50 bps			
K = 0.2			
Put	0.4696	0.5524	17.63%
Call	10.9355	9.7663	11.97%
Mean level = 50 bps			
K = 0.3			
Put	0.3510	0.5524	57.79%
Call	11.2031	9.7663	14.12%
Mean level = 80 bps			
K = 0.2			
Put	0.8729	0.5524	58.02%
Call	8.4907	9.7663	15.02%
Mean level = 80 bps			
K = 0.3			
Put	0.8887	0.5524	60.87%
Call	7.5411	9.7663	29.51%

Let

- $F_{t,\ T0,\ T}$ be the forward CDS spread at time t, for a CDS contract starting at time T_0 and maturing at time T;
- $S_{t,T}$ be the CDS spread at time t for a maturity T;
- *RPV01 (t,T)* be the value of the risky annuity of \$1 p.a. payable from time t to T. The credit risk is based on the survival curve associated with the credit.

The rationale to determining $F_{t,\ T0,\ T0+T}$ is by equating the cost of credit protection over the period t to T and the cost of the credit protection from t to T_0 plus the forward CDS protection from T_0 to T.

PV of Premium leg of cover credit protection from t to $T = PV$ of Premium leg of cover credit protection from t to T_0 plus PV of Premium leg of forward credit protection from T_0 to T.

$$S_{t,T} * RPV01\,(t,\ T) = S_{t,\ T0} * RPV01\,(t,\ T) \\ + \left[F_{t,\ T0,\ T} * (RPV01\,(t, T) - RPV01(t,\ T_0))\right]$$

TABLE 6.2 Comparison of model results (2).

Expiry in 12 months Risk-free rate = 10% Strike = 70 bps Credit spread = 60 bps Volatility = 20%	Mean reversion model price	Standard Black–Scholes price	% difference between standard Black–Scholes and mean reversion model price
Mean level = 50 bps *K* = 0.2			
Put	0.8501	1.4331	68.58%
Call	11.2952	10.4040	8.56%
Mean level = 50 bps *K* = 0.3			
Put	0.7624	1.4331	87.97%
Call	12.0504	10.4040	15.82%
Mean level = 80 bps *K* = 0.2			
Put	1.9876	1.4331	38.69%
Call	7.6776	10.4040	35.51%
Mean level = 80 bps *K* = 0.3			
Put	2.4198	1.4331	68.85%
Call	6.7290	10.4040	54.61%

So the estimate of the forward CDS $F_{t,\,T0,\,T}$ is:

$$F_{t,\,T0,\,T} = \left[S_{t,\,T} * RPV01\,(t,\,T) - S_{t,\,T0} * RPV01\,(t,\,T_0)\right] / \left[RPV01\,(t, T) - RPV01\,(t,\,T_0)\right].$$

For example, assume that we wish to determine the forward credit spread today for protection over the period three to seven years in the future. Let us also assume that we have available the following data:

Current CDS spread for a 3-year period starting at time 0, $S_{0,3} = 50$ bps.

$RPV01\,(0,3) = 2.75$ risky annuity at time 0 for a 3-year period.

Current CDS spread for a 7-year period starting at time 0, $S_{0,7} = 70$ bps.

$RPV01\,(0,7) = 6.5$ risky annuity at time 0 for a 7-year period.

The forward starting CDS at time 0 for the period beginning in three years and ending in seven years $F_{0,3,7}$ is:

$$F_{0,3,7} = [(70 \text{ bps} * 6.5) - (50 \text{ bps} * 2.75)]/[6.5 - 2.75] = 84.67 \text{ bps}.$$

Credit Default Swaption (CDS Swaption)

The CDS swaption gives the holder the right but not the obligation to enter into a single-name CDS contract at expiry date. Investors can use options to take views on credit spread volatility and also make directional trades to either hedge or speculate.

The payer swaption gives the option holder the right to buy protection at expiry at the agreed strike level. It gives the option holder the right to go short the credit. The holder will exercise the option if the CDS spread level at the expiry date is higher than the strike level. The scenario where spread levels are higher than the strike level would make the option valuable to the holder, since it is similar to having the right to sell a credit risky bond at a higher price than market price at expiry. Payers are similar to put options on bonds as they give investors the right to sell credit risk.

The receiver swaption gives the option holder the right to sell protection at the expiry date at the agreed strike level. It gives the option holder the right to go long the credit. The holder will exercise the option if the CDS spread level at the expiry date is lower than the strike level. The scenario where the spread levels are lower than the strike level would make the option valuable to the holder since it is similar to having the right to buy a credit risky bond at a lower price than market price at expiry. Receivers are similar to bond call options as they give investors the right to buy credit risk.

The option contract can be structured to either knock out if there is a credit event before expiry date with no cost or it may be structured to not knock before expiry date.

The valuation of the knock out version of the contract on a single name CDS can be considered by using an equation that is similar to the Black (1976) bond option pricing model:

$$\begin{aligned}&\text{Value of a payer swaption (knock out)} =\\&\quad \text{Notional Value} * [RPV01\,(0,\ T_E) - RPV01\,(0,\ T)]\\&\quad * [F_{0,\,TE,\,T}\Phi(d_1) - K * \Phi(d_2)]\end{aligned}$$

where

$$d_1 = \left[LN\left(F_{0,\,TE,\,T}/K\right) + \left(\sigma^2 * T_E\right)/2\right]/\left[\sigma * \sqrt{(T_E)}\,\right]$$

$$d_2 = d_1 - \sigma * \sqrt{(T_E)}$$

$[RPV01\,(0, T_E) - RPV01\,(0, T)]$ is equal to the value of the risky forward annuity at from T_E to T.

The model dynamics for the evolution of the spread is an important assumption. The choice of model is important and can lead to different values. The market standard for the CDS swaption is the based on the Black 1976 model.

Credit Index Options

Credit index options may be either:

- a payer swaption (giving the holder the right to buy protection at the strike level K at the expiry date); or
- a receiver swaption (giving the holder the right to sell protection at the strike level K at the expiry date).

The option typically references an underlying credit index. Credit index options do not knock out if there are credit events before expiry date. For example, at the expiry date of a payer swaption, the holder will determine if they wish to exercise the option and buy protection. In order to make this exercise decision the holder will consider the two areas that affect the value on exercising the option:

1. Receipt of the value of payments for any credit events on the credit index.
2. Value of entering into a transaction to buy protection on the credit index (the off-the-run index if there have been credit events, or the on-the-run index if there are no credit events) at the agreed strike level K. The value of this transaction can be analysed to consist of two elements:
   i. the present value of the difference between the fixed coupon on the index and strike level K, discounted using a risky spread equal to the strike level;
   ii. the present value of the difference between the index spread level at expiry and the coupon on the index, discounted using a risky spread equal to the spread level at expiry. This is the value of the short index position at expiry.

The exercise decision can only be made after considering the value of these elements. If the total value is greater than zero the holder should exercise the payer swaption. The settlement mechanics are designed to allow for the value of 1 and 2i, to settle at the expiry date.

The pricing of credit index options requires an adjustment to the Black (1976) model that is used for single-name CDS options, the adjustment is made to the forward and the strike inputs, to allow for the non-knockout features of the credit index option contract.

The Forward Credit Spread

The forward credit spread can be determined by considering the spot prices for the risky security and risk-free benchmark security, while the forward yield can be derived from the forward price of these securities. The forward credit spread is the difference between the forward risky security yield and the forward yield on a risk-free security. The forward credit spread is calculated by using yields to the forward date and the yield to the maturity of the risky assets.

EXAMPLE 6.1 DETERMINING THE FORWARD CREDIT SPREAD

Current date: 1/2/98
Forward date: 1/8/98
Maturity: 1/8/06
Time period from current date to maturity: 8 years and 6 months
Time period from current date to forward date: 6 months

YIELD TO FORWARD DATE

Risk-free security 6.25%
Risky security 6.50%

YIELD TO MATURITY

Risk-free security 7.80%
Risky security 8.20%
Forward yields (calculated from inputs above—see below for detail derivation)
Risk-free security 7.8976 %
Risky security 8.3071%

(*continued*)

The details of the calculation of forward rates are:
Risk-free security: $(1.0780)^{86/12} = (1.0625)^{6/12} * \left(1 + rf_{risk\text{-}free}\right)^8$
where

$rf_{risk\text{-}free}$ is the forward risk-free rate implied by the yields on a risk-free security. This equation implies that $rf_{risk\text{-}free}$ is 7.8976 %.

Similarly for the risky security we have:

$$(1.082)^{86/12} = (1.065)^{6/12} * \ (1 + rf_{risky})^8$$

where

rf_{risky} is the forward risky rate implied by the yields on a risky security. This equation implies that rf_{risky} is 8.3071%.

Therefore, the forward credit spread is the difference between the forward rate implied by the risky security less the forward rate implied by the yields on a risk-free security. In the example above, this is $rf_{risky} - rf_{risk\ free} = 8.3071 - 7.8976 = 0.4095\%$.

The current spread is equal to $8.20 - 7.80 = 0.40\% = 40$ bps.

The difference between the forward credit spread and the current spread is $0.4095 - 0.40 = 0.0095\% = 0.95$ bps.

The calculation of the forward credit spread is critical to the valuation of credit spread products. The payoff of spread forwards is highly sensitive to the implied forward credit spread.

Credit Spread Options

First generation pricing models for credit spread options may use models as described in the section on spread models. The key market parameters in a spread option model include the forward credit spread and the volatility of the credit spread.

The volatility of the credit spread is a difficult parameter to determine. It may be approached in different ways including:

- the historical volatility of the difference between the reference asset yield and the yield on a risk-free benchmark;

- estimation of the historical volatility by considering the components: historic volatility of the reference asset yield, historic volatility of the benchmark yield, correlation of the returns between the reference asset yield and the benchmark yield;
- the estimate of the volatility of the spread by using the implied volatility of the reference asset yield, implied volatility of the benchmark yield and a suitable forward-looking estimate of the correlation between the returns on the reference asset yield and benchmark asset yield.

If the model incorporates mean reversion, then other key inputs include the mean reversion level and the rate of mean reversion. These inputs cannot be observed directly and the choice should be supported by the model developers and constantly reviewed to ensure that they remain relevant. Other inputs include:

- the strike price;
- the time to expiry;
- the risk-free rate for discounting.

A key issue with credit spread options is ensuring that the pricing models used will calibrate to the market prices of credit risky reference assets. The recovery of forward prices of the reference asset is a constraint to the evolution of the credit spread. More complex spread models may allow for the correlation between the level of the credit spread and the interest rate level. The reduced form models described earlier are a new generation of credit derivative pricing models that are now increasingly being used to price spread options.

Asset Swaps

Assume that an investor holds a bond and enters into an asset swap with a bank. The value of an asset swap is the spread the bank pays over or under LIBOR. This is based on the following components:

1. the value of the coupons of the underlying asset compared to the market swap rate;
2. the accrued interest and the clean price premium or discount compared to par value. Thus when pricing the asset swap it is necessary to compare the par value and to the underlying bond price.

The spread above or below LIBOR reflects the credit spread difference between the bond and the swap rate.

The Bloomberg asset swap calculator pricing screens shown in Chapters 2 and 3 show these components in the analysis of the swapped spread details.

EXAMPLE 6.2 ASSET SWAP TERMS

Let us assume that we have a credit risky bond with the following details:

Currency:	EUR
Issue date:	31 March 2000
Maturity:	31 March 2007
Coupon:	5.5 % per annum
Price (Dirty):	105.3%
Price (Clean):	101.2%
Yield:	5%
Accrued interest:	4.1%
Rating:	A1

The investor pays 105.3% of par value to buy this bond and receives the fixed coupons of 5.5% of par value. Let us assume that the swap rate is 5%. The investor of this bond enters into an asset swap with a bank in which the investor pays the fixed coupon and receives LIBOR 1/2 spread.

The asset swap price (that is, spread) on this bond has the following components:

1. The excess value of the fixed coupons over the market swap rate is paid to the investor. Let us assume that in this case this is approximately 0.5% when spread into payments over the life of the asset swap.
2. The difference between the bond price and par value is another factor in the pricing of an asset swap. In this case the price premium, which is expressed in present value terms, should be spread over the term of the swap and treated as a payment by the investor to the bank (if a dirty price is at a discount to the par value then the payment is made from the bank to the investor). For example, in this case let us assume that this results in a

payment by the investor to the bank of approximately 0.23%, when spread over the term of the swap.

These two elements result in a net spread of 0.5% − 0.23% = 0.27%. Therefore the asset swap is quoted as LIBOR + 0.27% (or LIBOR plus 27 bps).

TOTAL RETURN SWAP (TRS) PRICING

The present value of the two legs of the TRS should be equivalent. This implies that the level of the spread is dependent on the following factors:

- credit quality of the underlying asset;
- credit quality of the TRS counterparty;
- capital costs and target profit margins;
- funding costs of the TRS provider, as they will hedge the swap by holding the position in the underlying asset.

The fair value for the TRS will be the value of the spread for which the present value of the LIBOR +/− spread leg equals the present value of the returns on the underlying reference asset. The present value of the returns on the underlying reference asset may be determined by evolving the underlying reference asset. The expected value of the TRS payoff at maturity should be discounted to the valuation date.

The reduced form models described earlier are a new generation of credit derivative pricing models that are now increasingly being used to price total return swaps.

Anson *et al.* (2004) present an intuitive and straightforward method of valuing TRS contracts, which we summarise with permission here.

Bearing in mind that the basic TRS is an instrument that swaps a regular LIBOR-based interest payment against the economic performance of an asset, we can set a formula for pricing the floating-leg LIBOR side, or rather, the spread over LIBOR paid on the floating leg. We use the following notation:

L_t is LIBOR at time t
s is the spread over LIBOR
R_t is the total return at time t
$L_t + s$ is the cash flow payout by the swap payer.

Under risk-neutral pricing both legs of the contract must net-present-value to zero. That is, the spread payable under the TRS must be such that payoff from both legs of the contract must net to zero. Therefore, as stated in Anson *et al* (2004) we can state:

$$E_0 = \left\{ \sum_{j=1}^{n} \exp\left(-\int_0^{T_j} r(t)dt \right) \left[R_j - \left(L_j + s \right) \right] \right\} = 0 \tag{6.8}$$

where r is the risk-free discount rate.

If we assume that r, R and L are three distinctly separate and random variables, we can re-arrange (6.8) above to give us:

$$E_0 = \left\{ \sum_{j=1}^{n} \exp\left(-\int_0^{T_j} r(t)dt \right) \left[R_j - L_j \right] \right\} = E_0 \left\{ \sum_{j=1}^{n} \exp\left(-\int_0^{T_j} r(t)dt \right) \right\} s \tag{6.9}$$

which can be transformed into:

$$\begin{aligned} E_0 = \left\{ \sum_{j=1}^{n} \exp\left(-\int_0^{T_j} r(t)dt \right) \right\} &= E_0 \sum_{j=1}^{n} E_0 \left[\exp\left(-\int_0^{T_j} r(t)dt \right) \right] \\ &= \sum_{j=1}^{n} P\left(0,\ T_j\right). \end{aligned} \tag{6.10}$$

This expression gives the value of the sum of credit-risk-free zero-coupon bond prices. It therefore implies:

$$E_0 \sum_{j=1}^{n} E_0 \left[\exp\left(-\int_0^{T_j} r(t)dt \right) R_j - L_j \right] = \sum_{j=1}^{n} P\left(0,\ T_j\right) s. \tag{6.11}$$

From this we can simplify the left-hand side of (6.12) above to give us:

$$\sum_{j=1}^{n} P\left(0,\ T_j\right) E_0^{Fj} \left[R_j - L_j \right] = \sum_{j=1}^{n} P\left(0,\ T_j\right) s. \tag{6.12}$$

The left-hand side of the expression above can be used to obtain the forward price of an asset, and hence is used to generate forward curves for

R the total return leg of the TRS as well as for L the LIBOR leg. This expression is:

$$\sum_{j=1}^{n} P(0,\ T_j)\left[f_j^R - f_j^L\right] = \sum_{j=1}^{n} P(0,\ T_j)s. \tag{6.13}$$

where f_j^i is the forward rate of i with i being applicable to both R and L. Using this, we are now in a position to solve for the TRS spread s using the expression:

$$s = \frac{\sum_{j=1}^{n} P(0,\ T_j)\left[f_j^R - f_j^L\right]}{\sum_{j=1}^{n} P(0,\ T_j)} \tag{6.14}$$

In fact, the expression above is what we would have guessed intuitively from our knowledge of interest-rate swaps; the spread s is the weighted-average of the expected difference between the two legs. The weight is given by:

$$\frac{P(0,\ T_j)}{\sum_{j=1}^{n} P(0,\ T_j)}$$

with the weights summing to one.

The reason the two legs in a TRS do not give identical cash flows and forward values is because of the perceived difference in credit risk of each leg (otherwise they would have the same value). It is the measure of this credit risk that is the key to credit derivative valuation.

For a detailed coverage of the various model approaches used in determining the forward curves, see Anson *et al* (2004), Chapter 5.

CREDIT CURVES

The credit curves (or default swap curves) reflect the term structure of spreads by maturity (or tenor) in the CDS markets. The shape of the credit curves is influenced by the demand and supply for credit protection in the CDS market and reflects the credit quality of the reference entities (both specific and systematic risk). The changing levels of credit curves provide traders and arbitragers with the opportunity to measure relative value and establish credit positions.

In this way, any changes of shape and perceptions of the premium for CDS protection are reflected in the spreads observed in the market. In periods of extreme price volatility—for example, as seen in the middle of 2002—the curves may invert to reflect the fact that the cost of protection for shorter dated protection trades at wider levels than the longer dated protection. This is consistent with the pricing theory for CDSs.

The probability of survival of a credit may be viewed as a decreasing function against time. The survival probabilities for each traded reference credit can be derived from its credit curve. The survival probability is a decreasing function because it reflects the fact that the probability of survival of a credit reduces over time. For example, the probability of survival to year 3 is higher than the probability of survival to year 5.

Under non-volatile market conditions, the shape of the survival probability and the resulting credit curve assumes a different form to the shape implied in volatile market conditions; that is, the graphs may change to reflect the higher perceived likelihood of default.

For example, the shape of the survival probability may take the form as shown in Figure 6.1.

The corresponding credit curves that are consistent with these survival probabilities take the form shown in Figure 6.2. This shows that the credit curve inversion is consistent with the changes in the survival probability functions. In this analysis, we assumed that the assumed recovery rate for the 'cheapest to deliver' bond remained the same at 35% of notional value.

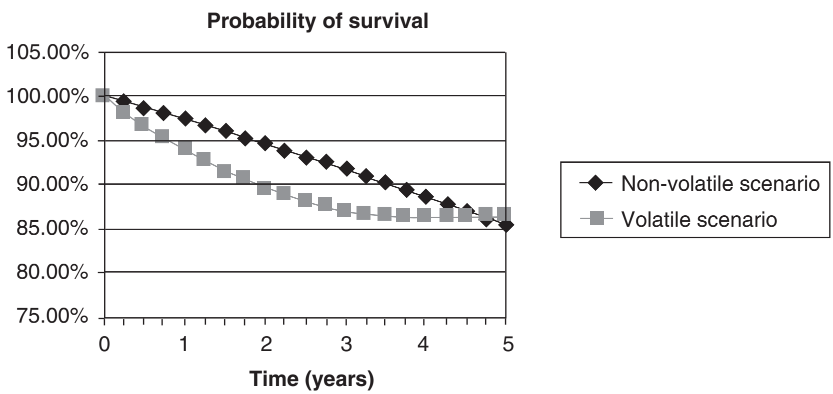

FIGURE 6.1 Probability of the survival of credit.

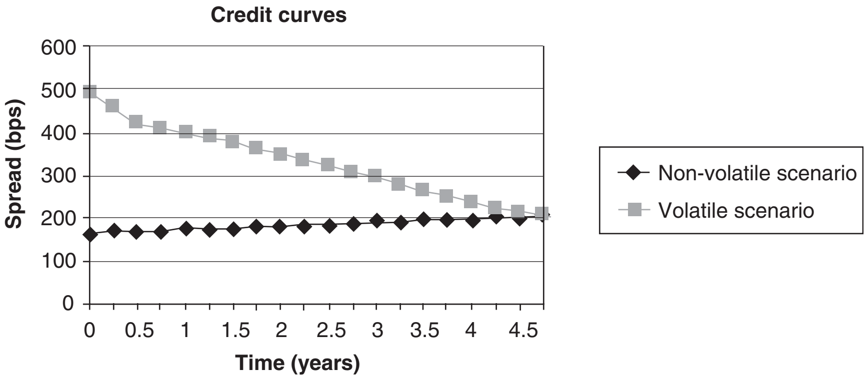

FIGURE 6.2 Credit curves corresponding to survival probabilities.

APPENDIX 6.1 DEFAULT PROBABILITIES[6]

Default probabilities are one of the most important factors to take into account when pricing credit derivatives. What makes one credit derivative cheaper than the other (assuming constant maturity periods and recovery rates)? The answer is the default probability of the underlying reference asset. To understand how default probabilities affect the price of, say, a CDS let us use the following analogy. Assume that one is currently residing in a financially risky country and has a certain amount of money placed in this country's bank. As the investor is worried about the bank defaulting he wants to 'insure' his loan so that if a default happens he will receive the notional amount of the loan. If a potential 'insurer' is found he will be most interested in gauging what the chances of default are for the bank. The higher the default probability the higher the insurance premium. The same principle is found when pricing a CDS. The CDS seller is interested in estimating the default probability of the reference asset. The higher this probability will be the higher the premium demanded.

How does a CDS seller estimate the default probability of the reference asset?

The most common approach taken is to measure the difference between the risk-free rate (usually the risk-free government benchmark yield or the LIBOR swap curve rate) and the risky rate that is taken either as the yield of the risky bond or the yield curve that the bond's credit rating and

[6] This section was co-authored with Aaron Nematnejad, during the time he worked at Bloomberg L.P. in London.

TABLE A6.1 Default probabilities by calculating the expected default loss.

Maturity	Risk-free zero	Corp. bond yield	Expected default loss % of no default value
1	4.00%	4.25%	0.24969%
2	4.00%	4.50%	0.99502%
3	4.00%	4.70%	2.07810%
4	4.00%	4.85%	3.34285%
5	4.00%	4.95%	4.63895%

industry is mapped to. Once we have this available raw data we can use a number of analytical procedures to calculate default probabilities.

The simplest method used to estimate default probabilities is the expected default loss method. The assumption here is that the increased amount of the corporate bond yield from the yield of the risk-free rate is due to the probability of default. Table A6.1 shows displays a set of risk-free rates as well as corporate bond risky rates for a term structure of five years.

Here the default probabilities are calculated by working out the percentage difference between the risky and the risk-free discount factors. For example, the value for maturity one year is obtained by:

$$1 - \exp(-(\text{Corp. bond yield} - \text{Risk-fee yield}) * \text{Time to maturity}). \quad \text{(A6.1)}$$

Note that the probabilities above are cumulative.[7] To obtain marginal default probabilities between two points on the term structure, take one rate and subtract it from the other. For example, the default probability between year 2 and 3 is 1.08309%.

The above analysis is however an unrealistic model for default probabilities. When bonds are defaulted they do not become worthless, rather there is a recovery rate associated with a bond depending the amount of assets that are recovered from the underlying reference entity of the bond. This recovery rate is conventionally defined by R. It represents the proportion of the face value of the bond that is recovered. We need to adjust equation (A6.1) to take into account of this recovery rate in the following manner:

$$\frac{[1 - \exp(-(\text{Corp. bond yield} - \text{Risk-fee yield}) * \text{Time to maturity})]}{1 - R}. \quad \text{(A6.2)}$$

Hull and White (2000) use a more sophisticated approach to modelling default probabilities. In their analysis they take into account the bond's face

[7] For a full derivation of how this formula is derived see Hull (2000).

value and accrued interest. Hull and White also use coupon-bearing bonds, which are easily observable to obtain default probabilities.

To understand this process we need to use Hull and White's approach to evaluating the cost of default. The *PV* of the cost of default is assigned as:

$$\beta = v(t)[F(t) - R(t)C(t)]$$

where $v(t)$ is the discount factor at time t, $F(t)$ is the forward price of a risk-free bond maturing at time t. $R(t)$ is the recovery rate of the risky bond at time t and $C(t)$ is the claim made by the holders of the bond. β is the present value from the loss of the bond. As there is a probability associated with β occurring, the total present value of the *j*th bond is:

$$G - B = \Sigma p\beta$$

where G is the price of a risk-free bond, B is the price of the risky bond.

The above equation allows p to be derived inductively. Rearranging the formula we obtain:

$$\frac{G - B = \Sigma p\beta}{\beta = p}.$$

There is one other limitation in the above analysis. We assumed that default can only happen at maturity. To extend the analysis for default to happen any time up to the maturity we set $\beta =$ integral (between $t(i)$ and $t(i - 1)$ ($\beta = v(t)$ $[F(t) - R(t)$ $C(t)]$) dt.

Above we represented different methods of computing default probabilities, starting with the simplest case and ending with the most sophisticated. In practice all models are used in CDS pricing. The simplest case is used when practitioners manually calculate these values for a quick estimate. The Hull and White model is used when complex computational processes are available.

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CHAPTER 7
Credit Default Swap Pricing

In this chapter, we concentrate specifically on the credit default swap (CDS) and a market approach for pricing this instrument. We consider the plain vanilla structure, in which a protection buyer pays a regular premium to a protection seller, up to the maturity date of the CDS, unless a credit event triggers termination of the CDS and a contingent payment from the protection seller to the protection buyer. If such a triggering event occurs, the protection buyer only pays a remaining fee for accrued protection from the last premium payment up the time of the credit event. The settlement of the CDS then follows a pre-specified procedure, which was discussed in Chapter 2.

THEORETICAL PRICING APPROACH

A credit default swap, like an interest rate swap, consists of two legs, one corresponding to the premium payments and the other to the contingent default payment. The present value (PV) of a default swap can be viewed as the algebraic sum of the present values of its two legs. The market premium is similar to an interest rate swap in that the premium makes the current aggregate PV equal to zero. That is, for a par interest rate swap, the theoretical net present value of the two legs must equal zero; the same principle applies for the two cash flow legs of a CDS.

The cash flows of a CDS are illustrated in Figure 7.1 on page 252.

Normally, the default payment on a CDS will be $(1 - \delta)$ times its notional amount, where δ is defined as the recovery rate of the reference security. The reason for this payout is clear—it allows a risky asset to be transformed into a risk-free asset by purchasing default protection referenced to this credit. For example, if the expected recovery rate for a given reference asset is 30% of its face value, upon default the remaining 70% will be paid by the protection seller. Credit agencies such as Moody's

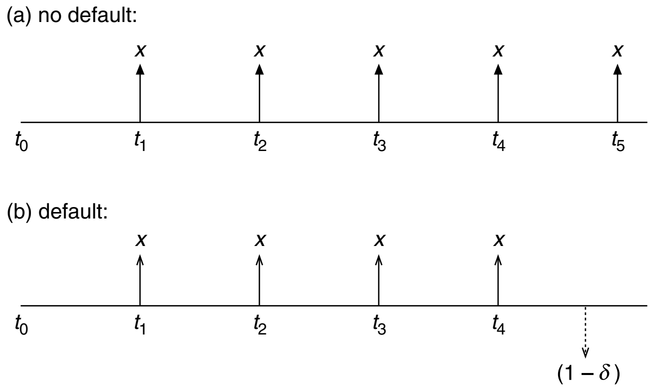


FIGURE 7.1 Illustration of cash flows in a credit default swap.

provide recovery rate estimates for corporate bonds with different credit ratings using historical data.

The valuation of each leg of the cash flows is considered below. As these cash flows may terminate at an unknown time during the life of the deal, their values are computed in a probabilistic sense, using the discounted expected value as calculated under the risk neutral method and assumptions.

The theoretical pricing of credit derivatives has attracted some attention in academic literature, as we discussed in the previous chapter. Longstaff and Schwartz (1995) present the pricing of credit spread options based on an exogenous mean-reverting process for credit spreads. Duffie (1999) presents a simple argument for the replication of a simple reduced form model of the instrument. Here we introduce a reduced form-type pricing model developed by Hull and White (2000). Their approach was to calibrate their model based on the traded bonds of the underlying reference name on a time series of CDS prices.

Like most other approaches, their model assumes that there is no counterparty default risk. Default probabilities, interest rates and recovery rates are independent.

Finally, they also assume that the claim in the event of default is the face value plus accrued interest. Consider the valuation of a plain vanilla CDS with \$1 notional principal. First, we introduce the notation below:

- T: life of credit default swap in years
- $q(t)$: risk neutral probability density at time t
- R: expected recovery rate on the reference obligation in a risk neutral world (independent of the time of default)

$u(t)$: present value of payments at the rate of \$1 per year on payment dates between time zero and time t

$e(t)$: present value of an accrual payment at time t equal to $t - t^*$ where t^* is the payment date immediately preceding time t

$v(t)$: present value of \$1 received at time t

w: total payment per year made by CDS buyer

s: value that causes the value of the CDS to have a value of zero

π: the risk neutral probability of no credit event during the life of the swap

$A(t)$: accrued interest on the reference obligation at time t as a percent of face value.

The value π is one minus the probability that a credit event will occur by time T. This is also referred to as the *survival probability* and can be calculated from $q(t)$:

$$\pi = 1 - \int_0^T q(t)dt. \tag{7.1}$$

The payments last until a credit event or until time T, whichever happens sooner. If default occurs at $t(t < T)$, the present value of the payment is $w[u(t) + e(t)]$. If there is no default prior to time T, the present value of the payment is $wu(T)$. The expected present value of the payment is, therefore:

$$w\int_0^T q(t)[u(t) + e(t)]dt + w\pi u(T). \tag{7.2}$$

Given the assumption about the claim amount, the risk neutral expected payoff from the CDS contract is derived as follows:

$$1 - R[1 + A(t)] \text{ multiplying } -R \text{ by } [1 + A(t)]$$

$$1 - R[1 + A(t)] = 1 - R - A(t)R.$$

The present value of the expected payoff from the CDS is given as:

$$\int_0^T [1 - R - A(t)R]q(t)v(t)dt. \tag{7.3}$$

The value of the CDS to the buyer is the present value of the expected payoff minus the present value of the payments made by the buyer, or:

$$\int_0^T [1 - R - A(t)R]q(t)v(t)dt - w\int_0^T q(t)[u(t) + e(t)]dt + w\pi u(T). \quad (7.4)$$

In equilibrium, the present value of each leg of the above equation should be equal. We can now calculate the CDS spread s, which is the value of w that makes the equation equal to zero by simply re-arranging the equation, as shown below:

$$s = \frac{\int_0^T [1 - R - A(t)R]q(t)v(t)dt}{\int_0^T q(t)[u(t) + e(t)]dt + \pi u(T)}. \quad (7.5)$$

The variable s is referred to as the credit default swap spread or CDS spread.

The formula at (7.5) is simple and intuitive for developing an analytical approach for pricing CDSs because of the assumptions used. For example, the model assumes that interest rates and default events are independent; also, the possibility of counterparty default is ignored. The spread s is the payment per year, as a percentage of notional principal, for a newly issued CDS.

MARKET PRICING APPROACH[1]

We now present a discrete form pricing approach that is based on the Duffie model, and is used by market practitioners.

We stated earlier that a CDS has two cash-flow legs: the fee premium leg and the contingent cash-flow leg. We wish to determine the par spread or premium of the CDS, remembering that for a par spread valuation, in accordance with no-arbitrage principles, the net present value of both legs must be equal to zero (that is, they have the same valuation).

The valuation of the fee leg is given by the following relationship:

$$PV\ of\ No\text{-}default\ fee\ payments = s_N \times Annuity_N$$

which is given by

$$PV = s_N \sum_{i=1}^{N} DF_i.PND_i.A_i \quad (7.6)$$

[1]A more descriptive explanation of this approach, including Excel spreadsheet formulae, is given in Appendix 7.1.

where

s_N is the par spread (CDS premium) for maturity N
DF_i is the risk-free discount factor from time T_0 to time T_i
PND_i is the no-default probability from T_0 to T_i
A_i is the accrual period from T_{i-1} to T_i.

Note that the value for PND is for the specific reference entity for which a CDS is being priced.

If the accrual fee for the CDS is paid upon default and termination,[2] then the valuation of the fee leg is given by the relationship which is given by

$$PV_{No\ default+Default\ accrual} = s_N \sum_{i=1}^{N} DF_i.PND_i.A_i + s_N \sum_{i=1}^{N} DF_i.(PND_{i-1} - PND_i).\frac{A_i}{2} \tag{7.7}$$

where

$(PND_{i-1} - PND_i)$ is the probability of a credit event occurring during the period T_{i-1} to T_i

$\frac{A_i}{2}$ is the average accrual amount from T_{i-1} to T_i.

The valuation of the contingent leg is approximated by:

$$PV \text{ of Contingent} = \text{Contingent}_N$$

which is given by:

$$PV_{Contigent} = (1 - R) \sum_{i=1}^{N} DF_i.(PND_{i-1} - PND_i) \tag{7.8}$$

where R is the recovery rate of the reference obligation.

For a par CDS, we know that:

$$\text{Valuation of fee} = \text{Valuation of contingent leg}$$

and therefore we can set:

$$\begin{aligned} &s_N\sum_{i=1}^{N}DF_i.PND_i.A_i + s_N\sum_{i=1}^{N}DF_i.(PND_{i-1} - PND_i)\,.\,\frac{A_i}{2} \\ &\quad = (1 - R)\sum_{i=1}^{N}DF_i.(PND_{i-1} - PND_i) \end{aligned} \tag{7.9}$$

[2]This is the amount of premium payable from the last payment date up to termination date, and similar to accrued coupon on a cash bond. Upon occurrence of a credit event and termination, the accrued premium to date is payable immediately. No protection payment is due from the protection seller until and after the accrual payment is made.

TABLE 7.1 Example of CDS spread pricing.

					Probability-weighted PVs			
Maturity *t*	Spot rates	Discount factors *DFj*	Survival probability *PSj*	Default probability *PDj*	PV of receipts if no default	PV of Receipt if default	Default payment if default	CDS premium *s*
0.5	3.57%	0.9826	0.9993	0.0007	0.4910	0.0002	0.0005	0.10%
1.0	3.70%	0.9643	0.9983	0.0017	0.9723	0.0006	0.0016	0.17%
1.5	3.81%	0.9455	0.9972	0.0028	1.4437	0.0012	0.0035	0.24%
2.0	3.95%	0.9254	0.9957	0.0043	1.9044	0.0022	0.0063	0.33%
2.5	4.06%	0.9053	0.9943	0.0057	2.3545	0.0035	0.0099	0.42%
3.0	4.16%	0.8849	0.9932	0.0068	2.7939	0.0050	0.0141	0.50%
3.5	4.24%	0.8647	0.9900	0.0100	3.2220	0.0072	0.0201	0.62%
4.0	4.33%	0.8440	0.9886	0.0114	3.6392	0.0096	0.0269	0.74%
4.5	4.42%	0.8231	0.9859	0.0141	4.0450	0.0125	0.0350	0.86%
5.0	4.45%	0.8044	0.9844	0.0156	4.4409	0.0156	0.0438	0.98%

Recovery rate 0.3

which may be rearranged to give us the formula for the CDS premium s as follows:

$$s_N = (1-R)\sum_{i=1}^{N} \frac{DF_i.(PND_{i-1} - PND_i)}{\sum_{i=1}^{N} DF_i.PND_i.A_i + DF_i.(PND_{i-1} - PND_i).\frac{A_i}{2}}. \quad (7.10)$$

In Table 7.1 we illustrate an application of the expression in equation (10) for a CDS of varying maturities, assuming a recovery rate of the defaulted reference asset of 30% and a given term structure of interest rates. It uses actual/360-day count convention.

We present a derivation of this valuation approach in Appendix 7.1.

RISK-NEUTRAL DEFAULT PROBABILITY[3]

Figure 7.2 is an Excel spreadsheet that can be set up to calculate risk-neutral default probabilities from market prices. In this example we use hypothetical risky corporate bonds of 1-, 2- and 3-year maturities, priced at par. Noting the following, where:

- SP is the spread between the benchmark discount factors, at 1-, 2- and 3-year maturities;
- PD is the default probability;
- RR is the recovery rate;
- DFB is the benchmark (risk-free) discount factor for years 1, 2 and 3,

the spreadsheet demonstrates an implementation of the following relationships:

$$PD_1 = \frac{SP_1}{(1-RR)(DFB_1)} \quad (7.11)$$

which is the default probability for year one. The default probabilities for years 2 and 3 are given below.

$$PD_2 = \frac{(SP_2 - SP_1)}{[((1-PD_1)(1-RR)) \times (DFB_2)]}$$
$$PD_3 = \frac{(SP_3 - SP_2)}{[((1-PD_1)(1-PD_2)(1-PD_3)) \times (DFB_3)]}$$

We see that using the market yields and an assumed recovery rate, we can calculate the default probabilities for each year.

Figure 7.3 shows the spreadsheet formulae used in Figure 7.2.

[3]This section was co-written with Abukar Ali.

	B	C	D	E	F	G
5						
6				DISC.FACT	DISC.FACT	DISC.FACT
7		PRICE	COUPON	YEAR 1	YEAR 2	YEAR 3
8	RISKY PAR BOND 1	100	8	0.9259		
9	RISKY PAR BOND 2	100	10		0.8249	
10	RISKY PAR BOND 3	100	12			0.70527
11						
12	BENCHMARK SWAP CURVE	PRICE	COUPON	3	4	5
13	SWAP BOND	100	5			
14	ASSUMED RECOVERY RATE	**0.5**				
15						
16						
17				DISC.FACT	DISC.FACT	DISC.FACT
18		PRICE	COUPON	YEAR 1	YEAR 2	YEAR 3
19	BENCHMARK 1	100	3	0.9709		
20	BENCHMARK 2	100	4		0.9335	
21	BENCHMARK 3	100	5			0.88908
22						
23						
24				YEAR 1	YEAR 2	YEAR 3
25	DISCOUNT SPREADS			0.0449	0.1086	0.18381
26	RISK NEUTRAL DEFAULT PROBABILITY			**0.09259**	**0.15032**	**0.219393**
27						

FIGURE 7.2 Risk-neutral default probability calculation.

	B	C	D	E	F	G
5						
6				DISC.FACT	DISC.FACT	DISC.FACT
7		PRICE	COUPON	YEAR 1	YEAR 2	YEAR 3
8	RISKY PAR BOND 1	100	8	= (100/(C8+D8))		
9	RISKY PAR BOND 2	100	10		= (100-D9*E8)/(C9+D9)	
10	RISKY PAR BOND 3	100	12			= (100-D10*E8-D10*F9)/(C10+D10)
11						
12	BENCHMARK SWAP CURVE	PRICE	COUPON	3	4	5
13	SWAP BOND	100	5			
14	ASSUMED RECOVERY RATE	0.5				
15						
16						
17				DISC.FACT	DISC.FACT	DISC.FACT
18		PRICE	COUPON	YEAR 1	YEAR 2	YEAR 3
19	BENCHMARK 1	100	3	= C19/(C19+D19)		
20	BENCHMARK 2	100	4		= E19*(C20/(C20+D20))	
21	BENCHMARK 3	100	5			= F20*(C21/(C21+D21))
22						
23						
24				YEAR 1	YEAR 2	YEAR 3
25	DISCOUNT SPREADS			= E19-E8	= F20-F9	= G21-G10
26	RISK NEUTRAL DEFAULT PROBABILITY			= E25/((1-$C$14)*E19)	= (F25-E25)/((1-E26)*(1-$C$14)*F20)	= (G25-F25)/((1-F26)*(1-E26)*(1-$C$14)*G21)
27						

FIGURE 7.3 Formulae used in Figure 7.2.

CREDIT DERIVATIVES PRICING IN VOLATILE ENVIRONMENTS: 'UPFRONT + CONSTANT SPREAD'

The foregoing and Appendix 7.1 show the standard approach to CDS pricing, and this conventional format is the 'all-running' format. This reflects that the CDS price is paid by the protection buyer through the life of the contract, as an annuity in effect, and there is no upfront payment at trade inception. A rough rule-of-thumb valuation at any time is given by:

$$\text{Value} = (\text{Current spread} - \text{Initial spread}) \times \text{Duration}.$$

The current and initial spreads are quoted data, but the duration must be calculated, and agreed between both counterparties. The calculation of duration is a function of the yield curve, the credit risky curve and the recovery rate. At low spreads the impact of these inputs on duration is negligible, at higher prices they can have a significant influence on duration, and hence the contract's value.

Following the 2007 liquidity crunch and the collapse of Lehman in 2008, CDS premiums reached very high levels, above 3,000 bps in some cases. When a price spread rises above about 1,200 bps, market practitioners do not value CDS on the basis of the 'all-running' approach, but instead use what is termed the 'upfront + constant spread' format. This means that the price spread of the contract is constant and fixed by market convention (generally at 500 bps), and a (variable) upfront payment is made at trade inception. Under this approach, a CDS contract is quoted as its upfront value only (the constant spread, being constant, does not need to be quoted) and the valuation of the contract is no longer dependent on duration. The new approach is given by:

$$\text{Value} = \text{Quoted upfront} - (\text{Current spread} - \text{Initial spread}) \times \text{Duration}.$$

This approach is also used for the iTraxx and CD-X indices and for equity tranches of structured products.

THE BASIS OF DEFAULT PROBABILITIES[4]

It is a well known fact that no-arbitrage arguments imply that the credit default swap basis, defined as the CDS spread minus the bond asset swap (ASW) spread, should be zero, meaning that cash and synthetic prices

[4]This section was co-authored with Daniel Sempere-Roldan.

should always match. However market observation confirms that CDS spreads and bond spreads do not usually agree, meaning that the no-arbitrage principle does not apply in practice. Chapters 8 and 9 provide a detailed discussion of the CDS synthetic basis.

The existence of a non-zero basis has particular implications for implied default probabilities. Specifically, whenever the credit basis becomes negative (that is, CDS spreads are lower than bond spreads), which became common during the 2007-2009 recessionary period and most especially for financial names, it could be argued that the common practice of using CDS spreads from which to bootstrap default probabilities would underestimate the actual (risk-neutral) default probabilities.

This observation raises two questions, as follows:

- what should we take as market data for default probabilities bootstrapping purposes: observed market bond spreads (cash) or market CDS spreads (synthetic)?
- would it make any sense to define some sort of 'basis of default probabilities' to account for the resulting discrepancies?

In order to address these questions we analysed market data for five credit reference names: Telefonica, Deutsche Bank, Pfizer, Sprint Nextel and Wells Fargo (these represent three US and two European reference names, and two financial and three corporate names). Specifically, we bootstrapped default probabilities for these names as at November 2009 from both CDS spreads and ASW spreads, and compared the results. For our purposes for the cash rate we used the bond ASW spread that Bloomberg refers to as the Z-spread, which is the asset swap spread computed using the relevant zero-coupon rate for each maturity period as opposed to a constant bond yield (but which in practice are quite close to conventional asset swap spreads). Note also that all the probabilities referred to here are risk-neutral ones, rather than 'real-world' probabilities.

While the conclusion remains what a market practitioner would have expected in advance, mainly that the CDS market provides a much more convenient source of data for implying default probabilities, nevertheless it remains worthwhile to undertake this analysis both for academic as well as practical reasons in order to help guide the investor's relative value analysis and better understand its fundamentals.

Bootstrapping from CDS spreads

The observed term structure of CDS spreads usually consists of the following tenors: 1-year; 2-year; 3-year; 4-year; 5-year; 7-year and 10-year. As commonplace in market practice, the piecewise-constant hazard rate model for the term structure of the survival probability was assumed, and the hazard rates were calibrated so that the implied fair CDS spreads matched those observed in the market. An assumption of 40% recovery rate of notional value was made and the recovery payment was assumed to occur on the next premium payment date. Finally, accrued premium payments were modelled in a discrete way and included in the valuation of the premium leg of the CDS.

Bootstrapping from bond spreads

As in Hull and White (2000), we used observable coupon-bearing bonds in our analysis. However it is not always possible in practice to observe the price of a Treasury bond promising the same cash flows as the observed credit-risky bonds. Therefore, rather than evaluating the cost of default and relating it to the extra price of the credit-risky bond above the Treasury, we follow a similar approach to the CDS case. We assume, as in the CDS case, a piecewise-constant hazard rate model for the term structure of the survival probability. This allows us to value each bond's dirty price by discounting its cash flows, where the set of cash flows consists of all the regular coupons and also any possible recovery payment due upon default.

As before, an assumption of 40% recovery rate of notional value is made and the recovery payment was assumed to occur on the next coupon payment date. Accrued interest is taken into account to compute the clean price from the theoretical dirty price, and it is this clean price that is matched against the observed bond price in order to achieve the bootstrapping of the probabilities.

Numerical examples

From a practical point of view, one of the main differences between the CDS and the bond ASW approach is that in the latter the set of tenors is not fixed. A simple sensitivity analysis for Wells Fargo for example shows that a −50bps price change has the following impact on the relative Z-spread change of the four considered bonds:

$$1\text{Y} \rightarrow 55\%;\ 3\text{Y} \rightarrow 20\%;\ 5\text{Y} \rightarrow 6\%;\ 8\text{Y} \rightarrow 4\%.$$

Small changes in the bond price will have a significant impact on the bond Z-spread, which for the first bond on the curve will essentially determine the hazard rate together with the recovery rate. Therefore the higher sensitivity of the Z-spread to the bond price for short-dated bonds is responsible for the short-dated default probabilities being more difficult to calibrate in practice. And because these short-dated default probabilities are an input to the medium- and long-term bootstrapping process, then we

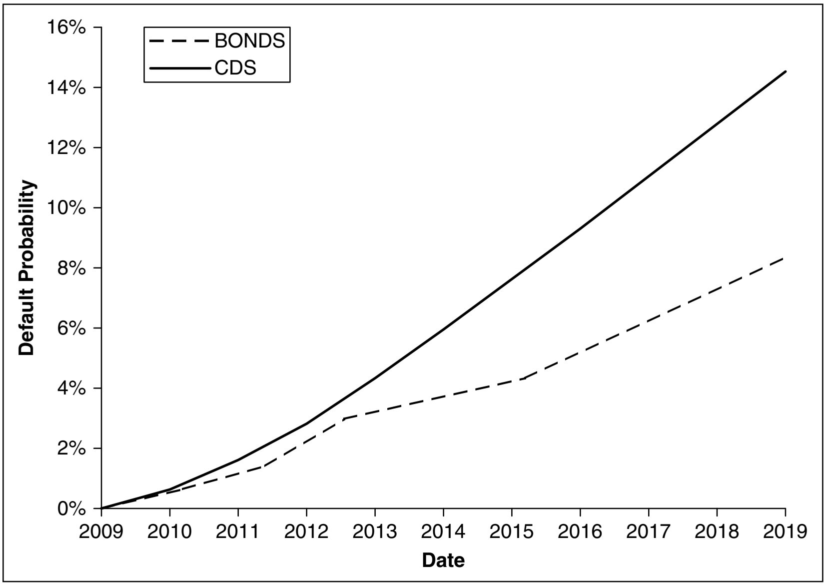


FIGURE 7.4 Telefonica default probability basis, positive basis; November 2009.

may expect to find a kinked self-correction behaviour of the default probability term structure when implied from bond ASW data.

This is indeed the case as we see at Figure 7.4, which shows the default probability curves for Telefonica. Figure 7.4 also provides an example of the difference between cash and synthetic default probabilities under a positive basis. At the opposite end we observe Sprint Nextel, with a deep negative basis, as shown in Figure 7.5.

Figure 7.6, the basis chart for Deutsche Bank, shows a change from positive to negative basis along the credit term structure. The remaining two charts (Figures 7.7 and 7.8) are the representations of the exercise undertaken for Pfizer and Wells Fargo.

Conclusions

From the exercise we conclude that the bond approach requires more data cleaning than the CDS approach, especially for short-dated bonds for which the Z-spread is highly sensitive to bond prices and can sometimes become negative. For the purposes of computing default probability, the CDS market provides data of a higher quality.

The CDS market also offers the availability of new contracts being issued every day for a fixed set of tenors. In the cash market of course on most days no new bonds will be being issued, so we have a fixed set of maturities rather than fixed tenors. The shrinking time to maturity of short-dated bonds appears to be

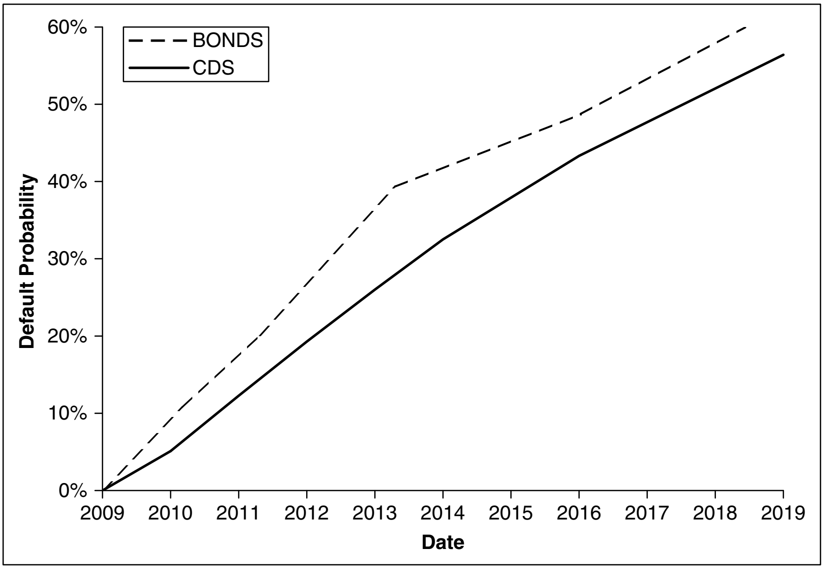


FIGURE 7.5 Sprint Nextel default probability basis, negative basis; November 2009.

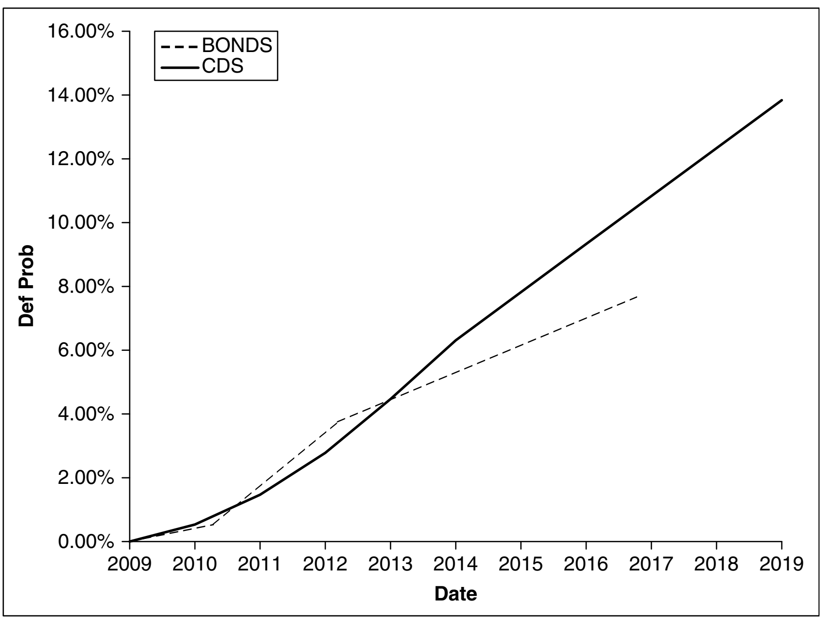


FIGURE 7.6 Deutsche Bank default probability basis, changing basis; November 2009.

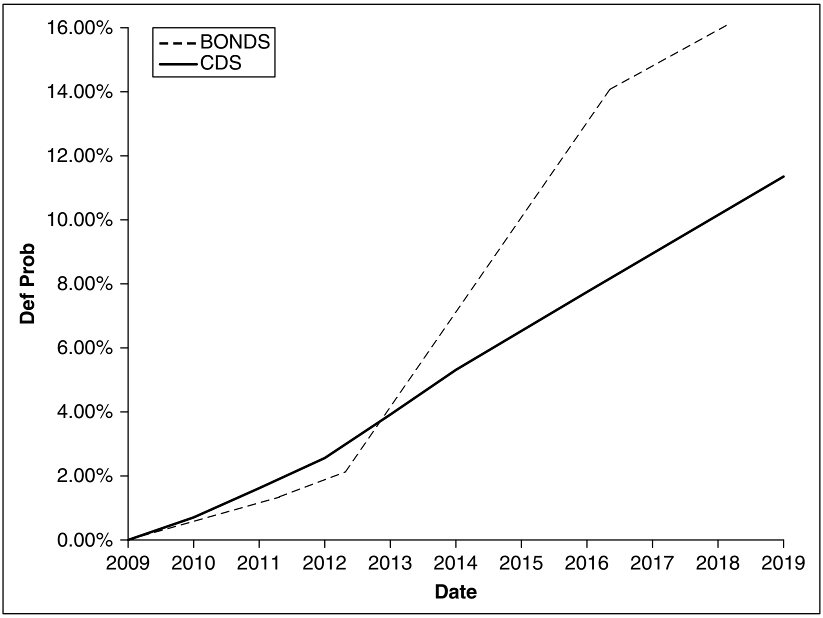


FIGURE 7.7 Pfizer default probability basis; November 2009.

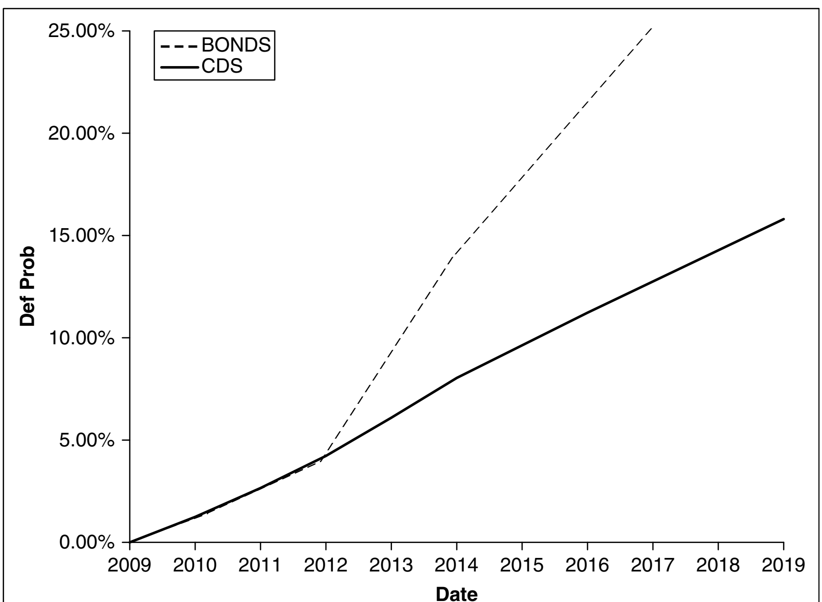


FIGURE 7.8 Wells Fargo default probability basis; November 2009.

responsible for the sensitiveness of the Z-spread mentioned above, which turns the calibration of default probabilities into a slightly unstable process. Thus the bond approach calibration is less efficient from a computational point of view due to the non-standardised cash flow dates along the spread term structure.

Under a negative basis, when CDS spreads imply lower default probabilities than bond ASW spreads, we need to note that the cash spread is higher because it contains a liquidity premium built in, as opposed to the synthetic price which reflects purely the credit risk default probability. Ultimately, a practitioner's own risk-reward view and degree of risk aversion will also dictate which market to use.

DESCRIPTION OF BLOOMBERG SCREEN CDSW[5]

Screen CDSW on Bloomberg, seen in Chapter 2, is an implementation of the procedure for pricing a CDS described in Hull and White (2000). The input used in the model to price the CDS contract is one of the three described above. The Bloomberg implementation links the market in CDS prices and the cash bond market with issuer default probabilities.

To calculate the present value of the CDS fee leg (premium leg), the Bloomberg system uses the curve of probabilities of default of the reference entity. To calculate the expected present value of the CDS contingent leg, it also requires an assumption on the payoff in the case of default, for this it uses [(par − R) + Accrued], where R is the recovery rate. The theoretical value of the CDS is then the difference in the expected present values of the two legs.

Calculating the Default Probability Default Curve

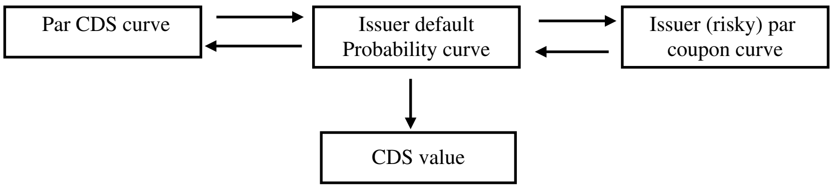
Given a curve of par CDS spreads (spreads of CDSs of various maturities, each with a net present value of zero), the system calculates an implied default probability curve by using a bootstrap procedure. Thus, it finds a default probability curve, such that all given CDS contracts have a zero value. An alternative procedure is, given a curve of risky par coupon rates (bond yields), the system calculates the default probability curve implied by this curve, again using a bootstrap process. The assumption is made that in the case of default of a bond, its value drops to a fraction R of par.

Calculating an Implied Issuer Par Coupon Curve (the 'Risky Curve')

If a default probability curve is known, the system can compute a corresponding curve of par coupon rates, corresponding to the size of the

[5]This section summarises (with permission) the notes behind Bloomberg page CDSW.

coupons an issuer of bonds will have to pay, in order to compensate investors for the default risk they are taking on. In other words, given one of the following curves, the system transforms it into the other two curves:



Liquidity Premium

The observed spread between an issuer par curve and the risk-free par curve reflects a liquidity premium as well as default risk. The Liquidity Premium field is a flat spread and selected measure of liquidity. This spread is deducted from the spread between the risky and the risk-free curves before calculation of the default probabilities. A market convention for the liquidity premium is the spread between AAA rates and the inter-bank swap rate. This spread is generally within a 0 to 25 basis point magnitude. The screen defaults to 0 bps.

Issuer Spread-to-Fair Value

The Bloomberg system assigns a relevant fair market curve to each bond in accordance with its currency, industry sector and credit rating (for example, USD A-rated utilities). It also assigns an option-adjusted spread to each issuer, so that the default probability analysis becomes issuer-specific rather than industry specific.[6]

APPENDIX 7.1 THE MARKET APPROACH TO CDS PRICING

The market approach to CDS pricing adopts the same no-arbitrage concept as used in interest-rate swap pricing. This states that, at inception:

$$\text{PV fixed leg} = \text{PV floating leg}.$$

Therefore for a CDS we set:

$$\text{PV premium leg} = \text{PV contingent leg}.$$

[6]See Choudhry (2001) for more information on option-adjusted spreads.

The PV of the premium leg is straightforward to calculate, especially if there is no credit event during the life of the CDS. However, the contingent leg is just that—contingent on occurrence of a credit event. Hence we need to determine the value of the premium leg at time of the credit event. This requires us to use default probabilities. We can use historical default rates to determine default probabilities, or back them out using market CDS prices. The latter approach is in fact *implied probabilities*.

Default Probabilities

To price a CDS, we need the answers to two basic questions:

- What is the probability of a credit event?
- If a credit event occurs, how much is the protection seller likely to pay? This revolves around an assumed *recovery rate*.

We may also need to know:

- If a credit event occurs, when does this happen?

Let us consider first the probability of default. One way to obtain default probabilities is to observe credit spreads in the corporate bond market. Risk-less investments establish a benchmark risk-less interest rate, usually the government bond yield. In the corporate (non-zero default probability) lenders and investors expect to receive a higher return from risky investments. The difference between the risky and risk-less rates is the *credit spread*. The credit spread will vary according to:

- credit quality (for example, credit rating);
- maturity;
- liquidity;
- supply and demand.

Of these factors, one of the most significant is the term to maturity. The *term structure of credit spreads* exhibits a number of features. For instance, lower quality credits trade at a wider spread than higher quality credits, and longer dated obligations normally have higher spreads than shorter dated ones. For example, for a particular sector they may look like this:

- 2-yr AA: 20 bps;
- 5-yr AA: 30 bps;
- 10-yr AA: 37 bps.

TABLE A7.1 Hypothetical corporate bond yields and risk spread.

Maturity t	Risk-free yield r	Corporate bond yield $r + y$	Risk spread y
0.5	3.57%	3.67%	0.10%
1.0	3.70%	3.82%	0.12%
1.5	3.81%	3.94%	0.13%
2.0	3.95%	4.10%	0.15%
2.5	4.06%	4.22%	0.16%
3.0	4.16%	4.32%	0.16%
3.5	4.24%	4.44%	0.20%
4.0	4.33%	4.53%	0.20%
4.5	4.42%	4.64%	0.22%
5.0	4.45%	4.67%	0.22%

An exception to this is at the very low end of the credit spectrum; for example, we may observe the following yields for CCC-rated assets:

- 2-yr CCC: 11%;
- 5-yr CCC: 7.75%;
- 10-yr CCC: 7%.

In the case of the CCC rating this reflects the belief that there is a higher probability of default risk right now rather than in five years from now, because if the company survives the first few years, the risk of later default is much lower later on. This gives rise to lower spreads.

Suppose that the corporate bonds of a particular issuer trade at the yields shown in Table A7.1.

We calculate the continuously compounded rate of return on the risk-free asset to be:

$$e^{rt}.$$

The rate of return on the risky asset is therefore given by:

$$e^{(r+y)t.}$$

We now calculate the default probability assuming zero recovery of the asset value following default. On this assumption, if the probability of default is p, then an investor should be indifferent between an expected return of:

$$(1 - p)e^{(r+y)t}$$

on the risky corporate bond, and:

$$e^{rt}.$$

TABLE A7.2 Default probabilities.

Maturity t	Risk-free yield r	Corporate bond yield $r+y$	Risk spread y	Cumulative probability of default	Annual probability of default
0.5	3.57%	3.67%	0.10%	0.050%	0.050%
1.0	3.70%	3.82%	0.12%	0.120%	0.070%
1.5	3.81%	3.94%	0.13%	0.195%	0.075%
2.0	3.95%	4.10%	0.15%	0.299%	0.104%
2.5	4.06%	4.22%	0.16%	0.399%	0.100%
3.0	4.16%	4.32%	0.16%	0.479%	0.080%
3.5	4.24%	4.44%	0.20%	0.698%	0.219%
4.0	4.33%	4.53%	0.20%	0.797%	0.099%
4.5	4.42%	4.64%	0.22%	0.985%	0.188%
5.0	4.45%	4.67%	0.22%	1.094%	0.109%

Setting these two expressions equal we have:

$$(1-p)e^{(r+y)t} = e^{rt}. \tag{A7.1}$$

Solving for p gives:

$$p = 1 - e^{-yt}. \tag{A7.2}$$

Using $p = 1 - e^{-yt}$ we can calculate therefore the probabilities of default from credit spreads that were shown in Table A7.1. These are shown in Table A7.2.

For example,

$$p_{0,5} = 1 - e^{-0.0025 \times 5} = 1.094\%$$

is the cumulative probability of default over the complete 5-year period, while:

$$p_{4,5} = p_{0,5} - p_{0,4} = 0.109\%$$

is the probability of default in year 5.

We then extend the analysis to an assumption of a specified recovery rate following default. If the probability of default is p, and the recovery rate is R, then an investor should now be indifferent between an expected return of:

$$(1-p)e^{(r+y)t} + Rpe^{(r+y)t} \tag{A7.3}$$

on the risky corporate bond, and e^{rt} on the (risk-free) government bond.

TABLE A7.3 Cumulative default probabilities.

Maturity t	Risk-free yield r	Corporate bond yield $r + y$	Risk spread y	Cumulative probability of default
0.5	3.57%	3.67%	0.10%	0.071%
1.0	3.70%	3.82%	0.12%	0.171%
1.5	3.81%	3.94%	0.13%	0.279%
2.0	3.95%	4.10%	0.15%	0.427%
2.5	4.06%	4.22%	0.16%	0.570%
3.0	4.16%	4.32%	0.16%	0.684%
3.5	4.24%	4.44%	0.20%	0.997%
4.0	4.33%	4.53%	0.20%	1.139%
4.5	4.42%	4.64%	0.22%	1.407%
5.0	4.45%	4.67%	0.22%	1.563%

Again, setting these two expressions equal, and solving for p gives:[7]

$$
\begin{aligned}
&(1-p)e^{(r+y)t} + Rpe^{(r+y)t} = e^{rt} \\
&p = \frac{1-e^{-yt}}{1-R}.
\end{aligned}
\tag{A7.4}
$$

Using this formula and assuming a recovery rate of 30% we calculate the cumulative default probabilities shown in Table A7.3.

[7]The steps in between are:

$$
\begin{aligned}
&(1-p)e^{(r+y)t} = e^{rt} \\
&(1-p)e^{rt}.e^{yt} = e^{rt} \\
&(1-p)e^{-yt} = 1 \\
&1-p = e^{-yt} \\
&p = 1-e^{-yt}
\end{aligned}
$$

Incorporating the recovery rate R we have the following steps:

$$
\begin{aligned}
&1-p+pR = e^{-yt} \\
&-p+pR = e^{-yt}-1 \\
&-p(1-R) = e^{-yt}-1 \\
&-p = \frac{e^{-yt}-1}{1-R} \\
&p = \frac{1-e^{-yt}}{1-R}
\end{aligned}
$$

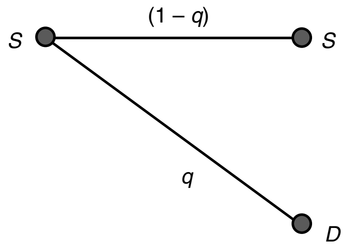


FIGURE A7.1 Binary process of survival or default.

For example,

$$p_{0,5} = \frac{1 - e^{-0.0022 \times 5}}{1 - 0.30} = 1.563\%$$

is the cumulative probability of default over the 5-year period.

We now expand the analysis to default and survival probabilities. Consider what happens to a risky asset over a specific period of time; there are just two possibilities, which are:

- there is a credit event, and the asset defaults;
- there is no credit event, and the asset survives.

Let us call these outcomes D (for default), having a probability q, and S (for survival) having probability of $(1 - q)$. We can represent this as a binary process, shown as Figure A7.1.

Over multiple periods this binary process can be illustrated as shown in Figure A7.2.

As shown in Figure A7.2, the probability of survival to period N is then:

$$PSN = (1 - q1) \times (1 - q2) \times (1 - q3) \times (1 - q4) \times \ldots \times (1 - q\mathrm{N}) \quad \text{(A7.5)}$$

while the probability of default in any period N is:

$$PSN - 1 \times qN = PSN - 1 - PSN \quad \text{(A7.6)}$$

Given these formulas, we can now price a CDS contract.

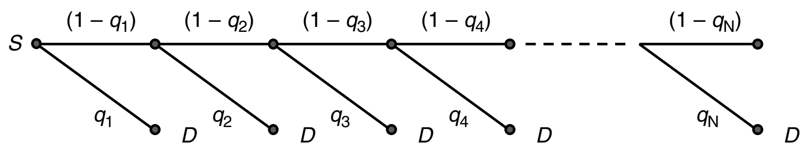


FIGURE A7.2 Binary process of survival or default over multiple periods.

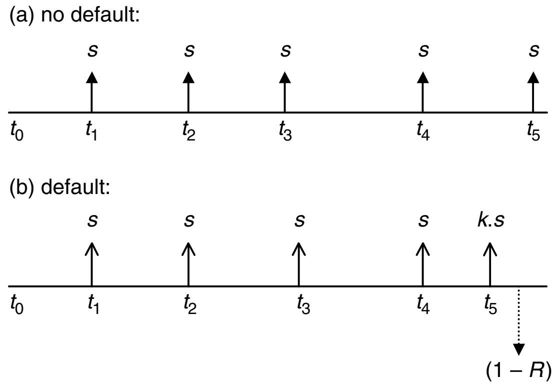


FIGURE A7.3 CDS contingent cash flows.

Pricing the CDS Contract

Given a set of default probabilities, we can calculate the fair premium for a CDS using the market approach.

To do this, consider a CDS as a series of contingent cash flows, the cash flows depending upon whether a credit event occurs. This is shown as Figure A7.3. The symbols are:

s is the CDS premium

k is the day count fraction when default occurred

R is the recovery rate.

We wish first to value the premium stream given no default, shown at Figure A7.3(a). The expected PV of the stream of CDS premiums over time can be calculated as:

$$PVS_{nd} = s\sum_{j=1}^{N} DF_j PS_j T_{j-1,j} \tag{A7.7}$$

where

PVS_{nd} is the expected present value of the stream of CDS premiums if there is no default

s is the CDS spread (fee or premium)

DF_j is the discount factor for period j

PS_j is the probability of survival through period j

$T_{j-1,j}$ is the length of time of period j (expressed as a fraction of a year).

We now require an expression for the value of the premium stream given default, which are the cash flows shown at Figure A7.3(b). If a default occurs exactly half way through period C, and the CDS makes the default payment at the end of that period, the expected present value of the fees received is:

$$PVS_d = s\sum_{j=1}^{C} DF_j PS_j T_{j-1,j} + s.DF_C PD_C \frac{T_{C-1,C}}{2} \tag{A7.8}$$

while the value of the default payment is:

$$(1 - R)DF_C PD_C \tag{A7.9}$$

where
$PVS_d$is the expected present value of the stream of CDS premiums if there is default in period C
$PD_C$is the probability of default in period C
$R$is the recovery rate

and the other terms are as before.

On the no-arbitrage principle, which is the same approach used to price interest rate swaps, for a CDS to be fairly priced the expected value of the premium stream must equal the expected value of the default payment.

As default can occur in any period j, we can write therefore:

$$s\sum_{j=1}^{N} DF_j PS_j T_{j-1,j} + s\sum_{j=1}^{N} DF_j PD_j \frac{T_{j-1,j}}{2} = (1 - R)\sum_{j=1}^{N} DF_j PD_j \tag{A7.10}$$

In equation (A7.10) the first part of the left-hand side (LHS) is the expected present value of the stream of premium payments if no default occurs, and the second part of the LHS is the expected present value of the accrued premium payment in the period when default occurs. The right-hand side of (A7.10) is the expected present value of the default payment in the period when default occurs.

Rearranging this expression gives the fair premium s for the CDS shown as (A7.11):

$$s = \frac{(1 - R)\sum_{j=1}^{N} DF_j PD_j}{\sum_{j=1}^{N} DF_j PS_j T_{j-1,j} + \sum_{j=1}^{N} DF_j PD_j \frac{T_{j-1,j}}{2}} \tag{A7.11}$$

Example Calculation

We have shown then that the price of a CDS contract can be calculated from the spot rates and default probability values given earlier. In this example we assume that the credit event (default) occurs halfway through the premium period, thus enabling us to illustrate the calculation of the present value of the receipt in event of default (the second part of the left-hand side of the original no-arbitrage equation (A7.10), the accrual factor) in more straightforward fashion.

Table A7.4 illustrates the pricing of a CDS contract written on the reference entity whose credit spread premium over the risk-free rate was introduced earlier. The default probabilities were calculated as shown in Table A7.3.

Table A7.5 on page 277 shows the Microsoft Excel formulae used in the calculation spreadsheet.

Consider the 1-year CDS premium. From Table A7.4 on page 276, the 1-year CDS premium is 0.17%. To check this calculation, we observe the expected present value of the premium for the 6-month and 1-year dates, which is:

$$\text{Survival probability} \times \text{Discount factor} \times \text{Premium} \times \text{Day count fraction.}$$

For the 6-month period this is $0.9993 \times 0.9826 \times 0.0017 \times 0.5$ or 0.0008346.

For the 1-year period this is $0.9983 \times 0.9643 \times 0.1017 \times 0.5$ or 0.00081826.

The expected present value of the accrued premium if default occurs halfway through a period is:

$$\text{Default probability} \times \text{Discount factor} \times \text{Premium} \times \text{Day count fraction.}$$

For the 6-month period this is $0.0007 \times 0.9826 \times 0.0017 \times 0.25$, which actually comes out to a negligible value. For the 1-year period the amount is:

$$0.0017 \times 0.9643 \times 0.0017 \times 0.25, \text{ which is also negligible.}$$

The total expected value of premium income is 0.00166.

The expected present value of the default payment if payment is made at end of the period is:

$$\text{Default probability} \times \text{Discount factor} \times (1 - \text{Recovery rate})$$

TABLE A7.4 Calculation of CDS prices.

					Probability-weighted PVs			
Maturity t	Spot rates	Discount factors DFj	Survival probability PSj	Default probability PDj	PV of receipts if no default	PV of receipt if default	Default payment if default	CDS premium s
0.5	3.57%	0.9826	0.9993	0.0007	0.4910	0.0002	0.0005	0.10%
1.0	3.70%	0.9643	0.9983	0.0017	0.9723	0.0006	0.0016	0.17%
1.5	3.81%	0.9455	0.9972	0.0028	1.4437	0.0012	0.0035	0.24%
2.0	3.95%	0.9254	0.9957	0.0043	1.9044	0.0022	0.0063	0.33%
2.5	4.06%	0.9053	0.9943	0.0057	2.3545	0.0035	0.0099	0.42%
3.0	4.16%	0.8849	0.9932	0.0068	2.7939	0.0050	0.0141	0.50%
3.5	4.24%	0.8647	0.9900	0.0100	3.2220	0.0072	0.0201	0.62%
4.0	4.33%	0.8440	0.9886	0.0114	3.6392	0.0096	0.0269	0.74%
4.5	4.42%	0.8231	0.9859	0.0141	4.0450	0.0125	0.0350	0.86%
5.0	4.45%	0.8044	0.9844	0.0156	4.4409	0.0156	0.0438	0.98%

Recovery rate 0.3

Source: Author's notes.

TABLE A7.5 CDS price calculation: Excel spreadsheet formulae.

					Probability-weighted PVs			
Maturity *t*	Spot rates	Discount factors *DFj*	Survival probability *PSj*	Default probability *PDj*	PV of receipts if no default	PV of receipt if default	Default payment if default	CDS premium *s*
0.5	3.57%	=1/(1+C6)^0.5	=1-F6	0.0007	=SUMPRODUCT($D$6:D6,$E$6:E6)*0.5	=SUMPRODUCT($D$6:D6,$F$6:F6)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D6,$F$6:F6)	=I6/(G6+H6)
1.0	3.70%	=1/(1+C7)^1	=1-F7	0.0017	=SUMPRODUCT($D$6:D7,$E$6:E7)*0.5	=SUMPRODUCT($D$6:D7,$F$6:F7)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D7,$F$6:F7)	=I7/(G7+H7)
1.5	3.81%	=1/(1+C8)^1.5	=1-F8	0.0028	=SUMPRODUCT($D$6:D8,$E$6:E8)*0.5	=SUMPRODUCT($D$6:D8,$F$6:F8)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D8,$F$6:F8)	=I8/(G8+H8)
2.0	3.95%	=1/(1+C9)^2	=1-F9	0.0043	=SUMPRODUCT($D$6:D9,$E$6:E9)*0.5	=SUMPRODUCT($D$6:D9,$F$6:F9)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D9,$F$6:F9)	=I9/(G9+H9)
2.5	4.06%	=1/(1+C10)^2.5	=1-F10	0.0057	=SUMPRODUCT($D$6:D10,$E$6:E10)*0.5	=SUMPRODUCT($D$6:D10,$F$6:F10)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D10,$F$6:F10)	=I10/(G10+H10)
3.0	4.16%	=1/(1+C11)^3	=1-F11	0.0068	=SUMPRODUCT($D$6:D11,$E$6:E11)*0.5	=SUMPRODUCT($D$6:D11,$F$6:F11)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D11,$F$6:F11)	=I11/(G11+H11)
3.5	4.24%	=1/(1+C12)^3.5	=1-F12	0.0100	=SUMPRODUCT($D$6:D12,$E$6:E12)*0.5	=SUMPRODUCT($D$6:D12,$F$6:F12)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D12,$F$6:F12)	=I12/(G12+H12)
4.0	4.33%	=1/(1+C13)^4	=1-F13	0.0114	=SUMPRODUCT($D$6:D13,$E$6:E13)*0.5	=SUMPRODUCT($D$6:D13,$F$6:F13)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D13,$F$6:F13)	=I13/(G13+H13)
4.5	4.42%	=1/(1+C14)^4.5	=1-F14	0.0141	=SUMPRODUCT($D$6:D14,$E$6:E14)*0.5	=SUMPRODUCT($D$6:D14,$F$6:F14)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D14,$F$6:F14)	=I14/(G14+H14)
5.0	4.45%	=1/(1+C15)^5	=1-F15	0.0156	=SUMPRODUCT($D$6:D15,$E$6:E15)*0.5	=SUMPRODUCT($D$6:D15,$F$6:F15)*0.5/2	=(1-$B$18)*SUMPRODUCT($D$6:D15,$F$6:F15)	=I15/(G15+H15)

Recovery rate 0.3

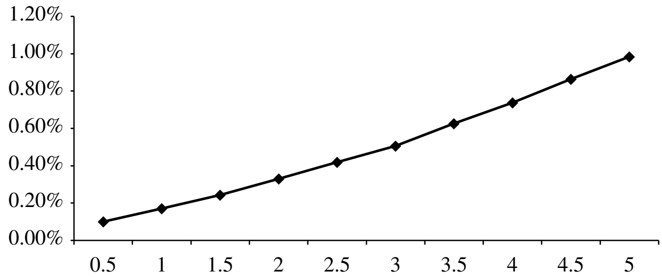


FIGURE A7.4 Term structure of credit rates.

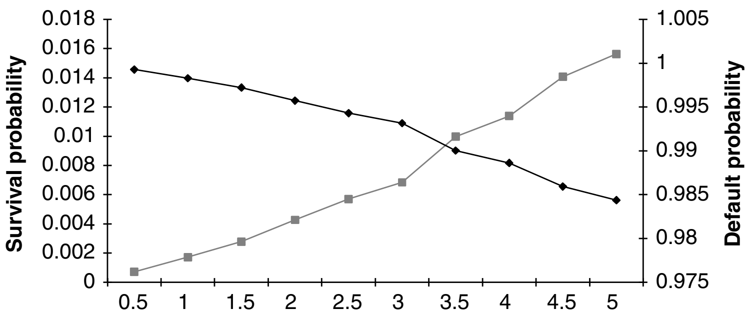


FIGURE A7.5 Term structure of default probabilities.

which for the two periods is:

6-mth: $0.0007 \times 0.9826 \times (1 - 30\%) = 0.000482;$
12-mth: $0.0017 \times 0.9643 \times (1 - 30\%) = 0.001148.$

So the total expected value of the default payment is 0.00166, which is equal to the earlier calculation. Our present values for both fixed leg and contingent legs are identical, which means we have the correct no-arbitrage value for the CDS contract.

From the CDS premium values we can construct a term structure of credit rates for this particular reference credit (or reference sector), which is shown at Figure A7.4. We can also construct a term structure of default probabilities, and this shown at Figure A7.5.

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Structured Credit Products:Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

CHAPTER 8

The Asset Swap—Credit Default Swap Basis I: The Asset Swap Pricing of Credit Default Swaps[1]

INTRODUCTION

As discussed in Chapter 2, asset swaps, although pre-dating the credit derivative market, are viewed as a form of credit derivative. They are cash market instruments. However, because an asset swap is a structure that explicitly prices a credit-risky bond in terms of its spread over LIBOR (inter-bank credit risk), it can be viewed as a means by which to price credit derivatives. In fact, in the early days of the credit derivatives market, the most common method of pricing credit default swaps (CDS) was by recourse to the asset swap spread of the reference credit, as the CDS premium should (in theory) be equal to the asset swap spread of the reference asset. Therefore we can say that the asset swap provides an indicator of the minimum returns that would be required for specific reference credits, as well as a mark-to-market reference. It is also in theory a hedging tool for a CDS position.

We first consider the use of this technique, before observing how these two spread levels differ. The next chapter will look in detail at the factors that cause this difference in spread, which is known as the *credit default swap basis*.

ASSET SWAP PRICING

Basic Concept

The asset swap market is a reasonably reliable indicator of the returns required for individual credit exposures, and provides a mark-to-market

[1]This chapter is an updated version of what first appeared in Choudhry (2001).

framework for reference assets as well as a hedging mechanism. As we saw in Chapter 2, a par asset swap typically combines the sale of an asset such as a fixed-rate corporate bond to a counterparty, at par and with no interest accrued, with an interest rate swap. The coupon on the bond is paid in return for LIBOR, plus a spread if necessary. This spread is the asset swap spread and is the price of the asset swap. In effect, the asset swap allows market participants that pay floating rate LIBOR-based funding to receive the asset swap spread. This spread is a function of the credit risk of the underlying bond asset, which is why it may be viewed as equivalent to the price payable on a CDS written on that asset.

The generic pricing is given by:

$$Y_a = Y_b - ir \tag{8.1}$$

where

Y_a is the asset swap spread;
Y_b is the asset spread over the benchmark;
ir is the interest rate swap spread.

The asset spread over the benchmark is the bond (asset) redemption yield over that of the government benchmark. The interest rate swap spread reflects the cost involved in converting fixed-coupon benchmark bonds into a floating-rate coupon during the life of the asset (or credit default swap), and is based on the swap rate for that maturity.

The theoretical basis for deriving a default swap price from the asset swap rate can be illustrated by looking at a basis-type trade involving a cash market reference asset (bond) and a credit default swap written on this bond. This is similar in concept to the risk-neutral or *no-arbitrage* concept used in derivatives pricing. The theoretical trade involves the following:

- a long position in a cash market floating-rate note (FRN) priced at par, which pays a coupon of LIBOR + X basis points;
- a short position (bought protection) in a CDS written on the same FRN, of identical term to maturity and at a cost of Y bps.

Assume that the buyer of the bond is able to fund the position at LIBOR. In other words, the bondholder has the following net cash flow:

$$(100 - 100) + [(\text{LIBOR} + X) - (\text{LIBOR} + Y)]$$

or $X - Y$ basis points.

In the event of default, the bond is delivered to the protection seller in return for payment of par, enabling the bondholder to close out the funding position. During the term of the trade, the bondholder has earned $X - Y$ basis points while assuming no credit risk. For the trade to meet the

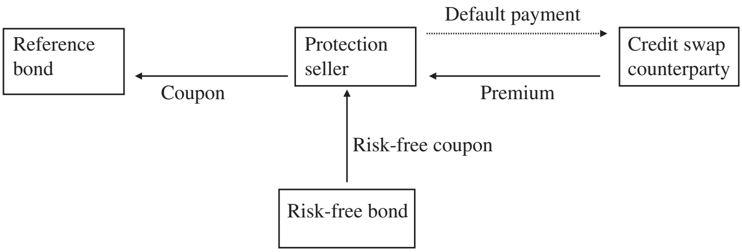

FIGURE 8.1 Credit default swap and asset swap hedge.

no-arbitrage condition, we must have $X = Y$. If $X \neq Y$ the investor would be able to establish the position and generate a risk-free profit.

This is a logically tenable argument as well as a reasonable assumption. The default risk of the cash bondholder is identical in theory to that of the default seller. In the next section, we illustrate an asset swap pricing example before looking at why, in practice, there exist differences in pricing between default swaps and cash market reference assets.

Asset Swap Pricing Example

XYZ plc is a Baa2-rated corporate. The 7-year asset swap for this entity is currently trading at 93 bps; the underlying 7-year bond is hedged by an interest rate swap with an Aa2-rated bank. The risk-free rate for floating-rate bonds is LIBID minus 12.5 bps (assume the bid–offer spread is 6 bps). This suggests that the credit spread for XYZ plc is 111.5 bps, given by $(93 + 12.5 + 6 = 111.5)$. The credit spread is the return required by an investor for holding the credit of XYZ plc. The protection seller is conceptually long the asset, and so would short the asset to hedge its position. This is illustrated in Figure 8.1. The price charged for the credit default swap is the price of shorting the asset, which works out as 111.5 bps each year.

Therefore we can price a credit default written on XYZ plc as the present value of 111.5 bps for seven years, discounted at the interest rate swap rate of 5.875%. This computes to a credit default swap price of 6.25%.

Reference:	XYZ plc
Term:	Seven years
Interest rate swap rate:	5.875%
Asset swap:	LIBOR plus 93 bps
Benchmark rate:	LIBID minus 12.5 bps

Margin:	6 bps
Credit default swap:	111.5 bps
Default swap price:	6.252%

Pricing Differentials

Market observation shows us that, contrary to what theory predicts, the prices of asset swaps and CDS contracts written on the same corporate entity differ, sometimes by a considerable extent. This should not surprise us, as the two instruments actually cover different things. A number of factors observed in the market serve to make the price of credit risk that has been established synthetically using credit default swaps to differ from its price as traded in the cash market. In fact, identifying (or predicting) such differences gives rise to arbitrage opportunities that may be exploited by basis trading in the cash and derivative markets.[2] These factors include the following:

- bond identity: the bondholder is aware of the exact issue that they are holding in the event of default; however, credit default swap sellers may receive potentially any bond from a basket of deliverable instruments that rank *pari passu* with the cash asset—this is the delivery option value that is afforded the long CDS holder;
- the borrowing rate for a cash bond in the repo market may differ from LIBOR if the bond is to any extent *special*—this does not impact the credit default swap price which is fixed at inception;
- certain bonds rated AAA (such as US agency securities) sometimes trade below LIBOR in the asset swap market; however, a bank writing protection on such a bond will expect a premium (that is, positive spread over LIBOR) for selling protection on the bond;
- depending on the precise reference credit, the credit default swap may be more liquid than the cash bond, resulting in a lower CDS price, or less liquid than the bond, resulting in a higher price;
- credit default swaps may be required to pay out on credit events that are technical defaults, and not the full default that impacts a cash bondholder; protection sellers may demand a premium for this additional risk;
- the credit default swap buyer is exposed to counterparty risk during the term of the trade, unlike the cash bondholder.

[2]This is known as trading the credit default swap basis and involves either buying the cash bond and buying a credit default swap written on this bond, or selling the cash bond and selling a CDS written on the bond.

For these and other reasons the credit default swap price usually differs from the cash market price for the same asset. We examine them again, in greater detail in the next chapter. In any case, the existence of the basis means that banks generally use credit pricing models, based on the same models used to price interest rate derivatives, when pricing credit derivatives.

ILLUSTRATION USING BLOOMBERG

Observations from the market show the difference in price between asset swaps on a bond and a CDS written on that bond, reflecting the factors stated in the previous section. We illustrate this now using a euro-denominated corporate bond.

The bond is the Air Products & Chemicals 6.5% bond due July 2007.[3] This bond is rated A3/A as shown in Figure 8.2, the description page from Bloomberg. The asset swap price for that specific bond to its term to

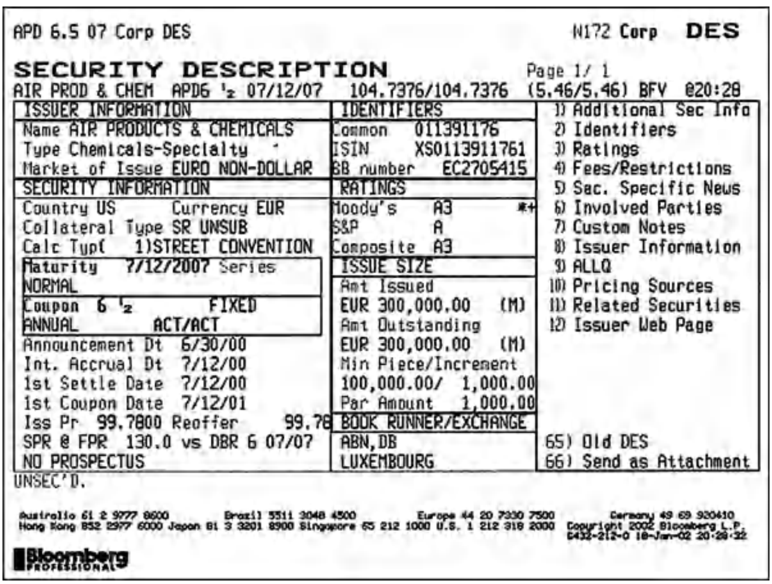

FIGURE 8.2 Bloomberg DES page for Air Products & Chemicals bond.
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[3]This bond has long since matured! However, the principles, as well as the relevant Bloomberg pages, remain unchanged. Readers may wish to apply them to a bond of their choice today, and look up the ASW level, the CDS price, the basis and the appropriate fair market curves.

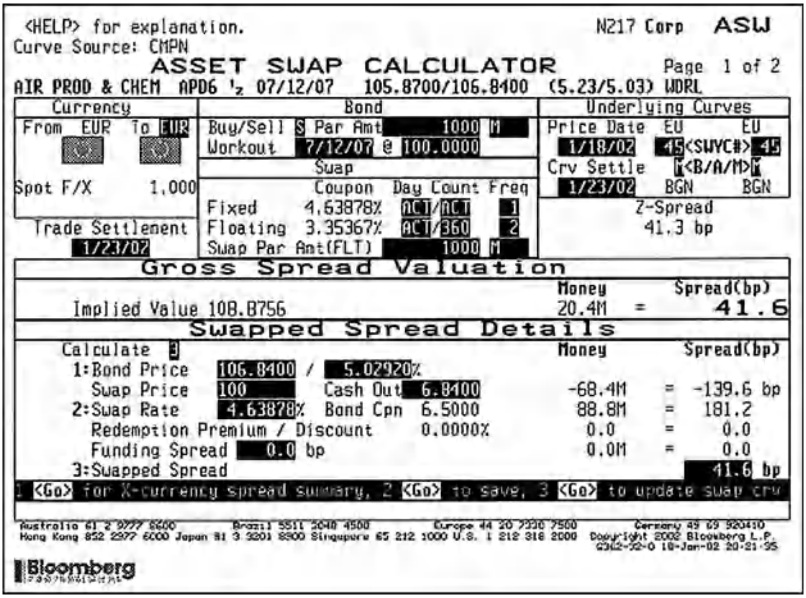

FIGURE 8.3 Asset swap calculator page ASW on Bloomberg, 18 January 2002.
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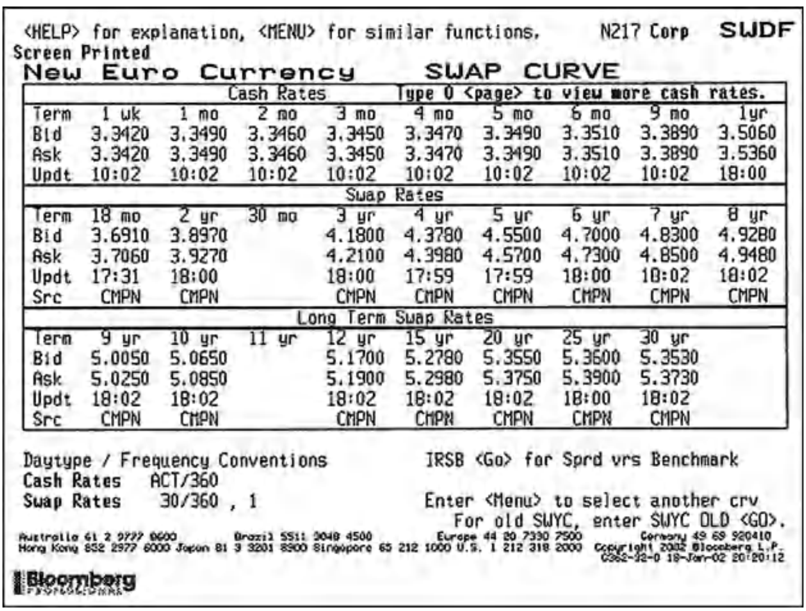

FIGURE 8.4 Euro swap curve on Bloomberg as at 18 January 2002.
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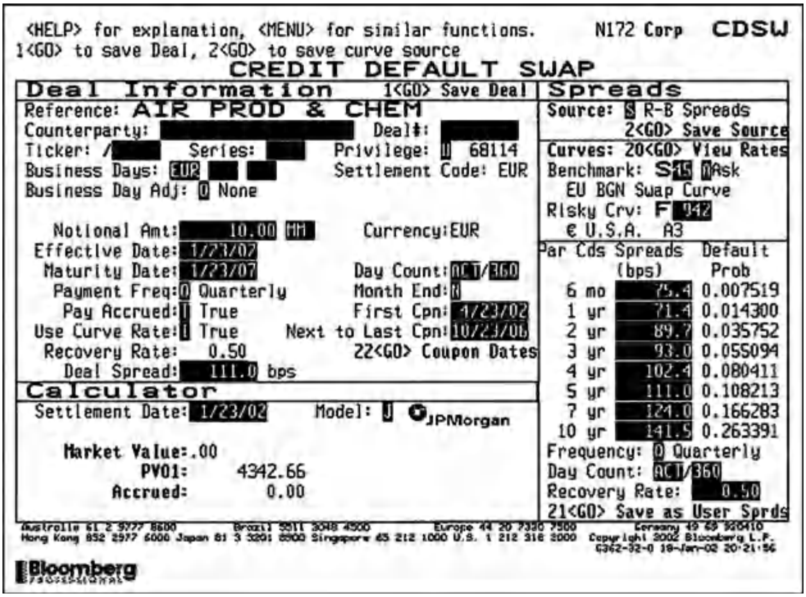

FIGURE 8.5 Default swap page CDSW for Air Products & Chemicals bond, 18 January 2002.
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maturity as at 18 January 2002 was 41.6 bps. This is shown in Figure 8.3 on page 286. The relevant swap curve used as the pricing reference is indicated on the screen as curve 45, which is the Bloomberg reference number for the euro swap curve and is shown in Figure 8.4 on page 286.

We now consider the CDS page on Bloomberg for the same bond, which is shown in Figure 8.5. For the similar maturity range, the CDS price would be approximately 115 bps. This differs significantly from the asset swap price.

From the screen we can see that the benchmark curve is the same as that used in the calculation shown in Figure 8.3. However, the corporate curve used as the pricing reference is indicated as the euro-denominated US-issuer A3 curve, and this is shown in Figure 8.6 on page 288. This is page CURV on Bloomberg, and is the fair value corporate credit curve constructed from a basket of A3 credits. We can view the list of bonds that are used to construct the curve on following pages of the same screen. For comparison, we also show the Bank A3 rated corporate credit yield curve, in Figure 8.7 on page 288.

Prices observed in the market invariably show this pattern of difference between the asset swap price and the CDS price. The page CDSW on Bloomberg uses the generic risky curve to calculate the default swap price, and adds the credit spread to the interest rate swap curve (shown in

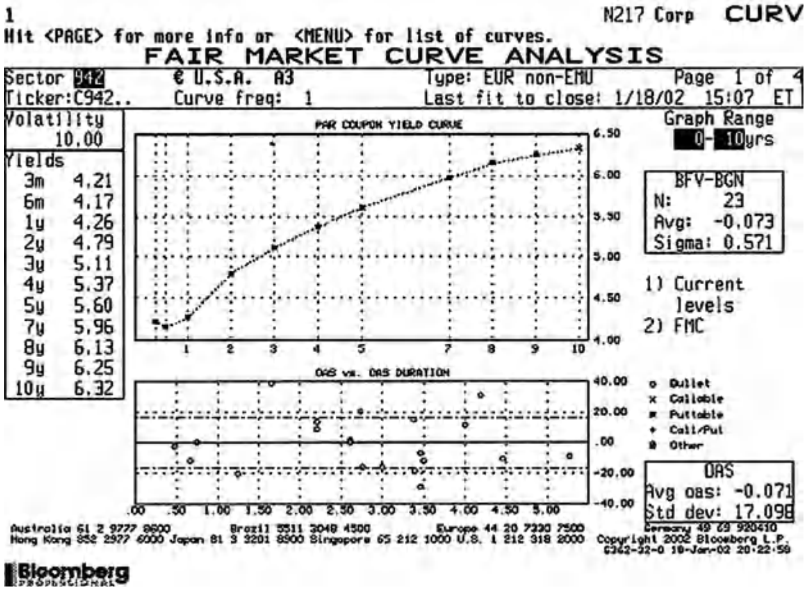

FIGURE 8.6 Fair market curve, euro A3 sector.

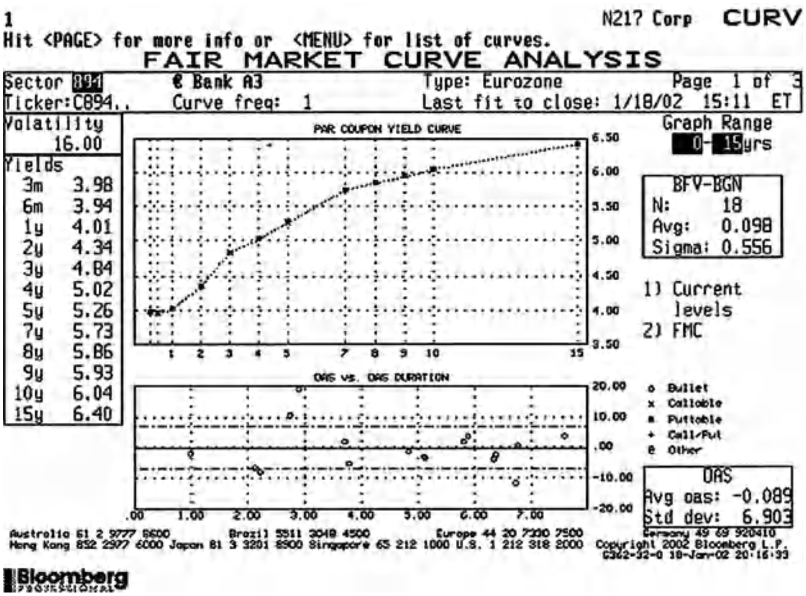

FIGURE 8.7 Fair market curve, euro Banks A3 sector.

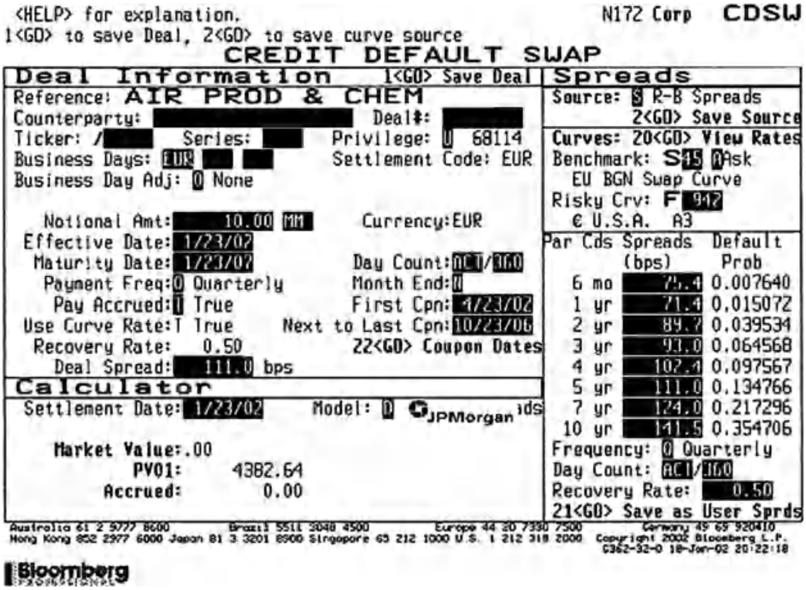

FIGURE 8.8 CDSW page with discounted spreads model selected.

Figure 8.4). However, the ASW page is the specific asset swap rate for that particular bond, to the bond's term to maturity and this is another reason why the prices of the two instruments differ significantly.

Using Bloomberg, we can select either the J.P. Morgan credit default swap pricing model or a generic discounted credit spreads model. These are indicated by 'J' or 'D' in the box marked 'Model' on the CDSW page. Figure 8.8 shows this page with the generic model selected. Although there is no difference in the swap prices, as expected, the default probabilities have changed under this setting.

Our example illustrates the difference in swap price that we discussed earlier, and can be observed for any number of corporate credits across sectors. This suggests that middle office staff and risk managers that use the asset swap technique to independently value default swap books are at risk of obtaining values that differ from those in the market. This is an important issue for credit derivative market-making banks.

The Basis as Market Indicator

From the previous section we saw that contrary to the no-arbitrage logic that might be expected to prevail, the CDS-bond basis does not revolve close to zero, and can exhibit quite large values. The factors that cause the basis to diverge away from a zero value are, as we saw earlier, a combination of contract-specific issues and market issues. Simple supply–demand factors and their impact in the cash and synthetic markets also influence the basis.

Market participants observe the basis closely, both as an indicator of current market levels and also as a predictor of future direction. This reflects the fact that the basis is an indicator of general market sentiment and its appetite for cash versus synthetic risk. The higher price for cash assets, compared to synthetic assets, in the period following the 2007–08 crash, reflects the greater value of cash in the market. This value commanded a significant premium over CDS prices. The relationship between the two markets flows both ways; that is, absolute values as well as the spread may widen first in the CDS market before moving onto the cash market, and vice-versa. For this reason the basis sometimes underperforms cash when spreads start to widen (such as going into a period of recession) while at other times it may outperform it. Generally though, the basis is a leading indicator of the market rather than a lagging one, essentially because it is part of what is often a more liquid market compared to the cash bonds in the same sector. For instance, the 5-year benchmark CDS can be traded in large size without having an adverse impact on the market. In many cases the CDS is easier to source in the market compared to the same-name cash bond.

The indicative nature of the basis is shown at Figure 8.9. This shows the average basis in the investment-grade US industrials sector during 2002–2003, calculated from a set of 50 reference names, compared to an investment bank corporate bond index for the same asset class.

One method we can use to measure the pace of change in the basis at any time is to check the change in the basis itself against the option-adjusted

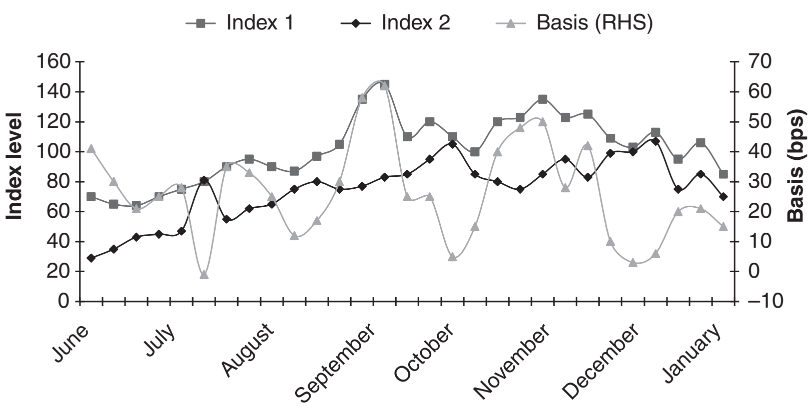

FIGURE 8.9 The CDS-basis plotted against a bond index, 2002–2003.
Source: CSFB investor research. Used with permission.

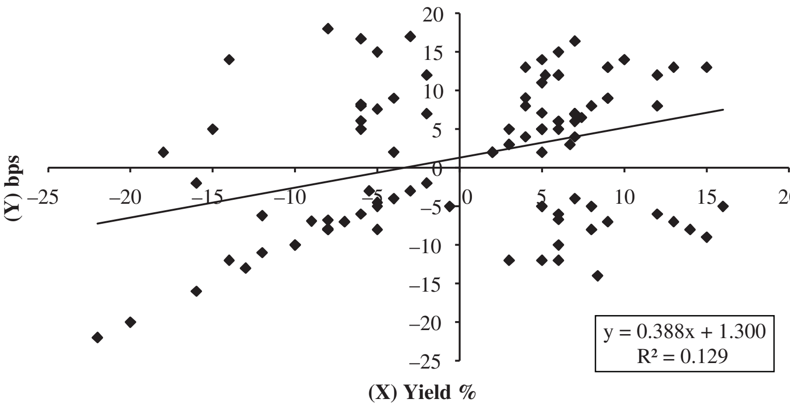

FIGURE 8.10 Regression analysis of weekly changes in the basis, compared to weekly changes in the cash OAS.
Source: Author' notes.

spread (OAS) for that sector.[4] That is, we study the relationship between changes in the basis for a particular sector and the change in that sector's OAS. Essentially, the liquidity of the synthetic market means that the CDS market is a leading indicator of market sentiment, compared to the cash market, and would appear to react more quickly to market sentiment. As such, portfolio managers observe the basis levels closely for an idea of future direction and sentiment. As the aggregate value of the basis has a low correlation with the direction of spreads, it can be considered a sensible diversification for the portfolio manager. This would normally be in the form of a basis trade of the type described at the start of this chapter. As the value of the basis is only weakly influenced by the market direction for credit, basis trades can be considered efficient portfolio allocation for some fund managers.

Figure 8.10 shows a regression analysis of weekly changes in the basis compared to the weekly changes in the cash OAS for that sector. We see that the two variables are only weakly correlated. Therefore, a portfolio manager may consider a basis-type trade as essential diversification, as well as useful for market intelligence purposes.

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[4]More information on OAS can be found in Choudhry, M., *Fixed Income Markets*, John Wiley & Sons (Asia), 2004.

Structured Credit Products:Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

CHAPTER 9

The Credit Default Swap Basis II: Analysing the Relationship Between Cash and Synthetic Markets

The rapid growth of the credit derivative market has produced a liquid market in CDS across the credit curve. This liquidity in turn has helped to generate further growth in the market. For a large number of corporate and certain sovereign names the liquidity of the credit derivative market frequently exceeds that available for the same reference names in the cash market.[1] It is this feature that enabled fund managers to exploit their knowledge of credit trading by originating *synthetic CDO* vehicles, which enabled them to arbitrage between cash and synthetic markets. These products were at the centre of the credit crunch and liquidity crisis during 2007–2009, and the market in them dried up almost completely. The basic CDS contract remained liquid, and as well as greater liquidity, the synthetic market also still offers investors the opportunity to access any part of the credit term structure, and not just those parts of the term structure where corporate borrowers have issued cash market paper. The liquidity of the synthetic market has resulted in many investors accessing both the credit derivative and the cash bond markets to meet their investment requirements. The synthetic market also offers other potential advantages to investors who would generally consider only the cash markets. For illustration, we list some potential advantages in Table 9.1 on page 294, which builds on what we first considered in Table 2.2.

[1]For instance, see *RISK*, Robeco CSO, May 2002. The asset swap market is part of the cash market, despite the fact that an interest rate derivative (the swap element) is part of an asset swap.

TABLE 9.1 Comparing cash and derivatives markets for investors.

	Cash bonds	Credit derivatives
Corporate (issuer) names available	Existing issuers only	Any reference name can be traded
Liquidity	Variable liquidity	No limit to size and term of trade
Bid–offer spread	Greater below AAA names	Smaller
Maturity	Fixed dates	Any date required
Principal guaranteed	Not common	Available if required
Coupon	Typically fixed	Fixed or floating
Yield	Lower	Higher

In this chapter, we consider the close relationship between the synthetic and cash markets in credit. This relationship manifests itself most clearly in the shape of the CDS *basis*. First, we consider briefly why the synthetic market price spread will necessarily differ from the cash spread. We then look in further detail at the factors that drive the basis and the implications this has for market participants. Finally, from market observation, we look at the dynamics of the CDS basis.

THE ASSET SWAP PRICE

A well-established risk management technique in the market combines an interest rate swap to transform the coupon base of a corporate bond. This produces an asset swap. This is an agreement that converts the cash flows of a bond from a fixed-rate to a floating-rate (or vice-versa). The coupon on the bond is paid in return for LIBOR, plus a spread if necessary. This spread is the asset swap spread and is the price of the asset swap. On the basis that the swap rate payable by a bank in the inter-bank market is LIBID, this asset swap spread is a function of the credit risk of the underlying bond.[2] As we saw in Chapter 8, this is why it may be viewed as equivalent to the

[2]Or, to put it another way, the LIBOR-flat asset swap rate is the rate payable for firms of roughly AA-rating quality, this being the accepted credit quality of the inter-bank market.

price payable on a CDS written on the same asset, because it reflects the credit risk of the asset over and above the inter-bank credit risk. In the previous chapter, we described the no-arbitrage argument that indicates why this should be the case. As we noted, however, there are a number of reasons why the asset swap spread will differ from the same-reference asset CDS premium.[3] This is also noted in Bomfim (2002), who illustrates the divergence of asset swap (ASW) and CDS spreads using financial entity and industrial entity reference names. The divergence is greatest with the industrial names considered in Bomfim's article.

During the initial phase of the CDS market, the asset swap price was frequently used in CDS valuation, particularly by middle office and product control. However, as noted in Choudhry (2002b), middle office desks and risk managers that use the asset swap technique to independently value default swap books are at risk of obtaining values that differ from those in the market. This is an important issue for credit derivative market-making banks. In practice, the CDS spread will differ from the ASW spread, and this has important implications for market participants in both cash and synthetic credit markets.

THE CDS BASIS

While the theoretical case can be made as to why the CDS price should be equal to the ASW price, market observation tells us that this is not the case. This difference in pricing between the cash and synthetic markets was noted in the previous chapter and results from the impact of a combination of factors. In essence, it is because credit derivatives isolate and trade credit as their sole asset, separately from any funding consideration, that they are priced at a different level than the asset swap on the same reference asset. However, there are other important factors that must be considered, which we consider shortly.

The difference between the CDS and the ASW price is known as the *basis*. The basis is given by:

$$\text{Credit default spread } (D) - \text{Asset swap spread } (S).^4 \tag{9.0}$$

Where $D - S > 0$, we have a *positive basis*. A positive basis occurs when the credit derivative trades higher than the asset swap price, and is

[3]Or from the same reference name.

[4]We may state the formal definition of the CDS-bond basis as being the difference between the CDS and the par bond floating-rate spread of the same reference asset, the latter as expressed for an asset swap on the bond.

TABLE 9.2a Selected reference name credit default swap and asset swap spreads, May 2003.

Reference credit	Credit rating	CDS spread	Asset swap spread (LIBOR Plus)	Basis
Financials				
Ford Motor Credit	A2/A	59.3	51.1	+8.2
Household Finance	A2/A	72.2	57.2	+15.0
JPMorgan Chase	Aa3/AA−	89.0	66.9	+22.1
Merrill Lynch	Aa3/AA−	108.1	60.4	+47.7
Industrials				
AT&T Corp	Baa2/BBB+	224.0	217.6	+6.4
FedEx Corp	Baa2/BBB+	499.0	481.2	+17.8
General Motors	A3/BBB	205.1	237.7	−32.6
IBM (6-yr callable bond)	A1/A+	27.2	8.2	+19.0
IBM (4-yr callable bond)	A1/A+	33.3	11.0	+22.3

Bonds used are 5-year conventional bullet bonds
CDS is 5-year maturity
AT&T is 4-year maturity
FedEx is 3-year maturity

Sources: Bloomberg L.P., CSFB, JPMorgan Chase, Bank of America.

common. Where $D - S < 0$, we have a *negative basis*. A negative basis occurs when the credit derivative trades tighter than the cash bond asset swap spread.

Table 9.2a shows the basis for a sample of reference credits during May 2003. We use mid-prices for 5-year CDS and ASW for each name. The sample reflects the customary market state, with a positive basis for all but one of the names. The same reference names are updated as at November 2008 at Table 9.2b on page 297. The impact of the global financial crisis on CDS levels is evident.

We illustrate further the different trading levels by looking at an issuer name in the Euro-markets, Telefonica. Figure 9.1a on page 297 shows the yield spread levels for a selection of US dollar and euro bonds issued by Telefonica, as at November 2002. We can see that the CDS price is at levels comparable with the cheapest bond in the group, the 7.35% 2005 bond, issued in US dollars.

We see that the position had reversed by November 2008, when the reference name was now showing a negative basis (see Figure 9.1b on page 298).

TABLE 9.2b Selected reference name 3-year CDS and ASW spreads, November 2008.

Reference credit	Credit rating	CDS spread	Asset swap spread (LIBOR Plus)	Basis
Financials				
Ford Motor Credit	B–	2787	2447	+340
Household Finance (HSBC)	AA–	462	411	+51
JPMorgan Chase	AA–	118	268	–150
Merrill Lynch	A	228	445	–217
Industrials				
AT&T Corp	A	169	263	–94
FedEx Corp	BBB	143	710	–567
General Motors	CCC+	6204	6708	–504
IBM	A+	74	138	–64

Bonds used are 3-year conventional bullet bonds.

Source: Bloomberg L.P.

The basis will fluctuate in line with market sentiment on the particular credit. For instance, for a worsening credit, the basis can become positive quickly. This is illustrated in Figure 9.2 on page 298, which shows the widening in spread between the 5-year CDS levels with the similar maturity May 2006 bond of the same name (in this case, British Airways

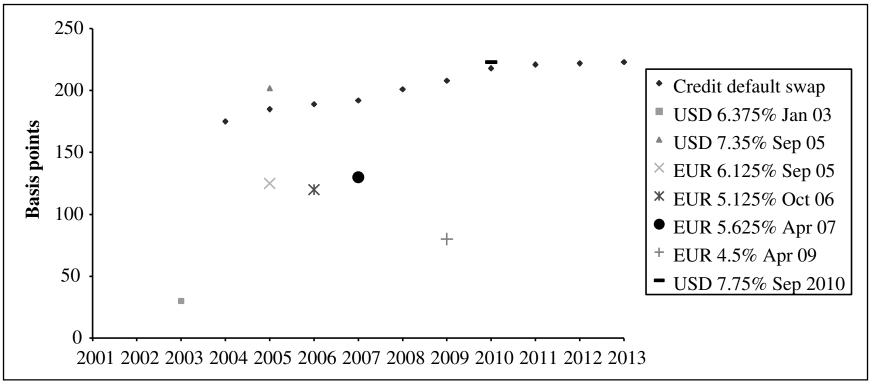

FIGURE 9.1a Telefonica bond asset swap and CDS spread levels, November 2002.
Source: Bloomberg L.P.

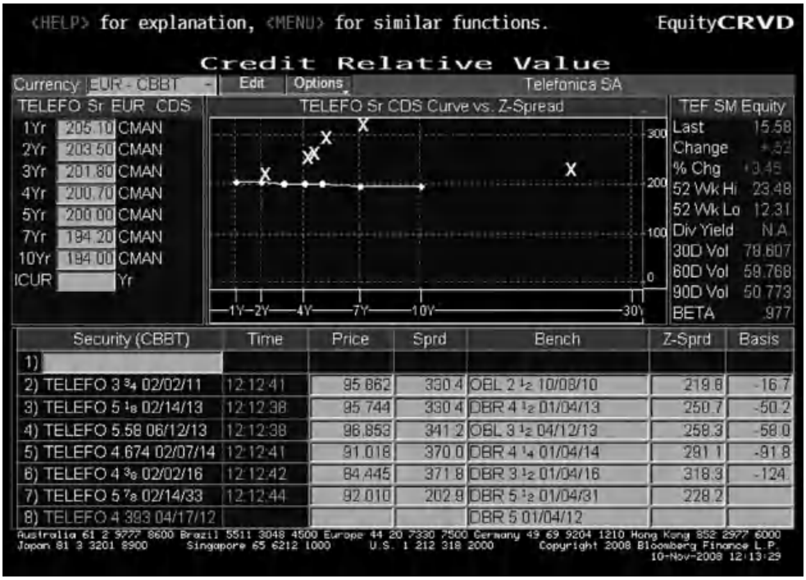

FIGURE 9.1b Telefonica basis position reversal, November 2008.

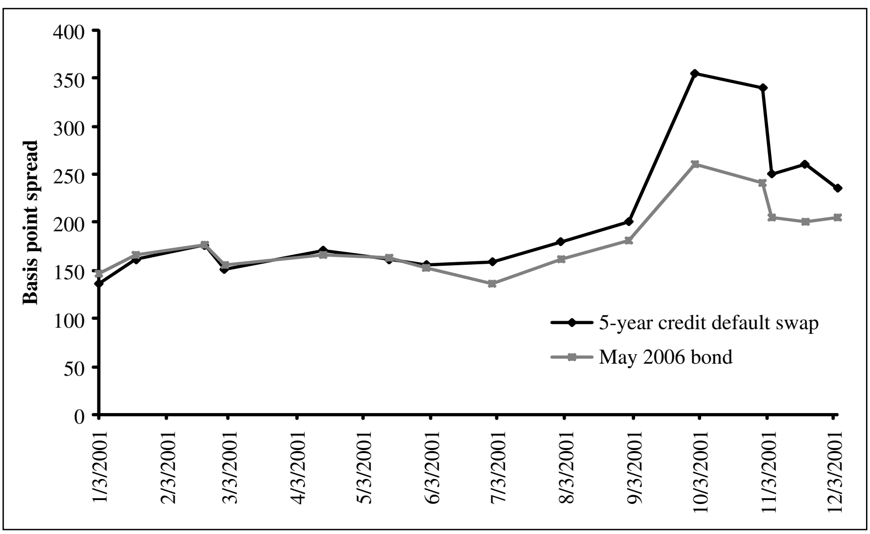

FIGURE 9.2 British Airways plc, credit default swap versus bond spread levels.
Source: Bloomberg L.P.

plc). The impact of the deteriorating business outlook in the last quarter of 2001 is prevalent, with the improving situation also illustrated towards the end of the year.

FACTORS DRIVING THE BASIS

The basis arises from a combination of factors, which we may group into:

- technical factors;
- market factors.

Technical factors, which are also referred to in the market variously as *fundamental* or *contractual* factors, are issues related to the definition or specification of the reference asset and of the CDS contract. *Market* factors, which are also referred to as *trading* factors, relate to issues connected with the state of the market in which credit swap contracts and reference assets are traded. Each factor exerts an influence on the basis, forcing it wider or tighter—the actual market basis at any one time will reflect the impact of all these factors together. We consider them in detail next.

Technical Factors

Technical factors that influence the size and direction of the basis include the following:

CDS premiums are above zero: the price of a CDS represents the premium paid by the protection buyer to the protection seller—in effect an insurance premium. As such it is always positive. Certain bonds rated AAA (such as US agency securities, World Bank bonds or German Pfandbriefe) frequently trade below LIBOR in the asset swap market; this reflects the market view of credit risk associated with these names as being very low and also above bank quality. However, a bank writing protection on such a bond will expect a premium (positive spread over LIBOR) for selling protection on the bond. This will lead to a positive basis.

Greater protection level of the CDS contract: CDSs are frequently required to pay out on credit events that are technical defaults, and not the full default that impacts a cash bondholder. Protection sellers therefore demand a premium for this additional risk that results in the CDS trading above the ASW spread.

Bond identity and the delivery option: many CDS contracts that are physically settled name a reference *entity* rather than a specific reference asset. On occurrence of a credit event, the protection buyer often has a choice of deliverable assets with which to effect settlement. The looser the definition of deliverable asset in the CDS contract documents, the larger the potential delivery basket: as long as the bond meets pre-specified requirements for seniority and maturity, it may be delivered. We can contrast this with the position of the bondholder in the cash market, who is aware of the exact issue that they are holding in the event of default. CDS protection sellers, on the other hand, may receive potentially any bond from the basket of deliverable instruments that rank *pari passu* with the cash asset—this is the delivery option afforded the CDS protection buyer.

In practice therefore, the protection buyer will deliver the *cheapest-to-deliver* bond from the delivery basket, exactly as it would for an exchange-traded futures contract. This delivery option has questionable value in theory, but significant value in practice. For example, the bonds of a specific obligor that might be trading cheaper in the market include:

- the bond with the lowest coupon;
- a convertible bond;
- an illiquid bond;
- an ABS bond compared to a conventional fixed-coupon bond;
- a very long-dated bond.

Following experience in the US market (see Tolk 2001), the US adopted 'modified restructuring' as one of the definitions of a credit event, which specifically restricts the delivery of long-dated bonds where restructuring is the credit event that triggers a contract payout. Nevertheless, the last named item is still relevant in the European market.

We can therefore see that the delivery option may carry value in the market. Similarly for an option contract, this value increases the closer the contract holder gets to the 'strike price', which for a CDS is a credit event. Market sentiment on the particular reference name drives the basis more or less positive, depending on how favourably the name is viewed. As the credit quality of the reference name worsens, protection sellers quote higher CDS premiums. The basis also widens as the probability of a credit event increases. This is illustrated at Figure 9.3, the basis graph for AT&T. In March 2002, the firm was rated A2/A. By October, the CDS spread had widened considerably, and similarly to other firms in its sector whose telecommunications customers had reduced expenditure, its rating had been downgraded to Baa2/BBB1. Where the opposite has occurred, and firms are upgraded as credit quality improves, the market has observed a narrowing basis.

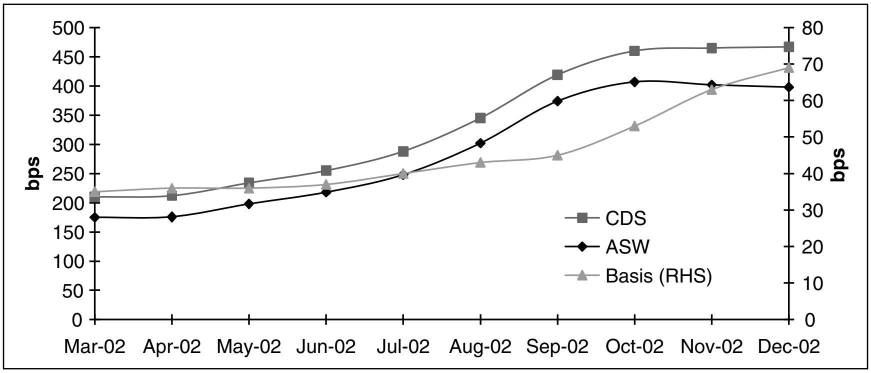

FIGURE 9.3 AT&T basis: increasing as perceived credit quality worsens.
Yield source: Bloomberg L.P.

As a consequence of all these factors, protection sellers demand a higher premium for taking on a long position synthetically, compared to a cash position.

Accrued coupon: this factor may be associated with cash- or physically-settled contracts. In certain cases, the reference bond accrued coupon is also delivered to the protection buyer in the event of default. This has the effect of driving the CDS premium (and hence the basis) higher.

Assets trading above or below par: unlike a long cash bond position, a CDS contract provides protection on the entire par value of the reference asset. On occurrence of a credit event, the CDS payout is par minus the recovery value (or minus the asset price at the time of default). If the asset is not trading at par, this payout will either over- or under-compensate the protection buyer, depending on whether the asset is trading at a premium or discount to par. Therefore if the bond is trading at a discount, the protection seller will experience a greater loss than that suffered by an investor who is holding the cash bond. For example, an investor who pays $90 per $100 nominal to buy a cash bond has less value at risk than an investor who has written CDS protection on the same bond. If the bond obligor defaults, and a recovery value for the bond is set at $30, the cash investor will have lost $60 while the CDS seller will have lost $70. As a result, the CDS price will trade at a higher level than the ASW price for the same asset where this is trading below par, leading to a larger basis.

The reverse applies for assets trading above par. If the reference asset is trading at a premium to par, the loss suffered by a CDS seller will be lower than that of the cash bondholder. This has the effect of driving the basis lower.

Funding versus LIBOR:[5] the funding cost of a bond plays a significant part in any trading strategy associated with it in the cash market. As such, it is a key driver of the ASW spread. A cash bond investor needs to fund the position, and we take the bond's repo rate as its funding rate.[6] The funding rate, or the bond's *cost-of-carry*, determines if it is worthwhile for the investor to buy and hold the bond. A CDS contract, however, is an unfunded credit derivative that assumes a LIBOR funding cost. Therefore an investor that has a funding cost of LIBOR plus 25 bps will view the following two investments as theoretically identical:

- buying a floating-rate note priced at par and paying LIBOR plus 125 bps;
- selling a CDS contract on the same FRN at a premium of 100 bps.

Therefore the funding cost in the market influences the basis. If it did not, the above two strategies would no longer be identical and arbitrage opportunities would result. Hence a LIBOR-plus funding cost will drive the basis higher. Equally, the reverse applies if the funding costs of an asset are below LIBOR (or if the investor can fund the asset at sub-LIBOR). This factor was discussed earlier.

Another factor to consider is the extent of any 'special-ness' in the repo market.[7] The borrowing rate for a cash bond in the repo market differs from LIBOR if the bond is to any extent *special*. This does not impact the default swap price, which is fixed at inception. This is more a market factor, however, which we consider in the next section.

Counterparty risk: the protection buyer in a CDS contract takes on the counterparty risk of the protection seller, which does not occur in the cash market. This exposure lasts for the life of the contract, and is significant if, on occurrence of a credit event, the protection seller is

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[5]It is a moot point if this is a technical factor or a market factor. *Funding risk* exists in the cash market, and does not exist in the CDS market—the risk that, having bought a bond for cash, the funding rate at which the cost of funds is renewed rises above the bond's cost-of-carry. This risk, if it is to be compensated in the cash (asset swap) market, demands a higher asset swap spread and hence drives the basis lower.

[6]This being market practice, even if the investor is a fund manager who has bought the bond outright as the bondholder, it can repo out the bond, for which it will pay the repo rate on the borrowed funds. Therefore the funding rate is always the bond's repo rate for purposes of analysis.

[7]If the repo rate for a specific bond is more than 25–30 bps lower than the 'general collateral' rate for that asset class's repo rate, it is deemed 'special'. The cost of funds payable by the holder of a special bond that is repo'ed out will be lower than LIBOR.

unable to fulfil its commitments. This feature has the effect of driving down the basis, because to offset against this risk, the buyer will look to a CDS premium that is *below* the cash asset swap spread. In addition, the protection buyer will wish to look for protection seller counterparties that have a low default correlation to the reference assets being protected, to further reduce counterparty risk exposure. For example, the counterparty risk exposure of a protection buyer in a CDS contract increases when the contract has been written by an investment bank on a bank that is also a CDS market-maker.

On the other hand, the protection seller is exposed to counterparty risk of the protection buyer. Should the latter default, the CDS contract will terminate. The protection seller will suffer a mark-to-market loss if the CDS premium has widened since trade inception.

Legal risk associated with CDS contract documentation: this risk has been highlighted in a number of high-profile cases, where a (unintended) broad definition of 'credit event' as stated in the contract documents has exposed the protection seller to unexpected risks. Typically this will be where a 'credit event' has been deemed to occur beyond what might be termed a default or technical default. This occurred, for example, with Conseco in the US, as first discussed in Tolk (2001).

Associated with legal risk is documentation risk, the general risk that credit events and other terms of trade, as defined in the CDS documentation, may be open to dispute or arguments over interpretation. We can expect documentation risk to decrease as legal documentation is standardised across a larger number of shares. The 2003 ISDA definitions also address this issue.

Market Factors

Market factors that influence the size and direction of the basis include the following:

Market demand: strong demand from protection buyers such as commercial banks protecting loan books, or insurance companies undertaking synthetic short selling trades, will drive the basis wider. Equally, strong market demand from protection sellers will drive the basis tighter.

Liquidity premium: the CDS for a particular reference asset may reflect a liquidity premium for that name. An investor seeking to gain exposure to that name can buy the bond in the cash market or sell protection on it in the CDS market. For illiquid maturities or terms, the protection seller may charge a premium. At the 2- to 5-year maturities, the CDS market is very liquid (as is the cash market). For some corporate names, however, cash market liquidity dries up towards the 10-year area. In addition, depending on the precise reference credit, the default swap may be more liquid than the cash bond, resulting in a lower default swap price, or less liquid than the bond, resulting in a higher price.

Liquidity in the cash market can be quite restricted for below investment-grade names, and secondary market trading is usually confined to 'current' issues. Similarly to the repo market, the relationship flows both ways and liquid names in the cash market are usually liquid names in the CDS market. However, for corporate names for which no bonds exist, CDS contracts are the only way for investors to gain an exposure (see below).

Relative liquidity is also related to the next item on our list.

Shortage of cash assets: in some markets it is easier to source a particular reference name or reference asset in the CDS market than in the cash market. This has always been the case in the loan market. While there has been a secondary market in loans in the US for some time, it is relatively illiquid in Europe. In the bond market, it can be difficult to short some corporate bonds due to problems in covering the position in repo, and also there is the risk that the bonds go special in repo. When cash assets are difficult to short, traders and speculators can buy protection in the CDS market. This does not involve any short covering or repo risk, and also fixes the cost of 'funding' (the CDS premium) at trade inception. The demand for undertaking this in CDS has a positive impact on the basis.

The structured finance market: the rapid growth of the market in synthetic collateralised debt obligations (CDO) has both arisen out of, and driven, the liquidity of the CDS market. These products are considered in detail in Goodman and Fabozzi (2002) and Choudhry (2002b). Synthetic CDOs use CDS contracts to source reference credits in the market and frequently make use of basket CDS and a portfolio of credits. As investment vehicles, they sell protection on reference names. The counterparty to the CDO vehicle will hedge out its exposure in the CDS market. Large demand in the CDS market, arising from hedging requirements of CDO counterparties, impacts the basis and frequently drives it lower.

New market issuance: the impact of new bond and loan issues on the CDS basis illustrates the rapid acceptance of this instrument in the market, and its high level of liquidity. Where previously market participants would hedge new issues using interest rate derivatives and/or government bonds, they now use CDS as a more exact hedge against credit risk. However, the impact on the basis flows both ways and may increase or decrease it, depending on specific factors. For example, new issues of corporate bonds enlarge the delivery basket for physically settled CDS contracts. This should widen the basis, but the cash market may also widen as well as investors move into the new bonds. For loans, a new issue by banks is often hedged in the CDS market, and this should cause the basis to widen. Convertible bond issuance also tends to widen the basis. We noted earlier the impact of the issue of an exchangeable bond by Fiat on the CDS basis for that name.

Cash market liquidity premium: one significant impact of the 2007–08 credit and liquidity crunch was the re-emphasis it placed on cash. In the wake of the crisis, the ability to raise actual cash carried it with a sizeable premium. This manifested itself in a large negative basis, as the cash bond was required to pay a higher return than the synthetic CDS instrument. Banks, which had suffered considerably when inter-bank liquidity dried up in the post-Lehman period, were observed to be trading at a large negative basis. Hence, we can conclude that cash funding, and the liquidity premium associated with it, drives the basis to negative territory.

The Basis 'Smile'

If plotted graphically, the CDS-cash basis tends to exhibit a 'smile'. This is illustrated in Figure 9.4 and is known as the *basis smile*. This reflects a number of the features we have discussed above. The main reasons for the smile effect is that highly rated reference names, such as AA or higher, fund in the asset swap market at sub-LIBOR. However, if an entity is buying protection on such a name, it will pay above LIBOR premiums. The basis therefore tends to increase with better quality names and results in the smile effect. Other factors that impact the smile are the cheapest-to-deliver option for lower rated credits.

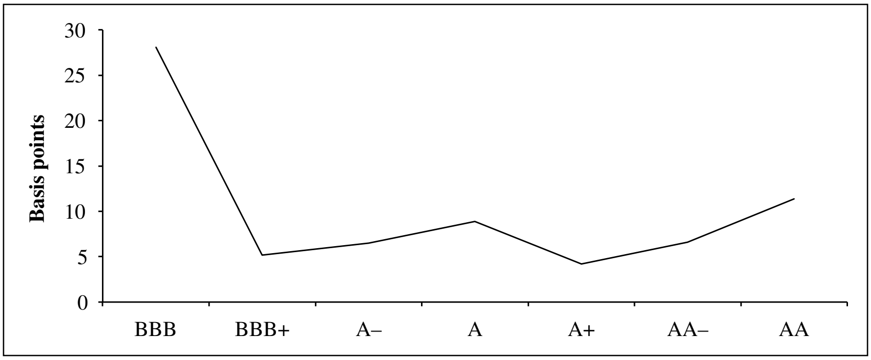

FIGURE 9.4 Basis smile for industrial names, November 2002.
Source: Author's notes.

THE DYNAMICS OF THE CDS BASIS

Positive and Negative Basis Situations

At any time, the CDS basis reflects the combined impact of all the above factors. Some of these will affect the basis with positive bias, whereas others will have a negative bias. Generally, technical and market factors that tend to drive the basis wider include:

- CDS premiums above zero;
- the delivery option;
- accrued coupon;
- bond price below par;
- funding below LIBOR;
- legal and documentation risk;
- market liquidity;
- new bond issuance;
- difficulty of shorting cash bonds.

The factors that tend to drive the basis lower include:

- counterparty risk;
- bonds priced above par;
- funding above LIBOR;
- impact of the structured finance market;
- cash market funding liquidity premium.

However, a reversal in market circumstances can lead to the same factor having a reverse impact. For instance, if a credit is viewed in the market as being of decreasing quality, factors such as the delivery option, bonds trading below par, difficulty in shorting the cash bond and worsening liquidity all push the basis wider. However, if the credit is viewed as improving in terms of quality, the impact of these factors diminishes (for example, the delivery option has decreasing value as the probability of a credit event occurring decreases).

Before the 2007–08 crash, the market norm was a positive basis, for all the reasons that we have discussed. While some of the factors above do influence the basis towards a negative value, observation tells us that the market norm is a positive basis. The combination of all the various factors tends to result in a negative basis usually only for reference names that are highly rated in terms of credit quality. This is because those factors that drive the basis lower carry greater influence for highly rated names. Specifically:

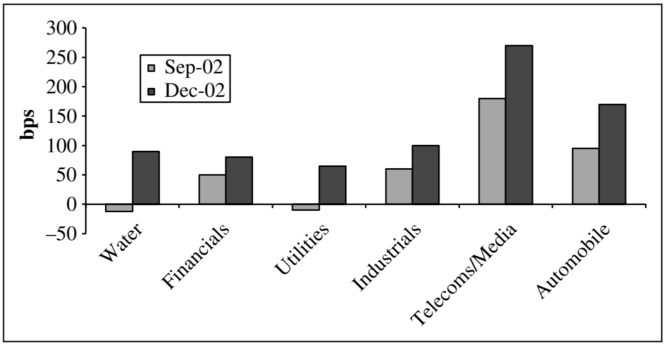

FIGURE 9.5 Basis values compared across sectors, September–December 2002.
Sources: Bloomberg L.P.; JPMorgan Chase Bank; Bank of America.

- the cash bond price is generally closer to par for high-quality credits;
- the value of the delivery option is less, as there is less chance of default or credit event for AAA and AA-rated names.

In addition, compared to sub-investment grade names, highly rated names are more often selected as reference credits in synthetic CDOs. All these factors combine to drive the basis lower for good-quality names, and this sometimes leads to negative values. Since the 2007–2008 financial crash though, a negative basis is much more common.

As well as being relatively uncommon, a negative basis was usually temporary. They usually reflected a particular set of circumstances, which disappeared over (short periods of) time. They also represented arbitrage opportunity for market participants that can trade across cash and synthetic markets, which returned the basis to positive territory as soon as it was exploited in the market. We illustrate the temporary nature of the negative basis during 2002 at Figure 9.5. This shows how the basis had reverted to positive for those sectors that had exhibited it, within three months.

Market Observation of the Basis Trend

To illustrate the interplay between cash and synthetic markets, and the influence of all the above factors acting together, we show at Figure 9.6 the ASW and CDS spreads (and the basis) for the JPMorgan Chase name from January 2007 to July 2009. This shows the asset swap level and the CDS basis trend during this period, with the overall basis staying positive on the whole, moving to negative following the sub-prime mortgage blowout in August 2007, and then occasionally back to positive, but moving to permanently negative following the Lehman's default in September 2008. The

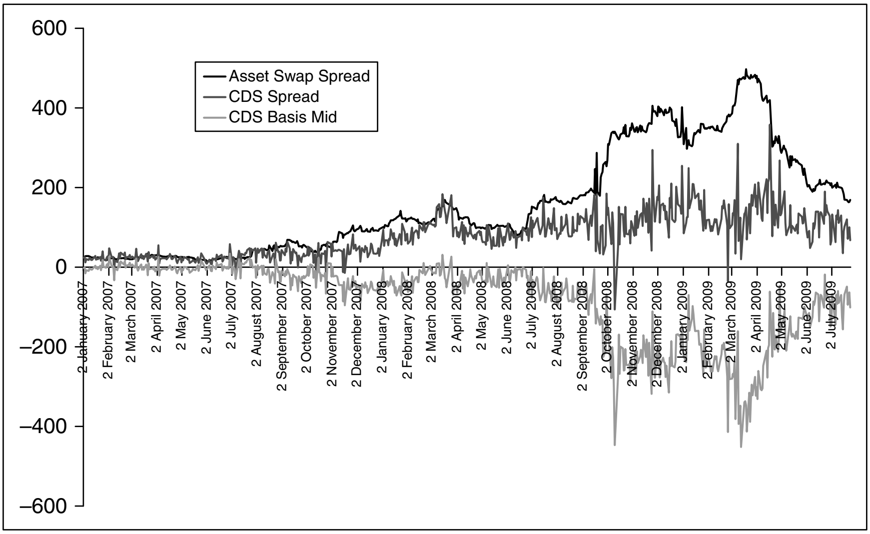

FIGURE 9.6 JPMorgan CDS, ASW and basis levels during 2007–2009.
Source: Bloomberg L.P.

basis remained negative from that point onwards up to July 2009, the last date on the graph.[8]

We conclude from this observation that:

- the overall credit default swap basis was positive during an overall period of market stability but following the Lehman collapse went to negative as cash market liquidity exerted a price premium;
- the CDS spread volatility at least matches that of the cash market, and sometimes exceeds it;
- at times the basis moved with the cash spread, but not to the same extent, thus widening as the cash spread widened;
- there is a high degree of correlation between the two markets, as we would expect;
- the basis often moves in the direction of the market; in other words, we observe that the basis widens as cash and synthetic spreads widen.

We conclude then that the basis acts much as the repo rate acts in the cash bond market. The relationship between special rates in repo and bond

[8]The specific bond used to measure the ASW level was the 5.125% of 2014, issued in September 2004.

prices moves both ways, and one can lead the other depending on circumstances (see Bank of England 1997). The CDS market has a two-way relationship with the cash asset swap market, and each will lead the other according to circumstance.

The Impact of the Basis on Trading Strategy

From the inception of trading in CDS, market participants have known that inefficiencies in pricing can result in arbitrage opportunities. Using CDS, the basic market neutral strategy (credit risk-free) is to buy the cash bond and swap it in the asset swap market, and buy protection using CDS. The trader receives the bond coupon as floating coupon, and pays the CDS premium. To match payment and receipt bases, the bond is a floating-rate bond with the coupon swapped out to fixed-rate.

The existence of the basis enables us to quantify the theoretical gain for the arbitrageur. As with other basis type trades, typified by the government bond basis, the existence of a non-zero basis implies a risk-free arbitrage opportunity. If the basis is non-zero, a trader can put on a credit risk-free arbitrage trade across the cash and synthetic markets. The two scenarios are:

- positive basis: sell the cash bond and sell protection on that bond;
- negative basis: buy the bond and buy protection using a CDS. In this trade, the investor has the value of the delivery option (we assume a physically settled CDS).

The first trade requires short-covering in the repo market, which exposes the investor to funding risks if the bond goes special. The latter trade is easier to implement as there are no short-cover issues to consider, but it must be funded on the balance sheet. Therefore, the investor's funding costs also impact the profitability of the trade. If it is sub-LIBOR, the trade looks attractive and the investor will profit by the amount of the basis. If the funding cost is above LIBOR, it must be below the negative basis value for the trade to work. However, because the basis trade for a negative basis is easier to implement, negative basis values rarely stay negative for long and revert to positive once arbitragers get to work.

The basis can also be used to identify ways to enhance portfolio returns for a fund manager that is able to switch from cash to synthetic markets and vice versa. As the basis moves, it indicates which sector is experiencing widening spreads into which fund managers can switch. Alternatively, a fund manager that has a view on which corporate sectors are likely to experience significant moves in the basis can move into that sector and undertake a basis trade to benefit from this move.

ANALYSING THE SPREAD MEASURE

A wide range of factors drive the basis, which were described in detail earlier in the chapter. The existence of a non-zero basis has implications for investment strategy. For instance, when the basis is negative investors may prefer to hold the cash bond, whereas if for liquidity, supply or other reasons the basis is positive the investor may wish to hold the asset synthetically, by selling protection using a credit default swap. This is most clearly demonstrated by the large negative basis in most names during 2008–2009, when cash traded at a premium over the synthetic.

Another approach is to arbitrage between the cash and synthetic markets, in the case of a negative basis by buying the cash bond and shorting it synthetically by buying protection in the CDS market. This is discussed in the next chapter. Investors have a range of spreads to use when performing their relative value analysis. An accurate measure of the basis is vital for an effective assessment of the relationship between the two markets to be made.

ASW Spread

The traditional method used to calculate the basis given by (9.0) earlier can be regarded as being of sufficient accuracy only if the following conditions are satisfied:

- the CDS and bond are of matching maturities;
- for many reference names, both instruments carry a similar level of subordination.

The conventional approach for analysing an asset swap uses the bond's yield-to-maturity (YTM) in calculating the spread. The assumptions implicit in the YTM calculation also make this spread problematic for relative analysis.

The most critical issue however, is the nature of the construction of the asset swap structure itself: the need for the cash bond price to be priced at or very near to par. Most corporate bonds trade significantly away from par, thus rendering the par asset swap price an inaccurate measure of their credit risk. The standard asset swap is constructed as a par product; hence if the bond being asset-swapped is trading above par then the swap price will overestimate the level of credit risk. If the bond is trading below par the asset swap will underestimate the credit risk associated with the bond. We see then that using the CDS–ASW method will provide an unreliable measure of the basis. We therefore need to use another methodology for measuring it.

Z-spread

A commonly used alternative to the ASW spread is the Z-spread. The Z-spread uses the zero-coupon yield curve to calculate spread, so in theory is a more effective spread to use. The zero-coupon curve used in the calculation is derived from the interest-rate swap curve. Put simply, the Z-spread is the basis point spread that would need to be added to the implied spot yield curve such that the discounted cash flows of the a bond are equal to its present value (its current market price). Each bond cashflow is discounted by the relevant spot rate for its maturity term. How does this differ from the conventional asset-swap spread? Essentially, in its use of zero-coupon rates when assigning a value to a bond. Each cashflow is discounted using its own particular zero-coupon rate. The price of a bond's price at any time can be taken to be the market's value of the bond's cashflows. Using the Z-spread we can quantify what the swap market thinks of this value, that is, by how much the conventional spread differs from the Z-spread. Both spreads can be viewed as the coupon of a swap market annuity of equivalent credit risk of the bond being valued.

The Z-spread was described in detail in Chapter 4.

In practice the Z-spread, especially for shorter-dated bonds and for higher credit-quality bonds, does not differ greatly from the conventional asset-swap spread. The Z-spread is usually the higher spread of the two, following the logic of spot rates, but not always. If it differs greatly, then the bond can be considered to be mis-priced.

Critique of the Z-spread

Although the Z-spread is an improved value to use when calculating the basis compared to the ASW spread, it is not a direct comparison with a CDS premium. This is because it does not allow for probability of default, or more specifically timing of default. The Z-spread uses the correct zero-coupon rates to discount each bond cashflow, but it does not reflect the fact that, as coupons are received over time, each cashflow will carry a different level of credit risk. In fact, each cashflow will represent different levels of credit risk.

Given that a corporate bond that pays a spread over Treasuries or LIBOR must, by definition, be assumed to carry credit risk, we need to incorporate a probability of default factor if we compare its value to that of the same-name CDS. If the bond defaults, investors expect to receive a proportion of their holding back; this amount is given by the recovery rate. If the probability of default is p, then investors will receive the recovery rate amount after default. Prior to this, they will receive $(1 - p)$. To gain an accurate measure of the basis therefore, we should incorporate this probability of default factor.

Adjusted Z-spread

For the most accurate measure of the basis when undertaking relative value strategy, investors should employ the adjusted Z-spread, sometimes known as the C-spread. With this methodology, cashflows are adjusted by their probability of being paid. Since the default probability will alter over time, a static value cannot be used so the calculation is done using a binomial approach, with the relevant default probability for each cashflow pay-date. An adjusted Z-spread can be calculated by either converting the bond price to a CDS-equivalent price, or converting a CDS spread to a bond-equivalent price. This is then subtracted from the CDS spread to give the adjusted basis.

ANALYSING THE BASIS

We wish to formulate a framework by which we can 'price' the basis, in effect a more effective method to analyse the basis beyond the first-generation principles outlined in the previous chapter. This requires that we understand the behaviour and characteristics of the CDS as a hedging instrument.

Simplified Approach

All else being equal, under (9.0) we would expect the basis to be negative, due to the financing costs associated with the cash bond position. In practice as we saw earlier in the chapter a wide range of technical and market factors drive the basis and it is not uncommon to observe a positive basis. When considering the basis, the coupon level on the cash bond is key to the analysis and also drives the basis. Bonds will trade above par when their coupon is high relative to current interest rates (given by swap rates); they trade below par when the opposite occurs. When above par, asset swap spreads should be expected to lie above CDS premiums and so drive the basis downwards, and vice-versa when the bond price is below par. In addition, the CDS exhibits convexity, since the profit & loss (P&L) on a CDS position does not move in direct proportion to the change in the credit spread. This is illustrated at Figure 9.7. Because this is not the case for asset swap values, especially at higher credit spreads, we take this into account when pricing the basis.

To value the basis then, we want to account for the instruments' convexity. We use the instruments duration in this analysis, a value required

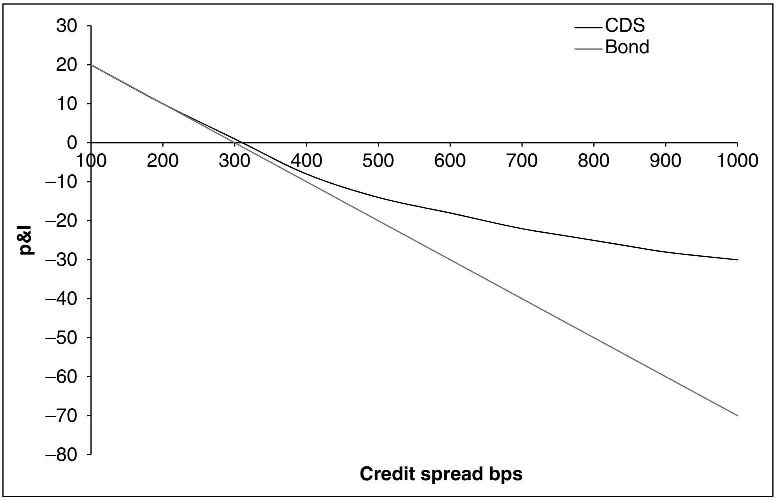

FIGURE 9.7 CDS convexity.

if calculating the position P&L. An effective approximation of CDS duration is given by:

$$D_{CDS} = \frac{1 - e^{-\left(rs + \frac{P_{CDS}}{LR}\right) \times M}}{rs + \frac{P_{CDS}}{LR}} \tag{9.1}$$

where

rs = swap rate
P_{CDS} = CDS margin
M = maturity (years)
LR = loss rate.

We noted there are two approaches to equate CDS premiums with bond prices. One approach is to value the bond using CDS reference prices. To do this we need to transform the latter into a synthetic bond, and then use this synthetic bond value to calculate the basis. This produces more of a 'like-for-like' spread that we can then compare to the cash spread.

We require therefore the asset swap spread, obtained from the CDS duration as follows:

$$ASW = CDS \times \frac{D_{CDS}}{D_{Swap}} + (C - rs) \times \left(1 - \frac{D_{CDS}}{D_{Swap}}\right) \tag{9.2}$$

where

$$CDS = \text{CDS spread}$$
$$C = \text{coupon.}$$

In other words, we can calculate the asset swap spread direct from the CDS of similar maturity. The simplified model shown above is straightforward to calculate and focuses on the two main factors that make basis calculation problematic: the convexity effects of CDS compared to bonds, and the coupon effects of bonds being priced away from par. With the former, as CDS spreads widen their duration decreases, so that bond spreads narrow relative to CDS spreads. With the latter, the higher the coupon relative to market rates (given by the swap rate for the same maturity), the wider will be the asset swap spread relative to CDS.

Unfortunately the simple model is not practical because coupons are not continuously compounded and so require adjustment. Also there is not always a bond and CDS of near similar maturities to use in comparison. We therefore adopt another approach.

Pricing the Basis

Given the shortcomings of the methods described up to now, we wish to apply a technique that enables us to calculate the basis more effectively, on a more 'like-for-like' level. Remember we have two sources of credit-risk pricing: the cash bond yield, and the CDS premium. When making the comparison between the two markets we need to adjust one before comparing to the other, hence the name 'adjusted basis' or 'adjusted Z-spread'. To calculate the basis then we can do one of the following:

- calculate the cash bond spread given by the CDS term structure; that is, price the bond according to the CDS curve, and compare this spread to the bond market spread; or
- calculate the CDS price given by the bond yield curve; that is, price the CDS on the bond curve and then compare it to the CDS market price.

In theory the basis should be the same whichever approach is used.

Either approach can be adopted in principle, although the first approach is more problematic because the bond price (yield) does not make explicit which term default probability it is that is being priced. Under the latter approach, we can use the CDS term structure to build a default probability curve. We look at both approaches in the next section; first, we examine the theoretical background.

General Pricing Framework

We need to set first the relationships for CDS and bond pricing. With a CDS, the contract is terminated on occurrence of a credit event, with settlement taking place upon payment of the accrued premium.

If

$$D(t) = \sum_i (T_i - T_{i-1}) \times P(T_i) \tag{9.3}$$

is the duration of an interest-rate swap of maturity t and T_i is the fixed-rate payment dates then we therefore write the duration of the CDS contract at the termination date as:

$$D_{\min}(t) = \sum_{(i)} (\min(t, T_i) - \min(t, T_{i-1})) \times P(t, T_i) \tag{9.4}$$

where

$P(t)$ is the price of a zero-coupon risk-free bond of maturity t
T is the maturity date of both CDS and cash bond.

The net present value (NPV) of the CDS fixed-rate premiums is given by

$$S(t)E\tau[D_{\min}(\tau)] = S(t) \times \left[\int_0^T D_{\min}(t)f_\tau(t)\mathrm{d}t + Q(\tau > T)D(T)\right] \tag{9.5}$$

where

$S(t)$ is the credit spread for contract of maturity t
τ is the date of the credit event
f_τ is the unconditional rate of default at any given time
E_τ is the expectations operator at the date of the credit event.

We assume that a credit event is a default and vice-versa. In fact the NPV is given by multiplying the CDS spread by the CDS duration D_{CDS}.

The NPV of the protection payment on occurrence of credit event, which we denote as the CDS floating-rate payment, is given by:

$$E_\tau\left[(1 - RR)P(\tau)_{\tau \le T}\right] = (1 - RR)\int_0^T P(t)f_\tau(t)\mathrm{d}t \tag{9.6}$$

where

RR is the recovery rate, usually assumed to be 40%.

Note that $RR = 1 - LR$ where LR is the loss rate.

For bond valuation we price the security as an asset-swap package. This is given by:

$$S(T)D_{ASW}(T) = \sum_i (T_i - T_{i-1}) \times C \times Q(\tau \le T_i)P(T_i) + Q(\tau \le T)P(T) - \int_0^T RR \times P(t)f_\tau(t)\mathrm{d}t \tag{9.7}$$

where

D_{ASW} is the duration of the interest-rate swap in an asset-swap package

C is the coupon of the fixed-rate bond in the asset-swap package

Q is the probability of survival.

To reiterate, we have two ways to compute the adjusted basis: we can price the CDS using the bond curve, or price the bond on the CDS curve.

If we wish to price the CDS on the bond curve, we use (9.6) above to obtain the probability density f_τ that gives us the correct market spreads for a set of asset swaps. We then use this density when calculating the CDS price using (9.7) above, which gives us a CDS spread based on the bond price. To price the bond on the CDS curve, we use the CDS price formula to find the probability density f_τ that gives us the correct market spreads for a set of CDS prices. We use this density in the bond price formula (9.7)x), which gives us a CDS-based bond asset-swap spread.

From the above it can be shown that

$$S_{ASW}(T)D(T) = (C - r) \times (D(T) - D_{CDS}(T)) + S_{CDS}(T)D_{CDS}(T) \tag{9.8}$$

where r is the swap rate corresponding to maturity date T.

The expression (9.8) above relates two significant factors driving the basis; namely:

- the coupon, or the change in asset swap spread given change in CDS spread, bond coupon and swap rate; and
- the convexity, a function of the difference between D_{CDS} and D_{ASW}.

In the next section we describe a practical market approach to calculating the adjusted basis.

ADJUSTED BASIS CALCULATION

We look now at pricing the CDS on the bond-equivalent convention; that is, converting the CDS price to a CDS-equivalent bond spread. This approach reduces uncertainty as there is a directly observable credit curve, the CDS curve, to which we can attach specific default probabilities. The CDS curve for a large number of reference names is liquid across the term structure from 1 through to 10, 15 and often 20 years. This is not the case with a corporate bond curve.[9]

The basis measure calculated using this method is known as the adjusted basis. It is given by:

$$\text{Adjusted basis} = \text{Adjusted CDS spread} - \text{Z-spread} \qquad (9.9)$$

The Z-spread is the same measure described in Chapter 4, above, that is, the actual Z-spread of the cash bond in question. Instead of comparing it to a market CDS premium though, we compare it to the CDS-equivalent spread of the traded bond. The adjusted CDS spread is known as the adjusted Z-spread, CDS spread or c-spread. The adjusted basis is the difference between these two spreads.

The adjusted CDS spread is calculated by applying CDS market default probabilities to the cash bond in question. In other words, it gives a hypothetical price for the actual bond. This price is not related to the actual market price but should, unless the latter is significantly mis-priced, be close to it. It is a function of the default probabilities implied by the CDS curve, the assumed recovery rate and the bonds cashflows. Once calculated, the adjusted CDS spread is used to obtain the basis.

To calculate the adjusted CDS spread we carry out the following:

- plot a term structure of credit rates using CDS quotes from the market. The quotes will all be single-name CDS prices for the reference credit in question. For the greatest accuracy we use as many CDS prices as possible (from the six-month to the 20-year maturity, at six-month intervals where possible), although the number of quotes will depend on the liquidity of the name;
- from the credit curve we derive a cumulative default probability curve. This is used together with the value for the recovery rate to construct a survival curve by bootstrapping default probabilities;
- the survival curve is used to price the bond in line with a binomial tree model. This is shown at Figure 9.8, where we see that the bond's cash

[9]Unless the corporate issuer in question has a continuous debt programme that means it has issued bonds at regular (say six month) intervals across the entire term structure.

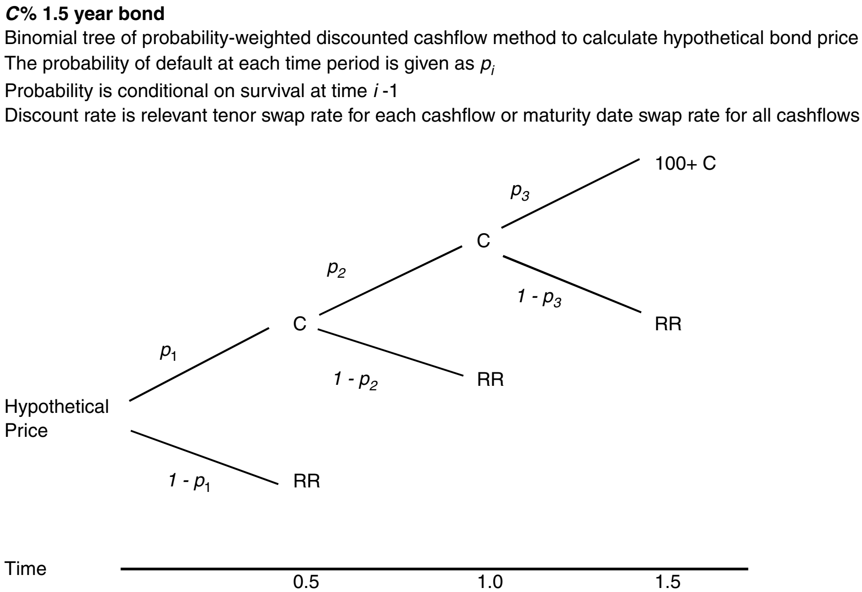

FIGURE 9.8 Calculating the bond hypothetical price using implied default probabilities.

flow of coupon and principal follows a binomial path of payment if no default or payment of recovery amount *RR* in event of default. Each cashflow is discounted at the swap rate relevant to that term; the discounting is weighted according to the relevant term default probability. The sum of these probability-weighted discounted cashflows is the bond's hypothetical price. It represents the price of the CDS if it traded as a bond, in effect the price of a credit-linked note or funded CDS. For simplicity the cash flow at each payment date can be discounted at a single market rate such as the swap rate or LIBOR rate as well. The aggregate of these cash flows, the hypothetical bond price, will differ from the observed market price;

- the adjusted CDS spread is the spread above (or below) the swap curve that equates the bond's observed market price to its hypothetical price calculated above.

The adjusted CDS spread can be viewed as the Z-spread of the bond at its hypothetical price. Comparing it to the actual Z-spread then gives us a like-for-like comparison and a more robust measure of the basis.

In other words, we produce an adjusted Z-spread based on CDS prices and compare it to the Z-spread of the bond at its actual market price. We have still compared the synthetic asset price to the cash asset price, as given originally in (9.0), but the comparison is now a logical one.

The alternative approach we suggested earlier of adjusting a bond spread into an equivalent CDS spread can also be followed but suffers from a paucity of observable market data. We would need a sufficient number of bonds with maturities from the short- to the long-end of the curve, and this is only available from large issuers with continuous programmes such as Ford. On the other hand, as we noted earlier the CDS market can be used to plot a credit curve for many more reference names out to the 20-year end of the curve or even beyond.

Illustration

We illustrate the technique with an example using a hypothetical corporate bond, the ABC plc 6% of 2008. This is shown at Figure 9.9. We set it so that the ABC plc bond has exactly three years to maturity, and we discount the cash flows using only the three-year rate, rather than each cash flow at its own specific term discount rate. This is just to simplify the calculation. If we have fractions in the remaining time to maturity we use the exact time period (in years) to adjust the default probabilities.

The market price of the bond is \$102.47. The hypothetical price is \$101.87. The Z-spread of the bond at its market price is 14 basis points. To calculate the adjusted Z-spread we apply the process we described in Chapter 4 earlier; this gives us an adjusted Z-spread or hypothetical price Z-spread of 19.9 basis points. This is near to the CDS spread of 21 basis points.

The adjusted basis is therefore:

$$\text{adjusted Z-spread} - \text{Z-spread}$$

which is $19.9 - 14$ or 5.9 basis points. Compare this to the conventional basis which is:

$$\text{CDS price} - \text{ASW spread}$$

which is $21 - 23.12$ or -2.12 basis points.

So the true basis is, in this example, not negative but positive. Further analysis of the kind we have undertaken would have argued against a basis trade that might have looked attractive due to the negative basis indicating potential value.

ABC plc	
6% Nov 2008 bond	USD bond
Price	102.47
8 November 2005	
Hypothetical price	The price obtained using default probabilities implied by CDS prices Given by:- (1) multiplying each bond cash flow by the probability of receiving that cash flow (2) Discounting each cash flow by the relevant swap curve discount factor to obtain present value (3) Aggregating discounted cash flows
ABC plc CDS prices	Mid-prices general screen quote
Term	1 3 5 10
Spread bps	12 21 30 41
	Mid-prices specific quotes
	0.5 1 1.5 2 2.5 3
	5 12 14 17 19 21
Default probability relationship	
CDS spread	= Default probability × (1 − RR) OR Default probability × LR
Default probability	= CDS spread/LR = 0.0021/0.6 = 0.0035
Date of cash flow	8-Nov-08
Maturity	3 years
Cash flows	0.5 1 1.5 2 2.5 3
	3 3 3 3 3 103 = 118
Default probability	0.0035
Survival probability	1 − Default probability = 0.9965
Loss rate	1 − RR = 60%
Swap rate	4.90
Discount factor	= 1/(1 + 3yr swap rate)^3 0.86631041
Hypothetical price	[Bond cash flow × Survival probability + RR × Default probability] × Discount factor **101.8680556**

FIGURE 9.9 Illustrating the hypothetical bond price calculation based on CDS-implied default probability.

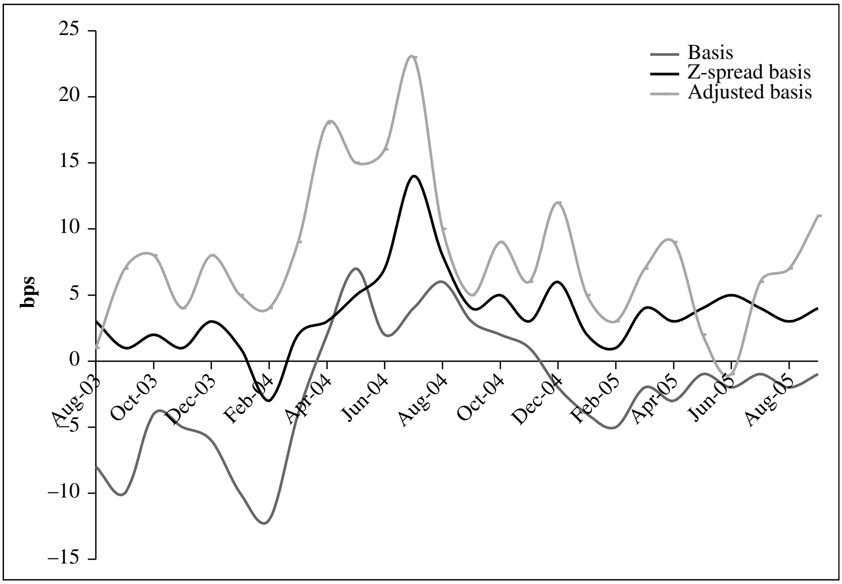

FIGURE 9.10 Selected telecoms corporate name, cash-CDS basis 2003–2005.
Yield source: Bloomberg. Calculation: Author.

Market Observation

The foregoing highlights some of the issues involved in measuring the basis. Irrespective of the calculation method employed, the one certainty is that corporate names in cash and synthetic markets do trade out of line; the basis is driven across positive and negative ranges due to the impact of a diverse range of technical, structural and market factors (see Chapter 8). Of course, any basis value that is not zero implies potential value in arbitrage trades in that reference name, be it buying or selling the basis.

The conventional situation is a positive basis, as a negative basis implies a risk-free arbitrage profit is available. Market observation suggests that a negative basis is more common than might be expected however. Figure 9.10 shows the basis—measured in each of the three ways we have highlighted—for a selected corporate name in the telecoms sector for the period August 2003 to September 2005. There is occasional relatively wide divergence between the measures, but all measures show the move from positive to negative territory and then back again.

THE iTRAXX INDEX BASIS[10]

The iTraxx and CD-X indices have developed into a reasonably liquid set of CDS contracts and as such are viewed as a key credit market indicator by investors. As a market benchmark, they can be taken to represent the market as a whole, similar to an equity index, and as such can provide a guide to the health of the credit market as well as imply market perception of future direction. Because there is an intrinsic 'fair value' implied for the index, which differs from the actual market level at any time, there is also a CDS index basis that can be observed. Assessing this basis therefore is an important part of investor's relative value analysis of the market.

A CDS index basis arises because of the different approaches available to valuing the index spread[11]. We can describe the following:

- Theoretical spread: this is the average of the single-name CDS spreads for all the constituent names in the index, weighted by probability of default.[12] It is also known as the *fair spread*.
- Market spread: this is the spread quoted for trading in the market. It is based on the theoretical spread, but adjusted using a flat credit curve. It is also known as the *intrinsic spread* or the *real spread*.

There is also the *average spread*, which is simply the average of all the constituent name CDS spreads equally weighted.

The index basis is given by:

$$\text{Basis} = \text{Market spread} - \text{Theoretical spread}.$$

From a relative value analysis point of view we require a tractable means of calculating the two spreads or at least of measuring the basis. This is considered next.

The Index Spread

The theoretical spread is sometimes defined as the average spread, but this is not correct because it does not weight the constituent names'

[10]The author would like to thank Suraj Gohil at KBC Financial Products for his invaluable assistance with this section. Any errors remain the sole responsibility of the author.

[11]One is reminded again that a more accurate term for 'spread' with respect to credit derivative prices is 'premium', particularly with respect to CDS prices, as the spread is not a spread over anything. However, the term is in common usage in the market.

[12]Probability of default (PD) = Spread / $(1 - R)$ where R is the recovery rate.

probability of default. In fact the theoretical spread will differ from the average spread because of the nature of the construction of the index: an investor will receive the same spread for all reference names, whereas the average CDS spread of the constituent names will be different from this fixed spread.

Instead we define the theoretical spread for a CDS written on the index as the spread that equates the net present value of the swap to zero. The expression for the spread is derived from the expression for the net present value of the CDS. The latter assumes—exactly for an interest rate swap—that the premium leg of the CDS is equal to the default leg. This is written as:

$$Index_{NPV} = S_{Index}\frac{1}{N}\sum_{i=1}^{N} CS01_i - \frac{1}{N}\sum_{i=1}^{N} S_i CS01_i \tag{9.10}$$

where

S_{Index} is the index theoretical spread
S_i is the spread of CDS_i
$CS01_i$ is the credit risk exposure of CDS_i.

Note that $CS01$ is also referred to as risky-DV01, risky-PV01 or risky-PVBP. It is defined as the change in market value of a CDS contract for a 1 bp change in the CDS premium.[13] The expression for the $CS01$ is given in the box.

Given (9.10) the expression for the index theoretical spread can be written as:

$$S_{Index} = \frac{\sum_{i=1}^{N} S_i CS01_i}{\sum_{i=1}^{N} CS01_i}. \tag{9.11}$$

In general, the theoretical spread lies below the index pure average spread.

The market or real spread differs from the spread given by (9.2). The difference arises because market convention is to value the index CDS using a flat credit curve.[14] So we describe the market spread as that spread that makes the net present value for the contract, assuming a flat

[13]Strictly speaking we define it as the change in contract market value for a 1 bp parallel shift in the credit curve. As with a bond instrument DV01, this is often taken as representing a change in market value for a 1 bp change in yield (bond) or CDS premium (CDS).
[14]This is also the methodology employed by the CDSW screen on Bloomberg.

credit curve, equate to the net present value given by (9.2) above. So formally for S_{Market} we write:

$$(F - S_{Market})CS01_{Flat} = (F - S_{Index})\sum_{i=1}^{N} CS01_i \tag{9.12}$$

where

$$S_{Index} = \frac{\sum_{i=1}^{N} S_i CS01_i}{\sum_{i=1}^{N} CS01_i}$$

F is the index fixed premium
$CS01_{Flat}$ is the $CS01$ calculated using a flat credit curve
$CS01_i$ is the $CS01$ of CDS_i calculated using the credit risky curve for reference entity i.

In practice the difference between the index theoretical spread and the market spread is not great, except for indices composed of high-volatility names. From the expressions above we can see that a key driver of the spread difference is the steepness of the credit risky curves for each constituent name; the steeper the curve(s), the greater the difference between the two spreads. At any CDS spread level, a flatter credit-risky curve means a lower $CS01$.

The level of the index fixed premium also influences the difference: if the fixed premium lies above the theoretical spread, the market spread will be lower than the theoretical spread, and vice-versa. This is because of the impact of the change in the market spread on the flat curve $CS01$, with increases in the spread reducing the $CS01$.

Market Observation

In practice the basis in index CDS is small, with exceptions being observed for high-volatility indices. We consider the June 2011 iTraxx investment-grade Europe index (series 5), which commenced trading in March 2006 as the 5-year benchmark. Figure 9.11 shows the levels for the market and theoretical spreads for this index during March 2006–June 2006, while Figure 9.12 shows the basis. We observe that the basis fluctuates from negative to positive and back, although the absolute values are small.

CDS MARK-TO-MARKET RISK EXPOSURE

In Chapter 7 we described the approach to pricing a CDS contract. In essence the CDS spread premium is that value that equates the net present value of the contract to zero, given our assumption that under no-arbitrage principles the fixed (premium) leg of the swap must equal the floating (default) leg. Therefore we may write:

$$(1 - R)\sum_{k=1}^{K} DF_k PD_k = S\frac{1}{M}\sum_{k=1}^{K} DF_k(1 - PD_k) \qquad (9.13)$$

where

R	is the recovery rate
DF_k	is the discount factor at time k
PD_k	is the probability of default at time k
S	is the CDS fixed spread (premium)
M	is the CDS premium payment frequency.

Note that $(1 - PD_k)$ is the probability of survival to time k, which is given by the expression shown, although in certain texts it is written out as a separate expression.[15]

From (9.13) we can derive an expression for the CDS $CS01$, which is the main CDS risk exposure measure. $CS01$ is the change in market value of a CDS for a 1 bp change in the CDS spread, and is usually given by:

$$CS01 = \frac{1}{M}\sum_{k=1}^{K} DF_k PS_k.$$

The expression for PS_k is derived in footnote 15 below. Some market practitioners refer to 'risky DV01' as the change in CDS value for a 1 bp parallel shift in the CDS credit risky curve.

[15] We would write $(1 - PD_k) = PS_k$ where PS_k is the survival probability to time k. It is given by

$$PS_k = e^{-\sum_{k=1}^{K} \lambda_k (t_k - t_{k-1})}$$

where

PS_k	is the survival probability at time t_k
λ_k	is the default intensity between time $t_{k\text{-}1}$ and time t_k, obtained by backing out default probabilities from the market-observed CDS curve.

FIGURE 9.11 iTraxx IG Europe index CDS theoretical and market spreads, March–June 2006.
Source: KBC Financial Products.

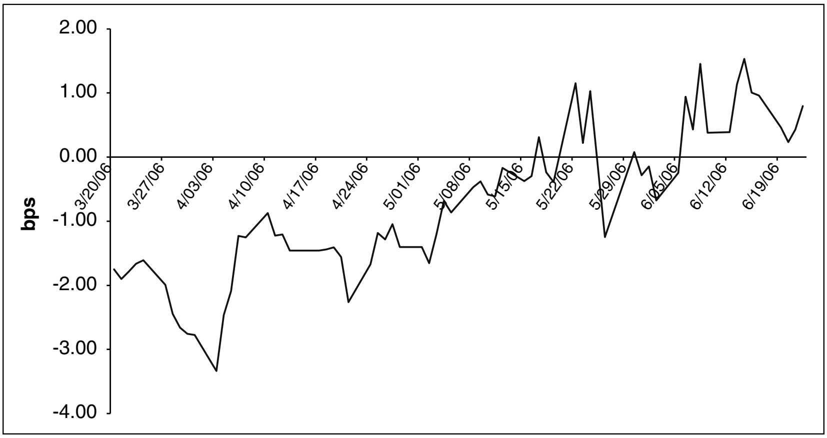

FIGURE 9.12 iTraxx IG Europe index CDS basis, Mar–Jun 2006.
Source: KBC Financial Products.

Irrespective of its absolute value, observing the basis enables investors to gauge perceived fair value for the index. By comparing the market spread against the theoretical spread we can assess whether the index is trading at fair value or not. For instance, during June 2005 the iTraxx Europe Crossover 5-year index was observed with a basis of around 13 bps, which

TABLE 9.3 Index CDS basis for selected indices, June 2006.

	Basis points				
Index	Average spread	Market spread	Theoretical spread	Average spread basis	Theoretical spread basis
iTraxx IG Europe 5-year	44	43	44	−1	−1
iTraxx IG Europe High Vol. 5-year	81	83	81	+2	+2
iTraxx Cross-over Europe 5-year	349	350	337	+1	+13
CDX NA IG 5-year	63	59	61	−4	−2
CDX NA IG High Vol. 5-year	139	133	133	−6	0

Source: MarkIt.

suggested mis-pricing of the index fair value. For comparison we show the basis values for other indices at the same time in Table 9.3, with data reported by MarkIt partners.

MARKET PICTURE POST-CREDIT CRUNCH

Table 9.4 on page 328 shows the range of negative and positive basis values that were observed for a selection of reference names in December 2008. The most notable feature is the high negative basis for bank names, which were viewed with extreme negative sentiment at this time by investors following the collapse of Lehman, and nationalisation of AIG, in September of that year. The sole exception is HSBC, viewed as one of the few banks that had weathered the financial crisis and emerged in still reasonable shape. Its name was still trading at a positive basis.

A number of factors had pushed the basis to previously unseen negative levels around this time, including:

- the premium attached to actual cash, as opposed to synthetic, investment;
- risk reduction by market makers;
- tighter funding conditions for leveraged investors;
- counterparty risk fears.

TABLE 9.4 Basis values for selected corporate names, December 2008.

12/11/2008		Source: iBoxx mid (bonds), MarkIt mid (CDS)			CDS is matched to the exact maturity (or next call) of bond			
Entity name	**Coupon**	**Maturity**	**Currency**	**Sector**	**CDS currency**	**Asset swap spread**	**CDS price**	**Basis**
AIG	5.625	3/29/2010	GBP	Financial Services	USD	4532.7	1477.7	**–3055.0**
CITIBANK	4.25	9/22/2011	EUR	Financial Services	USD	1749.7	1188.8	**–560.9**
DELH	5.625	6/27/2014	EUR	Retail	USD	598.8	128.1	**–470.7**
BBVASM	4.799	5/17/2012	EUR	Banks	EUR	561.4	135.1	**–426.3**
BAC	5.125	2/17/2011	GBP	Financial Services	USD	560.8	140.7	**–420.1**
IMTLN (subordinated)	7.25	9/15/2014	EUR	Personal & Household Goods	EUR	537.5	123.5	**–414.0**
AIG	4	9/20/2011	EUR	Insurance	USD	1535.3	1132.3	**–403.0**
BRADBINGLEY	5.625	2/2/2013	GBP	Banks	EUR	854.9	454.0	**–400.9**
NATIONWIDE	3.375	8/17/2010	EUR	Banks	EUR	583.6	202.8	**–380.8**
IMTLN	4.375	11/22/2013	EUR	Personal & Household Goods	EUR	493.8	125.0	**–368.8**
HBOS	10.5	2/16/2018	GBP	Banks	EUR	515.9	153.6	**–362.3**

BAC (subordinated)	4	3/28/2013	EUR	Banks	USD	576.3	217.4	**–358.9**
CMZB	5.625	11/29/2012	EUR	Banks	EUR	515.9	164.9	**–351.0**
FO	4	1/30/2013	EUR	Personal & Household Goods	USD	563.4	223.4	**–340.0**
MONTE	4.5	9/24/2010	EUR	Banks	EUR	469.1	129.9	**–339.3**
CMZB	4.125	9/13/2011	EUR	Banks	EUR	500.6	164.6	**–336.0**
MER	6.75	5/21/2013	EUR	Banks	USD	515.4	186.7	**–328.7**
MER	4.625	9/14/2018	EUR	Banks	USD	520.6	194.0	**–326.7**
HBOS	11	1/17/2014	GBP	Banks	EUR	484.6	158.1	**–326.5**
BAC	4.75	5/6/2014	EUR	Banks	USD	551.3	226.3	**–325.0**
MER	6	2/11/2013	EUR	Banks	USD	505.4	187.2	**–318.3**
AIG	4.125	11/29/2013	EUR	Financial Services	USD	1296.9	981.6	**–315.3**
JPMORGAN	4.625	5/29/2012	EUR	Banks	USD	491.1	175.9	**–315.2**
RBOS	4.5	1/28/2011	EUR	Banks	EUR	517.2	205.2	**–312.0**
FIAT	6.625	2/15/2013	EUR	Automobiles & Parts	EUR	1099.9	1087.7	**–12.2**
EDNIM	5.125	12/10/2010	EUR	Utilities	EUR	184.4	172.3	**–12.1**

(continued)

TABLE 9.4 Continued

12/11/2008		Source: iBoxx mid (bonds), MarkIt mid (CDS)			CDS is matched to the exact maturity (or next call) of bond			
Entity name	**Coupon**	**Maturity**	**Currency**	**Sector**	**CDS currency**	**Asset swap spread**	**CDS price**	**Basis**
FRTELECOM	3	10/14/2010	EUR	Telecommunications	EUR	131.1	119.5	**–11.6**
ELEPOR	5.875	3/28/2011	EUR	Utilities	EUR	165.6	155.0	**–10.6**
BNFP	5.25	5/6/2011	EUR	Food & Beverage	EUR	144.9	135.2	**–9.7**
DPW	5.125	10/4/2012	EUR	Industrial Goods & Services	EUR	117.1	107.8	**–9.3**
WMT	4.75	1/29/2013	GBP	Retail	USD	117.6	108.3	**–9.2**
IBM	4	11/11/2011	EUR	Technology	USD	124.4	115.3	**–9.1**
HVB	5.625	1/15/2010	EUR	Banks	EUR	103.0	104.0	**1.0**
FORTIS	4.375	2/1/2017	EUR	Banks	EUR	143.0	144.2	**1.1**
ENIIM	4.75	11/14/2017	EUR	Oil & Gas	EUR	117.7	119.6	**1.9**
IBESM	5.125	5/9/2013	EUR	Utilities	EUR	219.1	221.9	**2.7**
LXSGR	4.125	6/21/2012	EUR	Chemicals	EUR	366.7	369.9	**3.2**
BMW	6.375	6/28/2010	GBP	Automobiles & Parts	EUR	509.9	513.6	**3.6**

BACRED	4.875	12/20/2012	EUR	Banks	EUR	146.5	150.6	**4.1**
RENAUL	5.25	5/27/2011	EUR	Automobiles & Parts	EUR	518.6	523.6	**5.1**
EDF	4.125	9/27/2016	EUR	Utilities	EUR	137.6	142.9	**5.3**
IBESM	4.875	2/18/2013	EUR	Utilities	EUR	218.6	224.2	**5.6**
NGGLN	6.125	8/23/2011	EUR	Utilities	EUR	258.9	265.1	**6.2**
DB	5.5	5/18/2011	EUR	Banks	EUR	122.0	129.5	**7.5**
BERTEL	3.625	10/6/2015	EUR	Media	EUR	268.5	276.5	**8.0**
TITIM	4.75	5/19/2014	EUR	Telecommunications	EUR	412.9	421.4	**8.4**
EOANGR	5.125	5/7/2013	EUR	Utilities	EUR	114.2	122.6	**8.4**
EDF	5.125	9/12/2018	EUR	Utilities	EUR	130.5	139.1	**8.6**
AUTSTR	5	6/9/2014	EUR	Industrial Goods & Services	EUR	242.3	251.3	**9.0**
VW	4.875	10/18/2012	EUR	Automobiles & Parts	EUR	307.0	319.1	**12.1**
AZN	5.125	1/15/2015	EUR	Health Care	EUR	169.2	182.3	**13.1**
DOW	4.625	5/27/2011	EUR	Chemicals	USD	279.1	293.8	**14.7**
BOUY	4.625	2/25/2011	EUR	Construction & Materials	EUR	253.7	269.0	**15.3**

(continued)

TABLE 9.4 Continued

12/11/2008		Source: iBoxx mid (bonds), MarkIt mid (CDS)			CDS is matched to the exact maturity (or next call) of bond			
Entity name	Coupon	Maturity	Currency	Sector	CDS currency	Asset swap spread	CDS price	Basis
SLMA	3.125	9/17/2012	EUR	Financial Services	USD	930.6	946.7	**16.1**
SANFP	5.5	1/18/2010	GBP	Health Care	EUR	131.9	148.1	**16.2**
SYNNVX	4.125	9/21/2011	EUR	Chemicals	EUR	112.3	130.0	**17.7**
VATFAL	6	3/31/2010	EUR	Utilities	EUR	71.5	89.8	**18.3**
DT	3.25	1/19/2010	EUR	Telecommunications	EUR	140.4	159.3	**18.9**
DAIGR	6.125	9/8/2015	EUR	Automobiles & Parts	EUR	414.7	433.7	**19.0**
IBESM	6.625	1/14/2010	GBP	Utilities	EUR	222.3	241.3	**19.1**
NGGLN	6	6/7/2017	GBP	Utilities	EUR	213.2	232.7	**19.5**
SGOFP	4.75	4/11/2017	EUR	Construction & Materials	EUR	446.3	466.4	**20.1**
MOET	4.625	7/1/2011	EUR	Personal & Household Goods	EUR	168.9	189.4	**20.5**
EOANGR	5.125	10/2/2012	EUR	Utilities	EUR	107.0	127.7	**20.7**
IBESM	4.375	10/29/2010	EUR	Utilities	EUR	216.1	237.0	**20.9**

TOMKLN	6.125	9/16/2015	GBP	Industrial Goods & Services	EUR	674.8	696.6	**21.8**
CIT	4.25	3/17/2015	EUR	Financial Services	USD	916.5	939.4	**22.9**
EDF	4.875	5/6/2015	EUR	Utilities	EUR	122.2	145.5	**23.3**
IBM	3	2/8/2010	EUR	Technology	USD	76.8	100.5	**23.7**
AEGON	4.125	12/8/2014	EUR	Insurance	EUR	371.7	395.5	**23.7**
EDF	5.5	10/25/2016	EUR	Utilities	EUR	117.9	142.7	**24.8**
BPLN	4.5	11/8/2012	EUR	Oil & Gas	EUR	67.9	93.3	**25.3**
BPLN	5.75	11/8/2010	GBP	Oil & Gas	EUR	80.6	106.8	**26.2**
EDF	5.625	1/23/2013	EUR	Utilities	EUR	127.4	154.3	**26.8**
HSBC	7	10/5/2015	GBP	Banks	USD	276.4	572.4	**296.0**
LGFP	6.125	5/28/2015	EUR	Construction & Materials	EUR	619.2	919.8	**300.6**
HSBC	4.875	5/30/2017	EUR	Banks	USD	241.9	543.6	**301.7**
GE	3.375	2/8/2012	EUR	Financial Services	USD	217.5	523.1	**305.6**
BXTN	5.25	10/21/2015	GBP	Financial Services	EUR	623.0	934.0	**311.1**
LGFP	6.875	11/6/2012	GBP	Construction & Materials	EUR	695.0	1008.0	**312.9**
ASML	5.75	6/13/2017	EUR	Technology	EUR	615.3	931.0	**315.7**

(*continued*)

TABLE 9.4 Continued

12/11/2008		Source: iBoxx mid (bonds), MarkIt mid (CDS)			CDS is matched to the exact maturity (or next call) of bond			
Entity name	**Coupon**	**Maturity**	**Currency**	**Sector**	**CDS currency**	**Asset swap spread**	**CDS price**	**Basis**
AIG	5.375	12/7/2009	GBP	Insurance	USD	1323.1	1639.3	**316.2**
GE	5.75	9/23/2011	EUR	Financial Services	USD	211.3	532.5	**321.2**
GE (subordinated)	4.625	8/23/2010	EUR	Financial Services	USD	233.5	557.4	**323.9**
GE (subordinated)	4.375	3/30/2011	EUR	Financial Services	USD	217.8	543.1	**325.3**

Sources: HSBC, Bloomberg L.P., MarkIt, iBoxx

In addition, the market expected that banks would soon be issuing large amounts of new debt, at historically high spreads, in the near future. In essence, the main factor was liquidity, which had dried up in the inter-bank market since the collapse of Lehman. Hence, the basis incorporated a significant liquidity premium. In short—cash is king in a recessionary environment.

CONCLUSION

From this study of the CDS basis we can conclude that the CDS market is very liquid and very closely correlated to the movements of the cash bond market. Although the theoretical argument can be made, using the no-arbitrage principal, that the CDS premium must equal the asset swap premium, market observation tells us that a non-zero CDS bond basis always exists between the CDS and asset swap markets. A non-zero basis arises from the influence of a number of technical and market factors, the impact of which varies with market conditions.

The basis moves closely with the markets as a whole. The relationship between the synthetic and cash markets, which is measured by the basis, is a two-way one, and the synthetic market will often lead the cash market. This experience, which mirrors the relationship in the interest rate market between cash bonds and interest rate derivatives, is a clear indicator of the liquid market that now prevails in CDS.

EXAMPLE 9.1 SAMPLE CREDIT DERIVATIVE PROBLEMS AND ANSWERS[16]

Credit Derivatives

1. What are the cash market constituents of debt capital? How do credit derivatives allow for the unbundling of these constituents?
2. What instruments can a commercial bank use to hedge the credit risk exposure associated with a pool of corporate loans?

(*continued*)

[16]This is reproduced from the author's notes given as part of his lectures in the Certificate of Quantitative Finance (CQF) programme run by Dr. Paul Wilmott, with permission of 7city learning.

What advantages are there from using credit derivatives to hedge such risk?

3. For pure hedging purposes, which is the more appropriate instrument to use, a credit default swap (CDS) or total return swap (TRS)? How can a TRS be used to facilitate funding of a bond market-making book?
4. Consider the following corporate (financials) CDS premiums taken from page WCDS on Bloomberg on 20 April 2008.

Reference name	Fitch rating	Spread
ABN Amro	AA–	67.00
Abbey National plc	AA–	70.00
Alliance & Leicester plc	A+	267.50
Banca Monte dei Paschi di Siena SpA	A+	62.50
Banco Popolare SC	A	90.00

   a. For hedging purposes, suggest why one might use a portfolio CDS product as opposed to using single-name CDS for each name in the above basket.
   b. Relative to the single-name prices above, where do you expect a basket CDS to trade? (Assume the notional amount of each reference name is the same).
   c. How does the *n*th-to-default CDS differ in its mechanics from the basket CDS? Where should the *n*th-to-default price trade relative to the basket CDS price? Why? Are there any applications where a first- or *n*th-to-default portfolio CDS of the above names might be used rather than a basket CDS?
   d. Why do you think the Alliance & Leicester name is trading at such a premium over names of equivalent or lower rating?
5. What is the 'NOP' with regard to a CDS contract? Describe its mechanics.

Answers

1. The diagram below shows the cash market constituents, and how they can be unbundled.

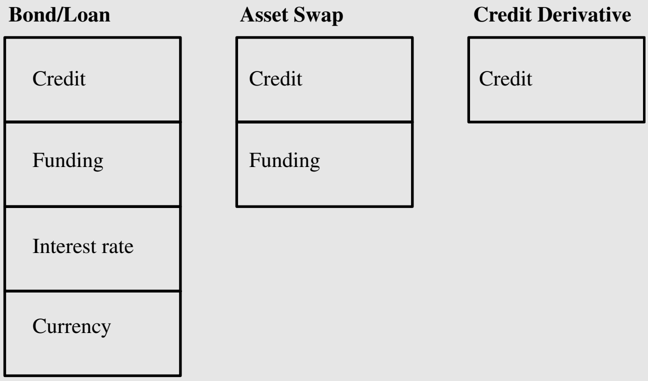

FIGURE 9.13 Isolating credit risk exposure.

Credit derivatives value pure credit, with no connection to funding or interest-rate considerations, hence enabling the isolation of credit as an asset class and risk element in its own right.

2. A bank can hedge corporate loans with cash deposits in the other direction from similar-rated corporations. This will be an inexact hedge. The advantage of the credit derivative is that the hedge can be tailor-made to suit specific requirements; for example, the hedge can be for as short or as long a tenor as required, and at the required credit rating. Credit derivatives also allow short-term hedges to be put on to meet short-term market contingencies, and as they are synthetic instruments they can be unwound with ease.
3. In theory, either instrument can be used to hedge credit risk. The CDS is more straightforward from an administrative and operational point of view. A TRS can be used to obtain liquidity for a bond trading book by being used as a synthetic repo. A bond is swapped out to the TRS counterparty who advances funds against it. The bondholder pays the TRS LIBOR-rate, and the TRS counterparty pays the 'total return' (coupon plus capital appreciation) to the bondholder. The cash flows are netted. This is economically identical to a classic repo trade.
4. a. A basket CDS may be easier to use for operational, settlement and administrative reasons. The iTraxx CDS will be the most straightforward hedge.
   b. The total premium using single-name CDS would be 557 bps, which is an average premium of 111.4 bps. The basket CDS would be expected to trade at the duration-weighted average price (here we assume equal duration) of 111.4 bps.

(*continued*)

c. The basket CDS notional amount is adjusted down in the event of default of one of the names, and the same premium is then paid until expiry on the reduced notional amount. An *n*th-to-default CDS will pay out on occurrence of credit event in one of the constituent names and then terminate. The exposure of the *n*th-to-default CDS protection seller will only be to the notional of one name. The price will be below the average level of 111.4 bps due to the impact of 'default correlation' in the price calculation.

   CDS may be preferred for investment purposes rather than hedge purposes, unless the hedger has a specific view on the names being hedged.

d. In a word (or two words): Northern Rock. This is related to sentiment rather than rational analysis. All such former building society names have been marked down since last summer, even though they remain solvent and are rated higher than some contemporaries (and, arguably, have an implied government underwriting since Northern Rock was not allowed to go bankrupt last summer).

5. There are two ways in which CDS contracts are settled on occurrence of a credit event:
   - physical settlement: when the protection seller takes delivery of the defaulted bond and pays the protection buyer par value;
   - cash settlement: where the protection seller pays the difference between the par value and the recovery value of the bond.

   To be triggered, physical settlement requires a credit event notice, a notice of physical settlement (NOP) and, if specified in the related confirmation, a notice of publicly available information. After a credit event has occurred, the protection buyer must send the NOP to the seller no later than 30 days after the other notices are delivered. This notice confirms that the protection buyer will physically settle the credit derivative transaction and contains a detailed description of the deliverable obligations that the buyer of protection will deliver to the seller, including their nominal value and accrued but unpaid interests.

CDS Pricing and The Basis

1. From first principles, derive an expression for calculating the implied probability of default (PD) from the market yield of a

company's debt, assuming 0% recovery value. Then derive the modified expression to allow for a credit-risky asset that has the recovery value R.

2. Calculate the 1-year PD given a 1-year risk-free rate of 5.00% and a risky rate of 5.50%. What is the new PD if we now introduce R of 40%?
3. With regard to the market approach to CDS pricing, how does PD feed into calculating the CDS premium?
4. A trader who previously used R of 30% to calculate CDS prices adjusts this value upwards to 40%. All else being equal, what impact will this have on the CDS term structure? Briefly explain what is behind this impact.
5. The CDS Basis
   a. Define the CDS basis.
   b. Why does the basis exist? Suggest factors that drive the existence of the basis.
   c. The screen shot below (Figure 9.14) shows the asset swap spread (the graph that touches the y-axis on left) and the CDS spread for Alliance & Leicester plc 2-year bond as at 21 April 2008, for the period November 2007–April 2008. What sort of trade can be put on to exploit this movement in cash and synthetic spreads?

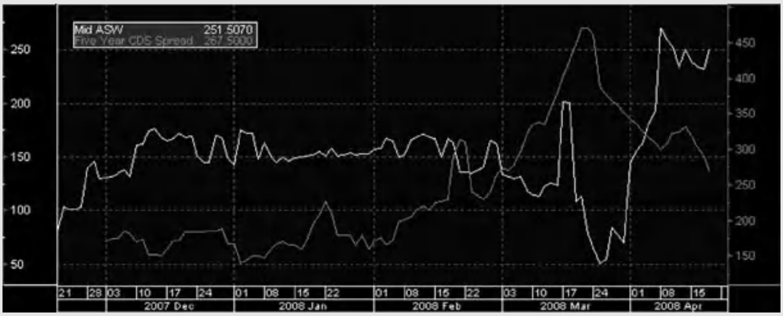

FIGURE 9.14 CDS and ASW history for Alliance & Leicester, 2007–2008.
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Answers

1. Given the risk-free yield of r and risky debt of $r + y$ where y is the spread over the risk-free yield, we can set

$$e^{rt}$$

(continued)

as the return on the risk-free asset and $e^{(r+y)t}$ as the return on the risky asset. If recovery on default is 0%, then the expected return on the risky asset is given by:

$$(1-p)e^{(r+y)t}$$

where p is the probability of default of the risky asset. A rational investor would be indifferent between this return and a risk-free return of e^{rt}. Therefore we may set:

$$(1-p)e^{(r+y)t} = e^{rt}.$$

Solving for p we obtain the expression for PD as:

$$p = 1 - e^{-yt}.$$

With a non-zero recovery rate R, and given the probability of default p, an investor would be indifferent between an expected return on the risky asset of:

$$(1-p)e^{(r+y)t} + p\mathrm{R}e^{(r+y)t}$$

and the return on the risk-free bond e^{rt}.

Setting the two expressions equal we have $(1-p)e^{(r+y)t} + p\mathrm{R}e^{(r+y)t} = e^{rt}$. Solving for p gives us:

$$p = \frac{1 - e^{-yt}}{1 - R}.$$

2. The risky asset pays a risk premium of 50 bps (the spread over the risk-free), so we use this and the expression above to calculate PD of 0.0049875 or 0.49875%. With R of 40% we have (1 – R) of 0.60 and so the PD is 0.0083125.
3. The 'no-arbitrage' approach to swap pricing (whether it is an interest rate swap or a CDS) assumes that the net present value of the fixed leg and the floating leg must be equal to zero. We use the PD to determine the expected PV of the fixed leg (the premium leg) of the CDS, using the discount factor for the tenor of the swap, and set this equal to the default payment leg of the CDS (the contingent payment on event of default). The contingent payment leg is expressed in terms of PD and recovery rate R. Solving the expression that the two legs must be equal gives us the CDS spread.

4. There will be a downward parallel shift in the CDS spread term structure, as the CDS prices will (all else being equal) fall in value. This is because a higher recovery rate results in a lower value of the contingency payment upon default. This produces a lower CDS price, as the protection seller is guaranteeing a lower protection payment.
5. a. The basis is the difference between the CDS premium and the same-reference-name asset swap spread, and is given by:

$$\text{Basis} = \text{CDS} - \text{ASW}.$$

   b. The basis exists because various market and technical factors result in the cash market price (the ASW) differing from the synthetic market price (CDS). These factors include:

   - bond identity: the delivery option afforded the protection buyer;
   - AAA stock trading below LIBOR: cash market versus premium in the CDS market;
   - risk exposure of the default swap seller: the payouts required on technical defaults (definition of credit event) that are not full defaults;
   - counterparty risk of the credit default swap buyer: unlike the cash bondholder, the CDS buyer is exposed to counterparty risk during the term of trade.

   c. In theory the basis should be zero. A non-zero basis suggests that an arbitrage profit can be made. The Alliance & Leicester bond had a negative basis at the start of the period under review, so a trader could have bought the ASW and bought protection using a CDS and locked in the difference for a theoretical credit risk-free gain.

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CHAPTER 10

Trading the Credit Default Swap Basis: Illustrating Positive and Negative Basis Arbitrage Trades

A basis exists in any market where cash and derivative forms of the same asset are traded. For example, there is a crude oil basis. Given that a derivative instrument such as a credit default swap (CDS) represents the cash asset in underlying form, there is a close relationship between the two asset types, which manifests itself in the basis and its magnitude. Fluctuations in the basis give rise to arbitrage trading opportunities between the two forms of the asset. This has proved the case in the more recent market of credit derivatives.[1]

In Chapter 8 we summarised the logic behind the no-arbitrage theory of pricing CDS, which suggests that the premium of a CDS should be equal to an asset swap (ASW) spread for the same reference name. There are a number of reasons why this is not the case however,[2] and in practice a non-zero basis exists for all reference names in the credit markets. The existence of a non-zero basis implies potential arbitrage gains that can be made if trading in both the cash and derivatives markets simultaneously. In this chapter we describe trading the basis, with real-world examples given of such trades, illustrating the positive basis trade and one the negative basis trade.

RELATIVE VALUE AND TRADING THE BASIS

The introduction of credit derivatives into the financial markets has provided a new asset class for investors in credit-risky assets. That credit

[1] The trades described here are not pure arbitrage trades, because they are not completely risk-free. This is discussed in the section on hedging and risk. This chapter is an updated version of Chapter 6 in Choudhry (2006). Reproduced and updated with permission.
[2] See Chapters 8 and 9.

derivatives, particularly CDS, can be traded in a liquid market in a wide range of names and provide investors and other market participants with an additional measure of relative value across the cash and synthetic markets. The existence of a non-zero basis, either positive or negative, can act as a powerful indicator of value in either or both markets. In addition, during an economic boom period or time of general business confidence when corporate credit spreads are tight, investors look to new opportunities to meet target rates of return or realise value. Exploiting mis-pricing in cash and synthetic markets, through basis arbitrage trading, is one such opportunity.

There are two types of basis trade:

- *negative basis* trade: this position defined as buying the bond and buying protection on the same reference name. It is generally put on if the CDS spread[3] is relatively low compared to where it has been and if the cash bond spread is relatively high. The objective of a negative basis trade is to earn a credit-risk-free return by buying the cash and the synthetic. In a negative basis trade, the cash bond is viewed as cheap and the CDS as dear;
- *positive basis* trade: this is where the arbitrager will sell the bond and sell CDS protection on the same name, to exploit a price differential that is brought about by a relatively high CDS price and a relatively low cash bond spread.

There is more than one way to measure the basis. Whichever approach we employ, in essence we are comparing a CDS premium to a spread over LIBOR, so all analysis is undertaken relative to LIBOR. Put simply, we wish to make a spread pickup on our trade, so the largest possible spread gain will generate the largest profit. There are other considerations as well, which can include the following:

- extent of credit risk premium received and/or earned;
- any impact of the 'cheapest-to-deliver' option for the protection buyer;
- impact of funding cost of the cash asset;
- the effect of basis trades in reference names that trade at sub-LIBOR in the cash market;[4]

[3] Throughout this book we have referred to the CDS 'spread' when a more accurate term would be 'premium' or 'fee'. The CDS spread is not a spread over anything, but more simply a fixed price quoted in basis points. However, market common practice is to refer to the CDS 'spread' in the same way as we refer to an asset swap spread, which is a spread over LIBOR, so we continue the practice here.

[4] Names such as the World Bank trade at sub-LIBOR in the cash market, so additional analysis is required to determine basis trade profit potential.

TABLE 10.1 Average CDS and ASW spreads for selected industrial names during 2005.

Credit rating	Average CDS premium	Average ASW spread	Difference (CDS – ASW)
AAA	22	12	10
AA	26	17	9
A	39	36	3
BBB	88	87	1
BB	256	247	9
Average	86.2	79.8	6.4

Spread source: Bloomberg L.P.

- the relative levels of liquidity in the cash and synthetic market;
- the effectiveness of the trade hedge.

The last point we mention is very important. To be a pure arbitrage, the basis package must hedge both credit risk and interest rate risk. For large-size trades, spread risk may also need to be hedged.[5] Otherwise the trade will not be a pure risk-free one and the final return on it will be influenced by (at the time of inception) unknown factors.

In a stable market, the various factors that drive the basis tend to drive it to positive territory. In other words, a positive basis is the norm when economic conditions are benign. Table 10.1 shows the average CDS premium and ASW spread across the ratings categories for selected industrial names during 2005. For no set of names was a negative basis the average value. At that time, a negative basis was a good initial indicator that special factors are at work. Following the 2007–2008 financial crisis, a negative basis was more the norm, for both bank and non-bank names (see Chapter 9). However, the implication remained that negative basis reflects a more 'special' environment than a positive basis would.

FACTORS INFLUENCING THE BASIS PACKAGE

When constructing the basis trade, it is important that we compare like-for-like, and that we hedge the trade as effectively as possible. That is, we need to consider the most appropriate cash market spread against which to measure the CDS spread, and we need to also construct the hedge with care.

[5] This is the risk that the relative spread of cash assets to LIBOR or the swap rate changes. One instrument that can be used to hedge spread risk is the LIFFE SwapNote contract. For details of this derivative see Choudhry (2004b).

Measuring the Basis

The question of which cash market spread to use when measuring the basis is an important one. The different measures for the cash spread, such as interpolated swap spread or ASW spread, produce different values for the basis. The answer to this problem is not clear-cut; CDS and cash bonds trade in different markets, with different market drivers, and a pure comparison may not actually be possible. We know that we need to select a LIBOR-based spread, the question is which spread? The CDS 'spread' is not a spread at all, but rather a fixed premium received quarterly by the protection seller. While in theory the CDS spread and the ASW spread measure the credit risk of the reference name, other more specific factors drive each of them, such that, in effect, they are actually measuring slightly different things. The CDS premium can be viewed as a pure credit risk price; that is, it is the credit premium for the name. Although other factors will drive this premium, including supply and demand, at least as an unfunded instrument and par-product we know these considerations do not apply. We want to compare it therefore to the cash measure that is the most accurate measure of the reference entity's credit risk.

A cash bond spread can be measured in a number of ways. Figure 10.1 shows the Bloomberg YAS page for a Thyssenkrupp AG issue, the 4.375%

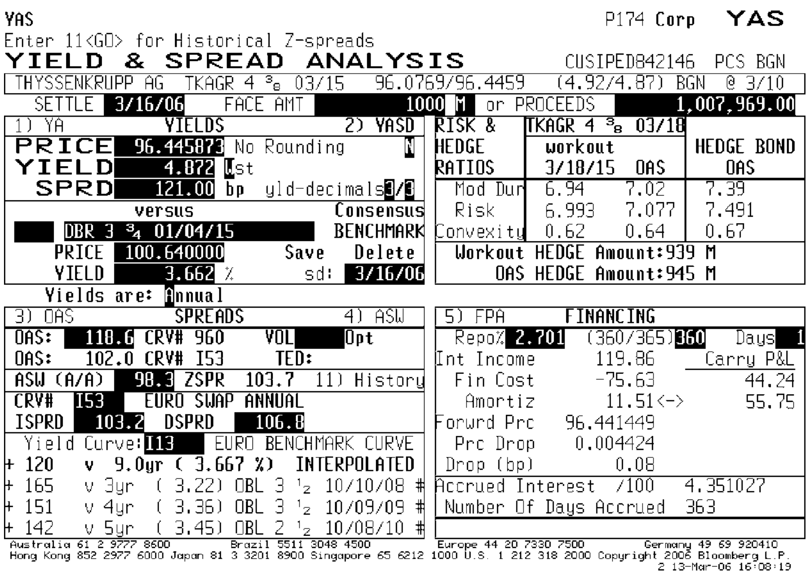

FIGURE 10.1 Bloomberg page YAS for Thyssenkrupp AG 4.375% March 2015, as at 13 March 2006.

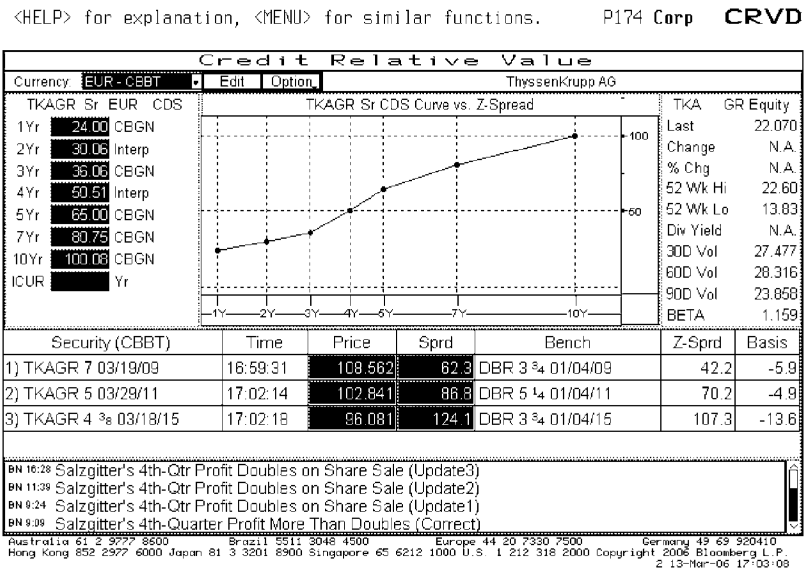

FIGURE 10.2 Bloomberg page CRVD for Thyssenkrupp AG reference name, as at 13 March 2006.

March 2015 bond. This shows the different bond spread measures that can be calculated. In a basis trade, it is the spread that is the best indicator of the reference name's credit risk premium that we should, ideally, be comparing the CDS spread to. The CDS price is 93.7 bps, which is an interpolated spread based on the CDS curve. The CDS curve is shown on screen CRVD for this name, given at Figure 10.2.

We see from Figure 10.1 that for this name, we have:

- an I-spread (ISPRD) of 103.2 bps;
- an ASW spread of 98.3 bps;
- a Z-spread (ZSPR) of 103.7 bps.

So in other words the LIBOR spread for this bond ranges from 98.3 bps to 103.7 bps. The spread to the government bond benchmark is 121 bps, based on the price of the bond at €96.445. In other words:

- the interpolated spread of 103.2 bps is the straight difference between the bond gross redemption yield and LIBOR rate for the same term;
- in an ASW package, the investor would receive LIBOR + 98.3 bps and an implied receipt of €3.555 upfront (as the bond is priced below par) while paying the coupon of 4.375% over the term of the deal;

- the Z-spread of 103.7 bps represents the spread over and above the inter-bank interest rate swap curve that would equal the bond's present value with its coupon and principal payments over the term to maturity.

As we noted, for basis trading purposes ideally we should use the bond spread that best represents the credit premium payable for taking on the issuer's credit risk. There is no real 'true' answer, although in practice the ASW spread and the Z-spread are the most commonly used. Note, however, as in this case, for bonds that trade close to par the various spread measures are actually quite close.

As part of the analysis in a real-world situation we should also consider the actual return generated by a basis trade package. This takes into account market factors such as bid–offer spread and funding costs. Table 10.2 shows how we would undertake this analysis at the close-out of the trade, be it after one month, three months, one year or other target horizon. In this analysis the total return of the trade is, unsurprisingly, a function of the actual price of the bond at close-out. The actual result is not known, as we do not know the price of the bond in the future, at the time we put on the trade, hence the blank fields in Table 10.2—we show this table to suggest how we should look to perform the analysis. Later on in this chapter we show some real-world trade results.

The Hedge Construction

It is intuitively easy to view a basis package as a straight par-for-par trade of notionals. That is, we would buy (or sell) $10 million nominal of a bond against buying (or selling) $10 million of notional in the CDS. This type of trade is still quite common due to its simplicity. However, unless the cash bond in question is priced at par, this approach is not correct and the analysis will not be accurate. The biggest errors will arise when the bond is trading significantly away from par.

As part of the analysis into the trade then we need to assess how much nominal of bond to buy or sell against a set amount of CDS notional, or conversely how much CDS protection to put on against a set amount of the bond. There is no one way to approach this; the key is the assumption made about the recovery rate in the event of default. In practice, traders will adopt one of the following methods:

- par/par: this is a common approach. In such a trade, identical par amounts of the bond and the CDS are traded. The advantage of this method is that the position is straightforward to maintain. The disadvantage is that the trader is not accurately credit-risk hedged if the

TABLE 10.2 Suggested return analysis for negative basis trade for the 6-month trade horizon, Thyssenkrupp bond.

	Cash flow position versus par	1.00795	
	Price today 13 Mar 2006	**Price at Close-Out**	**Cost/Gain**
Bond mechanics			
clean	96.445	*x*	*x* −96.445
accrued	4.35	*ai*	*ai* −4.35
dirty	100.795	*x*+*ai*	(*x*+*ai*) −100.795
Fund bond position in repo (pay 1.00795%) 6-month EUR LIBOR 2.847%			−1.434
Interest-rate swap hedge: cash flow			
Pay fixed at 3.843%			−1.936
Receive 6-month LIBOR 2.847%			1.434
Total bond cash flows			
CDS mechanics			
Buy 9-year CDS protection at 93.7 bps			−0.4685
Total return			

bond is priced away from par. The CDS pays our par (minus the deliverable asset or cash value on default) on default, but if the bond is priced above par, greater cash value is at risk in a negative basis trade. Therefore this approach is recommended for bonds priced near to par or for trades with a long-term horizon. It is not recommended for use with bonds at a higher risk of default (for instance, sub-investment grade bonds) as default events expose this trade to potentially the highest loss; it is also more at risk for anything other than small changes in spread;

- delta-neutral: this is a similar approach used to duration-weighted bond spread trades such as butterfly/barbell trades (see Choudhry 2004b). It

is appropriate when the maturity of the bond does not match precisely the maturity of the CDS;
- DV01: this approach sets the CDS notional relative to the actual price of the bond. For example, in a negative basis trade if the bond is trading at €120, we would buy 120% notional of the CDS. This is a logical approach and recommended if the bond is trading away from par.

An assumption of the recovery rate will influence the choice of hedging approach and the notional amount of CDS protection to buy. This is discussed in the next section.

Hedging and Risk

Basis trades are termed as 'arbitrage' trades, but are not pure arbitrage because they are not risk-free. More accurately, they should be called relative value trades. Here we discuss some issues in un-hedged risk. For instance, the coupon on the bond is not hedged: to do this, we would need to put on a series of coupon strips synthetically to hedge each coupon payable during the life of the bond. In the event of default, the timing of default is crucial; if this occurs just prior to a coupon payment, the actual loss on the trade will be higher than if default occurred just after a coupon payment. In either case, the CDS position does not protect against coupon risk, so remains un-hedged.

Another risk factor is the recovery rate assumed for the bond. The rate of recovery cannot be hedged and the actual recovery after event of default will impact the final profit/loss position. The impact is greatest for bonds that are priced significantly away from par. To illustrate this, consider a bond priced at $110.00. To hedge a long position of $10 million of this bond, assume we buy protection in $11 million nominal of the CDS. We do not use a par/par approach because otherwise we would be under-hedged. Now consider, in the event of default, the following recovery rates:

- 0% recovery: we receive $11 million on the CDS, and lose $11 million ($1.10 \times 10{,}000{,}000$) on the bond, so net we are flat;
- 50% recovery: we receive $5.5 million on the CDS and lose $6 million on the bond (the bond loss is $5 million nominal and we receive back $5 million, having paid out $11 million), so net we are down $500,000.

In other words, under a 50% recovery rate scenario we are under-hedged still and would need more notional of CDS to cover the loss on the bond. If the recovery rate is 30% we will gain on the position. The higher over 50% it is the more we will lose progressively. Note that the reverse analysis applies when the bond is priced below par. Overall then, we conclude that the assumption of the recovery rate must influence the notional size of the CDS position.

Generally, the market assumed the following recovery rates:

- investment-grade 40%;
- insurance companies and corporates 30%;
- sub-investment grade 20%.

Following the 2007–2008 credit crunch banks started to assume a 50% recovery rate in their pricing models. A more robust approach might be to take historical data of actual defaults and ultimate recovery rates; however, at the current time some markets, notably those in Europe and Asia, suffer from a paucity of data and so for the time being market participants use assumed recovery rates. However, the issue of recovery rate remains problematic in both CDS and synthetic collateralised debt obligation (CDO) note pricing, because the assumed value can be far away from the actual realised recovery value in practice. If using CDS for hedging purposes, the safest approach is to assume a 0% recovery.

TRADE EXAMPLES

Here we illustrate the concept of basis trading with hypothetical trade ideas. For the purposes of this hypothetical illustration, we determine at the outset to run the trade for a 1-month time horizon, so after one month we unwind the trade and see how the trade idea has performed, by checking market prices at the time of the un-wind (that is, one month later). In reality, we may have a longer horizon, or keep running a trade that is offside because our view is a longer term one.

Positive Basis Trade

In a positive basis trade the CDS trades above the cash spread, which can be measured using the ASW spread or the Z-spread.[6] The potential arbitrage trade is to sell the basis; that is, sell the cash bond and sell protection on the same reference name. We would do this if we expect the basis to converge or narrow.

To illustrate this we describe an example of a basis trade in France Telecom. The cash side of the trade is a euro-denominated bond issued by

[6] See Chapters 4 and 9 for a description of the different ways to measure the basis and an example of a Z-spread calculation.

France Telecom, the 3.625% 2015, rated A3/A– and which is trading on 8 December 2005 as follows:[7]

Bond	France Telecom 3.625% 2015
ISIN	FR0010245555
Maturity	14 October 2015
Price	97.52–97.62 clean
ASW	42.9 bps
Z-spread	45.2 bps
CDS price	77–87 bps (10-year CDS)
Repo rate	2.06–2.02 (LIBOR minus 35 bps)

The ASW spreads can be seen in Figure 10.3 (they are slightly different to the levels quoted above because the screens were printed the next day and the market had moved). This is Bloomberg screen ASW for the bond. The basis for this bond is positive, as shown in Figure 10.4, which is Bloomberg screen CRVD.

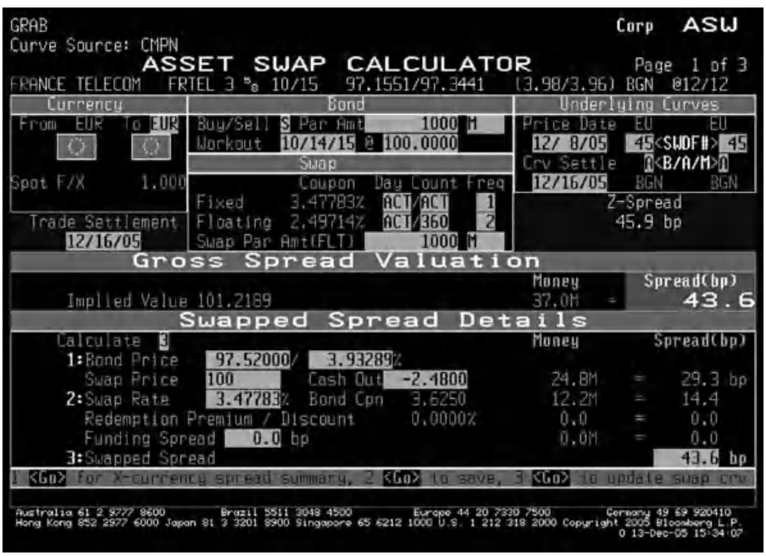

FIGURE 10.3 Asset swap spread on screen ASW, France Telecom 3.625% 2015 bond, 9 December 2005.

[7] Prices are taken from Bloomberg L.P. (bond and repo) and market makers (CDS).

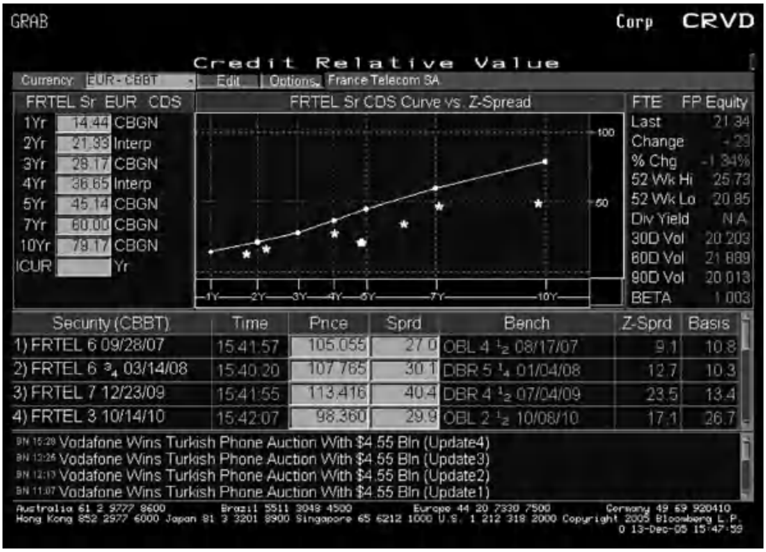

FIGURE 10.4 Cash-CDS basis for France Telecom, 9 December 2005.
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From the above we see that the basis is (77 – 45.2) or +31.8 bps. If we have the view that the bond will under-perform, or the basis will otherwise narrow and go towards zero and/or negative, we will sell the basis. We consider historical data on the basis during our analysis, as shown in Figure 10.5, which is from screen BQ and shows the 1-year historical ASW spread against the 5-year CDS spread.[8]

The trade is put on in the following terms:

- sell €6 million nominal of the bond at 97.52 clean price, 98.1158 dirty price;
- sell protection €5.85 million CDS at 77 bps.

As we are shorting the bond we fund it in reverse repo, which is done at 2.02 bps, or LIBOR minus 35 bps.

The credit risk on the bond position is hedged using the CDS. The interest rate risk ('DV01') is hedged using Bund futures contracts. The hedge calculation is a straightforward one and uses the ratio of the respective DV01

[8] Our view on where the basis is going may be based on any combination of factors; these can include speculation about future direction based on historical trade patterns, specific company intelligence such as expectations of a takeover or other buy-out, views on credit quality and so on.

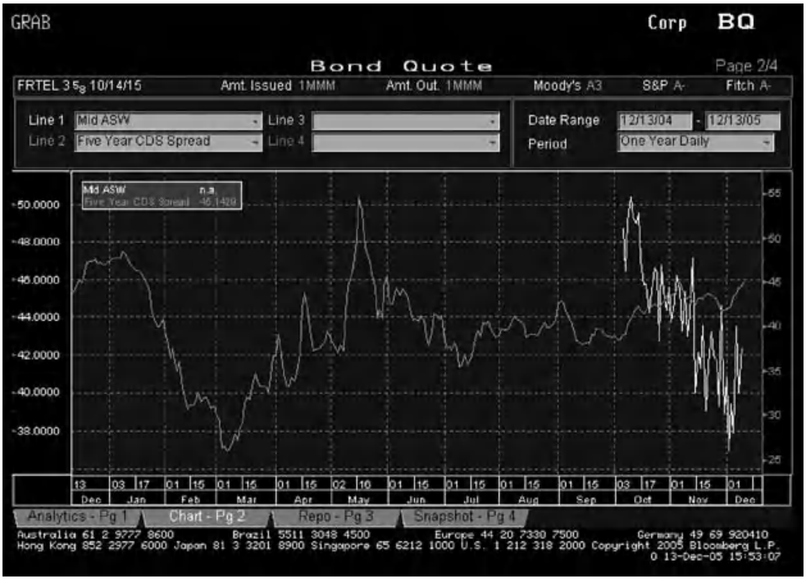

FIGURE 10.5 One-year historical CDS-ASW spread, France Telecom, December 2005.
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of the bond and futures contract; see Choudhry (2005) for the hedge calculation mechanics.[9] From this we determine that we need to buy 52 lots of the Bund future to hedge the bond position.

For readers' reference we show the DV01 hedge calculation at Table 10.3, which is the Excel spreadsheet used to determine the futures hedge.[10] Note that the example shown is for a hypothetical hedge, not our example—we show it here for instructional purposes. Table 10.4 shows the Excel formulae.

The analysis is undertaken with reference to LIBOR, not absolute levels such as the yield-to-maturity. The cash flows are:

Sell bond:	pay 42.9 bps
Sell protection:	receive 62 bps.

[9] The hedge calculation is based on a ratio of bp values ('DV01') of the bond to be hedged and the futures contract. See Tables 10.3 and 10.4 for the calculation spreadsheet.
[10] The hedge spreadsheet was written by Stuart Turner and is reproduced with permission.

In addition, the reverse repo position is 35 bps below LIBOR. As it represents interest income we consider this spread a funding loss, so we incorporate it into the funding calculation; that is, we also pay 35 bps. We ignore the futures position for funding purposes. This is a net carry of:

$$62 - (42.9 + 35)$$

or −15.9 bps. In other words, the net carry for this position is negative. Funding cost must form part of the trade analysis. Funding has a greater impact on the trade net P&L the longer it is kept on. If the trade is maintained over one month, the funding impact will not be significant if we generated, say 5 bps gain in the basis, because that is 5 bps over a 10-year horizon (the maturity of the bond and CDS), the present value of which will exceed the 15.9 bps loss on one month's funding. If the position is maintained over a year, the impact of the funding cost will be greater.

TABLE 10.3 Futures hedge calculation spreadsheet.

A1	B	C	D
2	**Hedging Bonds with Futures**		
3			
4			
5–6	$Number\ of\ Contracts = \dfrac{Mbond}{Mfut}\ x\ \dfrac{BPVbond}{BPVfut}$		
7			
8			
9			
10	**Inputs**		
11			
12	**Nominal Value of the bond (Mbond)**	10,000,000.00	
13			
14	**Nominal Value of futures Contract (Mfut)**	100,000.00	
15			
16	**BPV of the Futures CTD bond**	7.484	
17			
18	**Conversion Factor of CTD**	0.852	
19			
20	**BPV of the Bond (BPVbond)**	7.558	
21			
22	BPV of the Future (BPVfut)	8.780	
23			
24			
25	**Number of Contracts to Hedge**	**86.083**	
26			
27			
28			

Source: Stuart Turner. Reproduced with permission.

TABLE 10.4 Table 10.3 hedge spreadsheet showing Microsoft Excel formulae.

A1	B	C	D
2	**Hedging Bonds with Futures**		
3			
4			
5	$\text{Number of Contracts} = \dfrac{Mbond}{Mfut} x \dfrac{BPVbond}{BPVfut}$		
6			
7			
8			
9			
10	**Inputs**		
11			
12	**Nominal Value of the bond (Mbond)**	10,000,000.00	
13			
14	**Nominal Value of futures Contract (Mfut)**	100,000.00	
15			
16	**BPV of the Futures CTD bond**	7.484	
17			
18	**Conversion Factor of CTD**	0.852	
19			
20	**BPV of the Bond (BPVbond)**	7.558	
21			
22	BPV of the Future (BPVfut)	=C16/C18	
23			
24			
25	**Number of Contracts to Hedge**	**=((C12/C14)*(C20/C22))**	
26			
27			
28			

Source: Stuart Turner. Reproduced with permission.

Position After One Month

On 10 January 2006 we record the following prices for the France Telecom bond and reference name:

Bond	France Telecom 3.625% 2015
Price	98.35–98.45
ASW	42.0 bps
Z-spread	43.8 bps
CDS price	76–80 bps

Spreads are shown at Figure 10.6.

To unwind this position we would take the other side of the CDS quote, so the basis is now at (80 – 43.8) or 36.2 bps. In other words, it has not gone

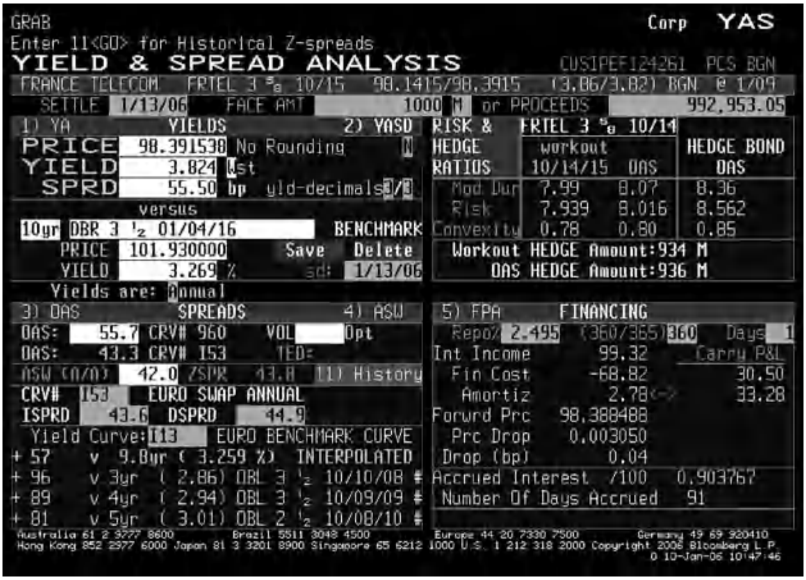


FIGURE 10.6 France Telecom bond YAS page for ASW and Z-spreads, 10 January 2006.

the way we expected but has widened. As we sell the basis, the position would lose money if we unwind it now. The decision to unwind would be based on the original trade strategy: if the trader's time horizon were six months or longer, then the decision may be made to continue holding the position. If the trader's time horizon were shorter, it is probably sensible to cut one's losses now. Note that this trade is running at negative net carry, so it incurs a carry loss if maintained irrespective of where the basis is going.

Negative Basis Trade Negative basis observations are not uncommon. In the event of a negative basis condition, the potential arbitrage is to buy the basis; that is, to buy the bond and buy protection on the same reference name. We illustrate such a trade here.

The bond identified was observed as trading at a negative basis on 8 December 2005. It is the Degussa AG 5.125% of December 2013, which is a euro-denominated bond rated Baa1/BBB+. Its terms are as follows:

Bond	Degussa AG 5.125% 12/2013
ISIN	XS0181557454
Maturity	10 December 2013

Price	103.68
ASW	121.6
Z-spread	122.7
CDS price	5 year: 75–80
	7 year: 95–105
	10 year: 113–123
Interpolated 8-year offer	111 bps
Repo rate	2.44 (LIBOR + 2)

These rates are seen in Figure 10.7, the ASW page for this bond, while the basis and basis history are seen at Figures 10.8 and 10.9 respectively. The basis is (111 – 122.7) or –11.7 bps. We expect the basis to widen; that is, move from negative towards zero and then into positive territory. We therefore buy the bond, and buy protection on the Degussa name. The interest rate hedge is put on in the same way as before; again, we weight the CDS notional amount to match the risk of the bond because the bond is trading away from par and so a greater amount of CDS notional is required.

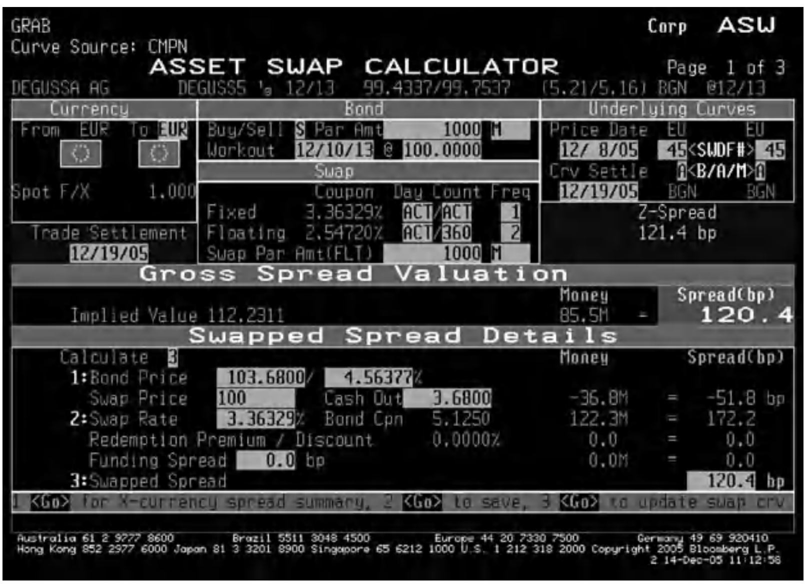


FIGURE 10.7 Degussa 5.125% 2013 bond, ASW page, 9 December 2005.

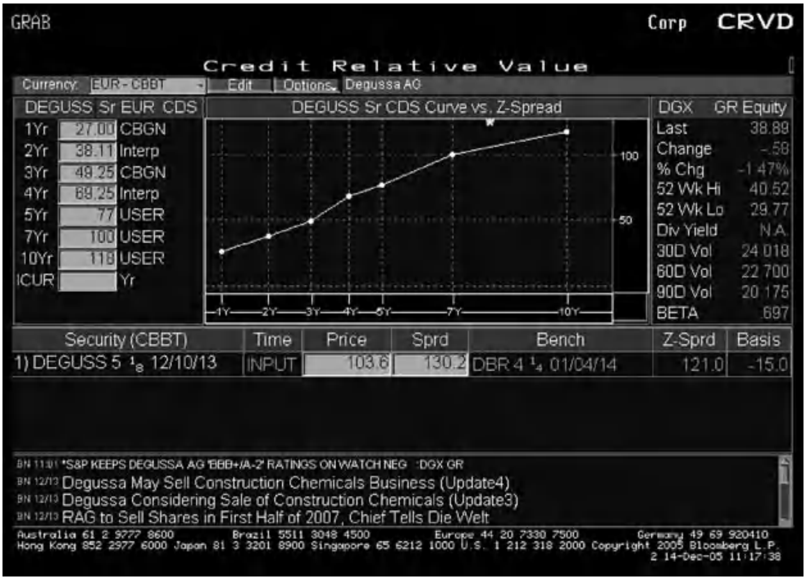


FIGURE 10.8 Cash-CDS basis, Degussa AG, 9 December 2005.

FIGURE 10.9 One-Year CDS-ASW spread, Degussa AG, 9 December 2005.

The trade cash flows are as follows:

Buy bond	receive 121.6 bps
Buy protection pay	111 bps
Repo	pay 2 bps

This is a net carry of +8.6 bps, so this trade runs at a funding gain each day. We expect the basis to widen, at which point we will unwind the trade to extract our profit.

Position After One Month

On 10 January 2006 we recorded the following prices for the Degussa bond and reference name: Spreads are shown at Figure 10.10.

Bond	Degussa AG 5.125% 12/2013
Price	101.75
ASW	153.2 bps
Z-spread	155.8 bps
CDS price	152–162

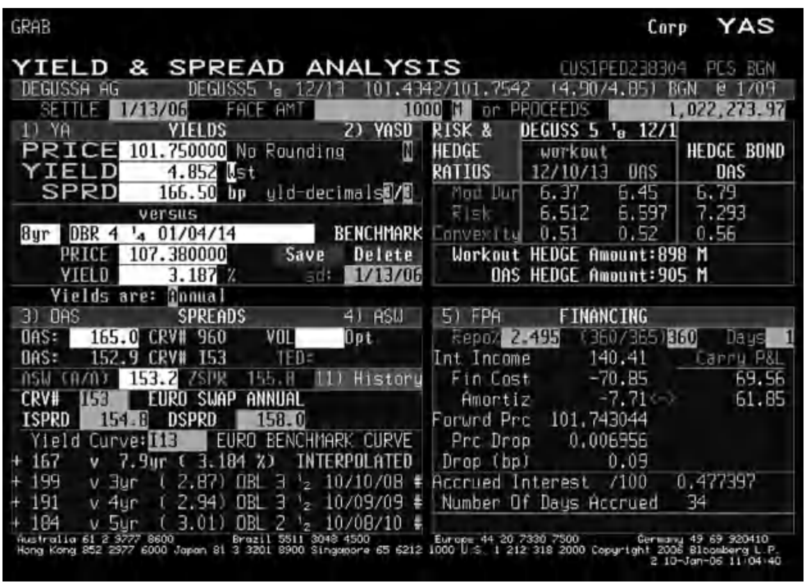


FIGURE 10.10 Asset swap and Z-spreads for Degussa bond, 10 January 2006.

The basis is (152 – 155.8) or –3.8 basis points. The basis has tightened, as we expected, and is now in profit. The P&L is positive, and is (–11.7 – (–3.8)) or 7.9 bps, together with the funding gain accrued each day. We can unwind the trade to take profit now or continue to run it, at a net positive carry, if we expect the basis to move further in the same direction and then into positive territory.

Notice how the gain itself is small, just a few basis points. Futures basis trading in government bonds is often undertaken in very large size for precisely this reason, because the small potential gain means to make the trade worthwhile we have to deal in size. This is not always possible in corporate markets because of lower liquidity levels in the cash market.

Mark-to-Market Risk

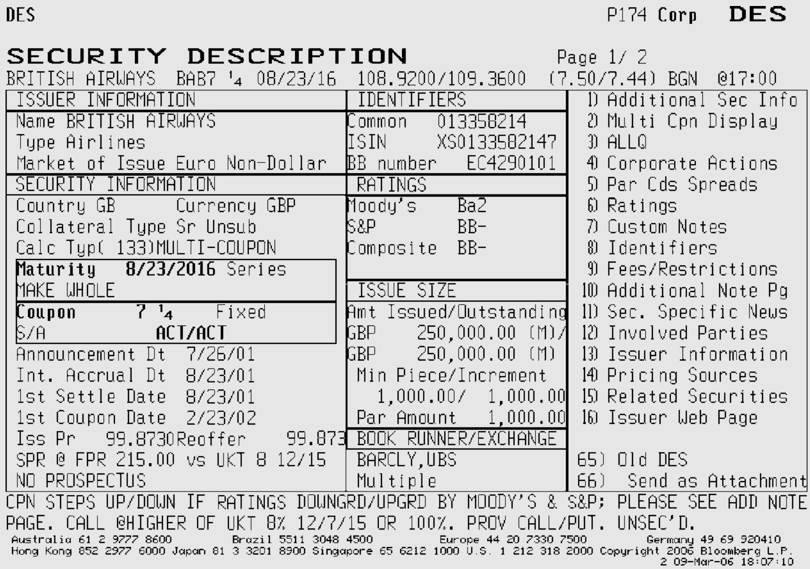
If we assume that no credit event occurs during the time that a basis trade is put on, then the main risk exposure for the investor is of course basis risk, the risk that the basis will move in the opposite direction to the trade itself. This will create mark-to-market loss (m-t-m) on the position, which will be recorded as a loss in unrealised P&L.

The investor needs to be able to withstand this loss, unrealised or otherwise, during the anticipated time of the trade, otherwise it may be forced to exit the trade when it is offside. There is no practical way to mitigate m-t-m risk, and so the investor needs to set up risk limits to accommodate any m-t-m volatility.

EXAMPLE 10.1 NEGATIVE BASIS TRADE: BRITISH AIRWAYS

In this example we illustrate an example of a reference name trading at large negative basis. The reference name is British Airways, which was experiencing credit downgrade issues during 2005, both general issues relevant to its (airline) sector and specific issues associated with its passenger performance and industrial relations. An observation of the negative basis spread, which widened considerably in a short time, suggested that the spread would narrow again (heading towards positive territory) over the next three to six months.

Accordingly, a negative basis trade was considered an appropriate trade. Details of the bond being purchased, the 7.25% of August 2016, are shown at Figure 10.11. The performance of the basis in the three months preceding the trade start date is given at Figure 10.12,


DES P174 Corp DES

SECURITY DESCRIPTION Page 1/ 2

BRITISH AIRWAYS BAB7 ¼ 08/23/16 108.9200/109.3600 (7.50/7.44) BGN @17:00

ISSUER INFORMATION	IDENTIFIERS	
Name BRITISH AIRWAYS	Common 013358214	1) Additional Sec Info
Type Airlines	ISIN XS0133582147	2) Multi Cpn Display
Market of Issue Euro Non-Dollar	BB number EC4290101	3) ALLQ
SECURITY INFORMATION	RATINGS	4) Corporate Actions
Country GB Currency GBP	Moody's Ba2	5) Par Cds Spreads
Collateral Type Sr Unsub	S&P BB-	6) Ratings
Calc Typ(133)MULTI-COUPON	Composite BB-	7) Custom Notes
Maturity 8/23/2016 Series		8) Identifiers
MAKE WHOLE	ISSUE SIZE	9) Fees/Restrictions
Coupon 7 ¼ Fixed	Amt Issued/Outstanding	10) Additional Note Pg
S/A ACT/ACT	GBP 250,000.00 (M)/	11) Sec. Specific News
Announcement Dt 7/26/01	GBP 250,000.00 (M)	12) Involved Parties
Int. Accrual Dt 8/23/01	Min Piece/Increment	13) Issuer Information
1st Settle Date 8/23/01	1,000.00/ 1,000.00	14) Pricing Sources
1st Coupon Date 2/23/02	Par Amount 1,000.00	15) Related Securities
Iss Pr 99.8730Reoffer 99.873	BOOK RUNNER/EXCHANGE	16) Issuer Web Page
SPR @ FPR 215.00 vs UKT 8 12/15	BARCLY,UBS	65) Old DES
NO PROSPECTUS	Multiple	66) Send as Attachment

CPN STEPS UP/DOWN IF RATINGS DOWNGRD/UPGRD BY MOODY'S & S&P; PLEASE SEE ADD NOTE PAGE. CALL @HIGHER OF UKT 8% 12/7/15 OR 100%. PROV CALL/PUT. UNSEC'D.

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2006 Bloomberg L.P.
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FIGURE 10.11 Bloomberg page DES for British Airways 7.25% 2016 bond.
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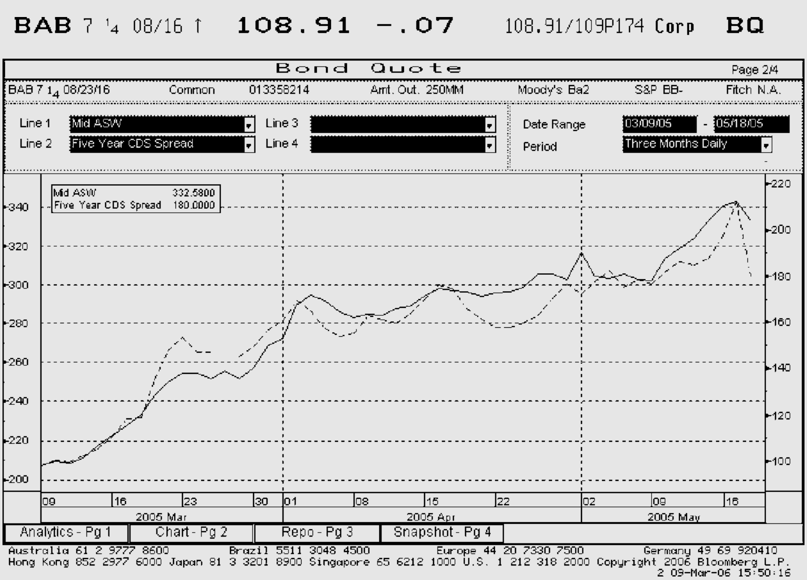

FIGURE 10.12 BA bond CDS-ASW basis performance, March 2005–May 2005.
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which is screen BQ from Bloomberg and shows the CDS-ASW spread during this time. Note how the basis, already negative, moves into greater negative territory quite quickly in early May 2005.

The trade is put on 18 May 2005 at the following terms:

- buy £5 million BAB 7.25% 2016;
- price £106.41 (yield 7.878 %);
- buy CDS protection £5 million notional.

The CDS spread is 180 bps. At the ASW spread of 332.58 this represents a basis of –152 bps. On 17 October 2005 we unwind the trade. The price of the bond is now £110.43 (yield is 7.337%), and the CDS spread is CDS 152.6 bps. At an ASW spread of 278.8 bps this represents a basis of –126 bps. So the profit on this trade is 26 bps.[11]

Figure 10.13 shows the basis performance from the trade start date to the trade unwind date. We note how the spread has narrowed—as predicted—during the trade term. Figure 10.14 shows the bond price

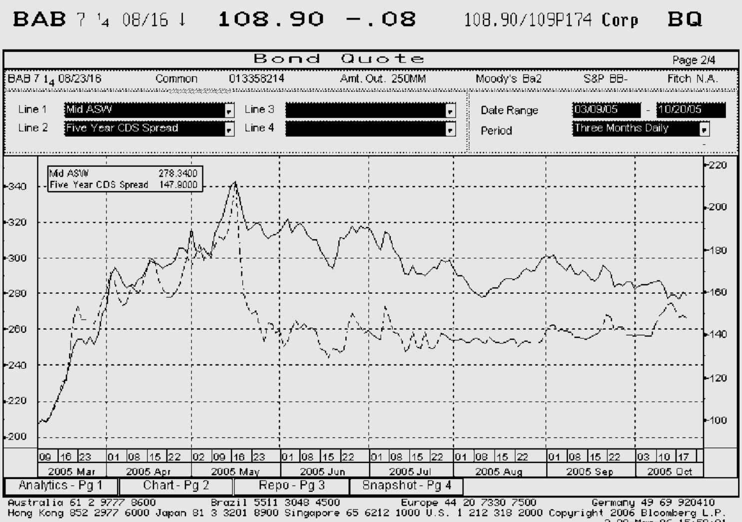

FIGURE 10.13 BA bond CDS-ASW basis performance, March 2005–October 2005.
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[11] This is gross profit, before factors such as bid–offer spread and hedge costs are taken into account.

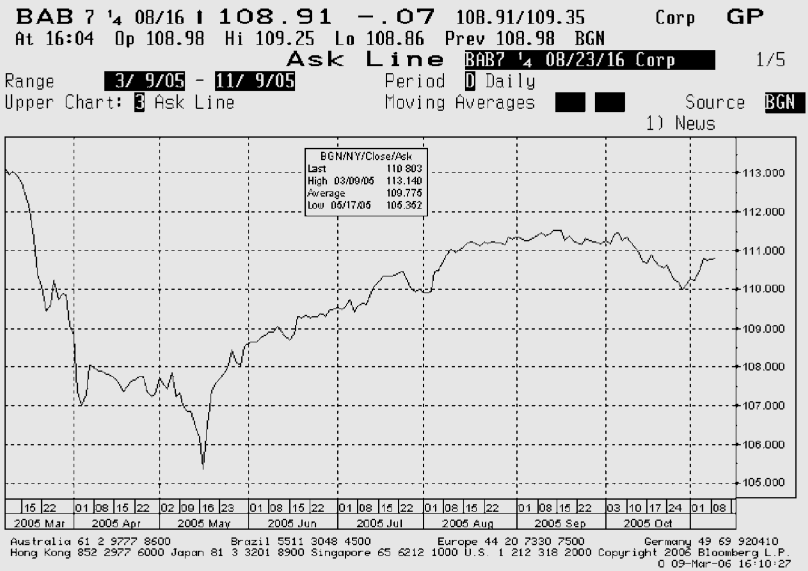

FIGURE 10.14 BA bond price performance, March 2005–October 2005.
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performance, while Figure 10.15 shows how the basis has behaved since the trade was unwound: note how it widened out again up to March 2006.

The funding considerations followed those described earlier when we discussed the Thyssenkrupp bond. The bond was funded at LIBOR-flat, so there is no price impact either way on this side. This reflects that all analysis is conducted relative to LIBOR-flat. Because in this case the funding is at L-flat there is no impact. The interest rate hedge can be carried out with futures contracts, the benchmark bond (in this case gilts) or with an interest rate swap. With a swap to match maturity, we would pay fixed to receive floating, which would be LIBOR-flat. If we hedge with futures, there are no funding issues. If we hedge with a gilt, we need to note the reverse repo rate applicable on the gilt, in case it goes special during the term of the trade. If it does not, then the gain on lending funds against gilts will be matched on the other wide in what we pay out for shorting the gilt—both rates will be at sub-LIBOR and should have no impact. In the actual case of this bond, the hedge was undertaken with a matched-maturity interest rate swap.

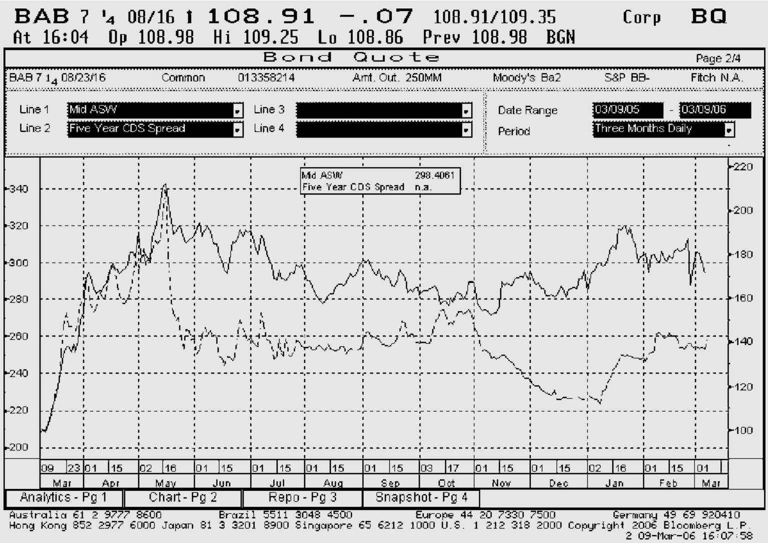

FIGURE 10.15 BA bond CDS-ASW basis performance, March 2005–March 2006.
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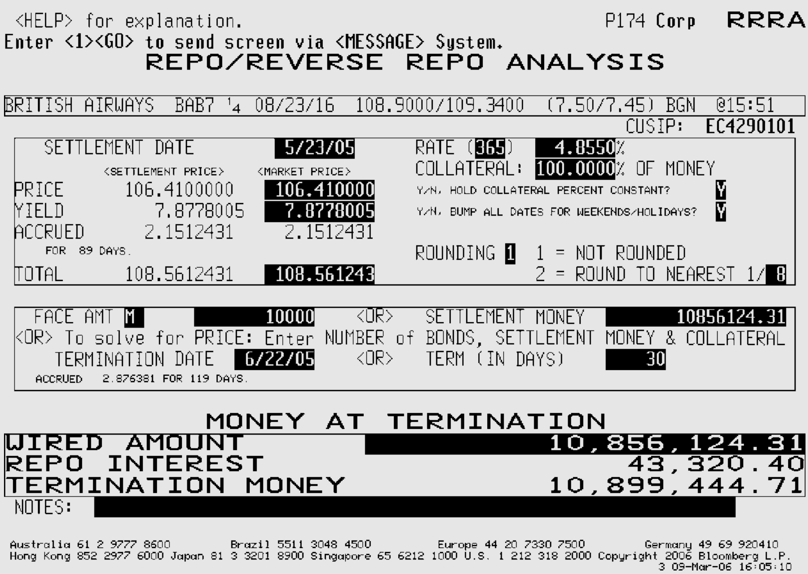

FIGURE 10.16 Bloomberg screen RRRA, repo funding of BA bond at LIBOR-flat.
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Finally, Figure 10.16 shows the Bloomberg screen RRRA used to calculate cash flows when we fund the BA bond in repo. The trade was funded at one-month intervals in repo.

A CREDIT DEFAULT SWAP RELATIVE VALUE TRADE IN EU AAA-RATED SOVEREIGN NAMES[12]

In the aftermath of the Lehman default, CDS prices for all reference names reflected a general negative economic sentiment. A low-risk method to benefit from high prices in sovereign names, using relative value CDS trades, was an opportunity that presented itself in 2008–2009.

Rationale

The market crisis in 2007–08 resulted in exceptional opportunities for revenue for certain sovereign names that investors would not expect to default under any circumstances. The CDS market in sovereign debt is very large and very liquid. The widening of sovereign CDS prices in countries such as Ireland and Austria was widely reported, but the CDS of the strongest EU nations (Germany, France and so on) was also dramatic. For example, to sell 5-year protection on the UK, Netherlands, France and Germany in June 2008 would have paid 11 bps, 11.3 bps, 7.4 bps and 4.9 bps respectively. Selling protection on the same countries in June 2009 paid 86.9 bps, 51.9 bps, 37.7 and 34 bps (see Figure 10.17 for performance).

The trade that presented itself was to sell protection on AAA-rated EU sovereign names to generate essentially risk-free revenue. The main risk in this trade is mark-to-market risk. A negative mark-to-market movement will generate unrealised negative P&L. To mitigate, the investor will put on an offsetting buy-protection CDS trade in a risk-free name such as Germany sovereign name. There is a high degree of correlation between EU sovereigns and Germany, and this correlation will largely offset against mark-to-market movements on systematic risk in CDS of sovereigns. The basis differential represents pure profit.

[12] This section was co-written with Stuart Turner, who is a portfolio manager in the Treasury department at Europe Arab Bank plc, London.

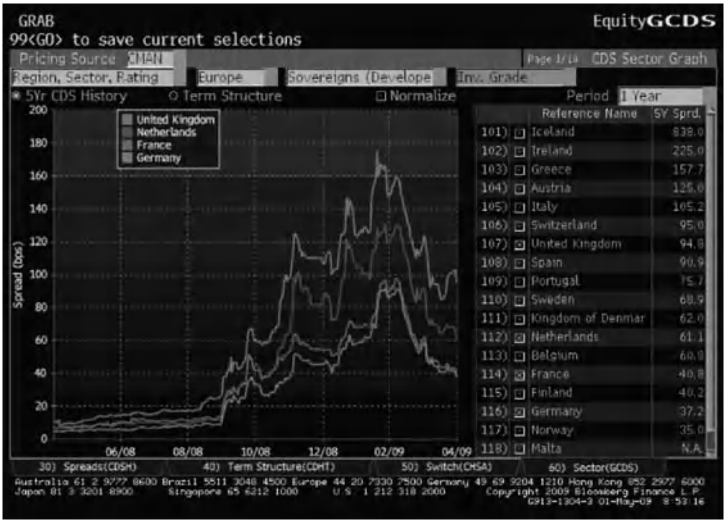

FIGURE 10.17 Sovereign CDS levels, June 2008–April 2009.
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Example Trade Cash Flows: June 2009

In this example we sell protection on Netherlands and buy the same protection on Germany:

- Sell €50 million of protection on the Netherlands at 48 bps: we receive €240,000 per year.
- Buy €50 million of protection on Germany at 31bps: we pay €155,000 per year.

Net profit per year on the above trade is 17 bps of carry on €50 million, or €85,000.

Risk Exposure

The risk on the trade described in trade cash flows above is that the 5-year CDS on the Netherlands will widen to a greater extent than Germany; this will cause mark-to-market P&L losses. There will not, however, be any loss in principle unless there is a credit event on the country in which the investor sells protection, in this case the Netherlands.

To analyse the 12-month mean spread between the two CDS values that covers the most volatile period from September 2008 (see Figure 10.18), the investor estimates potential estimated loss as the credit spread mean, which is 23.6 bps.

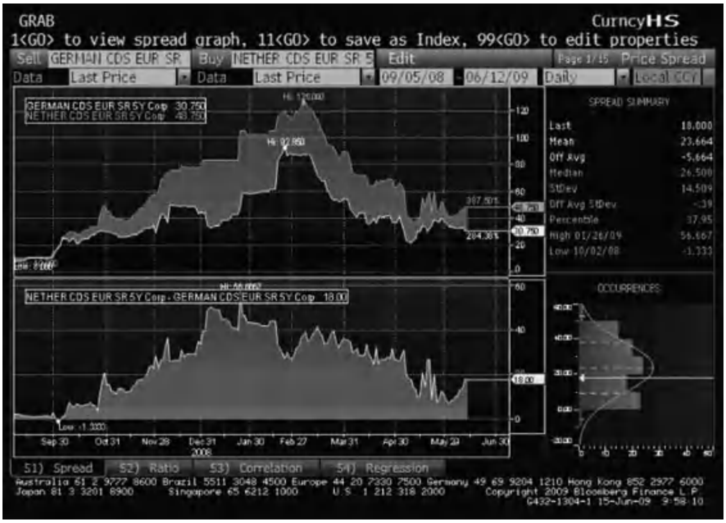

FIGURE 10.18 EUR 5-Year CDS spread between Germany and the Netherlands, September 2008–June 2009.
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Under the trade described above the investor sold the spread at 17 bps so we would have lost 6.6 bps. The EUR CS01 (the euro value of a 1 bp move in the credit spread) is €23,298, so using the average spread difference over 12 months as a worst case scenario the value-at-risk over the next 12 months would be:

$$6.6 \times 23{,}298 = €153{,}767 \text{ mark-to-market loss.}$$

Note that this is the worst case and would be a mark-to-market unrealised loss—no actual realised loss would be suffered unless there was a credit event on the Netherlands.

EXAMPLE 10.2 NEGATIVE BASIS TRADE: CHECKING THE THEORETICAL BOND PRICE

We have noted in this and the previous chapter the various means by which the basis can be measured, and the approach to conducting the requisite analysis before putting on the basis trade. CDS market-making banks often make a basis package available from the outset; when this happens there is no need for the arbitrager to construct the trade because both the cash and the CDS sides will take place simultaneously.

For example, on 30 September 2009 a market maker offered the following maturity matched negative basis package:

- €15 million of British Telecom 6.50% July 2015 bonds, rated BBB and Baa2, trading at a negative basis of 56 bps.

The indicators shown were:

Price	107.83
Yield	4.90%
Spread	246 bps
Z-spread	206
CDS	150
Basis	56

The decision to trade will reflect the individual's view, however it is possible to check the theoretical bond price derived from the CDS curve using Bloomberg screen VCDS. This is shown at Figure 10.19. We see that using a recovery rate of 40%, the theoretical bond price of 110.01 is some way away from the market price of 107.83.

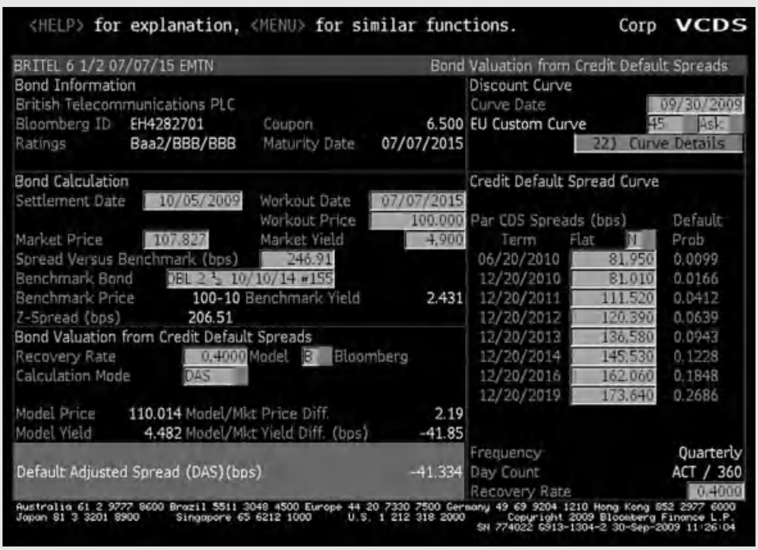

FIGURE 10.19 Bloomberg screen used to analyse negative basis package in British Telecom 6.5% 2015 bond, as at 30 September 2009. Note CDS-implied price of 110.01.

Consequently we conclude that the market perception of cash market value is different from that implied by the synthetic market; hence the relatively large negative basis. On this analysis, as the cash bond is 'cheap' relative to the theoretical price, the negative basis trade has some attraction, as the trader will be buying the cash and hedging the credit risk via the CDS market.

CONCLUSION

The trades we have described illustrate the mechanics for CDS basis trades, both positive and negative basis. We saw how an arbitrage gain can be made, at theoretically zero credit risk, by buying or selling the basis, provided our initial view is correct. Opportunities for basis trading are rare and often require good market intelligence on specific corporate names, which can be used to formulate views on these names. Hence an expertise in credit analysis is essential. In addition, liquidity levels in the cash Eurobond market can be low, depending on the name, and should therefore also be considered when formulating the trade idea.

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CHAPTER 11

Syndicated Loans, Loan-only Credit Default Swaps and CDS Legal Documentation[1]

INTRODUCTION

Loan-only credit default swaps (LCDS) are a later development of the over-the-counter (OTC) credit derivative. LCDS share the purpose of credit default swaps (CDS) in that they allow trading the credit risk associated with some debt obligation. 'Traditional' CDS are not intended to reference leveraged loans, an asset class that has become the primary funding source for sub-investment grade companies. In this chapter, we provide a detailed discussion of the characteristics of single-name US and European LCDS, and compare them to those of vanilla CDS. As background, we take a closer look at the differences between leveraged loans and high-yield bonds, as both are typical underlyings in LCDS and CDS, respectively.

The Emergence of LCDS

To raise debt capital, companies may issue bonds or loans (as well as other debt-like instruments not of relevance here), both of which are associated with a certain seniority or ranking. In a credit event, the borrower's

[1] This chapter was written by Timo S. Schläfer and Marliese Uhrig-Homburg. The authors would like to thank Karin Artmann for her very valuable comments and suggestions.

TABLE 11.1 Typical priorities of corporate bonds and loans of investment grade and sub-investment grade borrowers.

	Investment-grade borrower	Sub-investment-grade borrower
Bonds	• Senior unsecured	• Senior secured (high-yield bonds)
Loans	• Senior unsecured	• Senior secured (leveraged loans/syndicated secured loans)

remaining assets are distributed according to a waterfall: obligations with the highest seniority are repaid first, and only if assets remain thereafter are obligations with lower seniorities repaid. Further, debt instruments may be secured or unsecured: if certain of the borrower's assets are ring-fenced to serve as collateral for the lenders under a particular obligation only, this obligation is called 'secured'. Together, seniority and collateral determine the *priority* of an obligation. As illustrated in Table 11.1, bonds and loans issued by investment-grade companies, as well as bonds issued by sub-investment grade companies, called 'high-yield bonds', are typically senior unsecured. However, loans issued by sub-investment grade companies are typically senior secured. Often, these are called 'leveraged loans' or 'syndicated secured loans'. We use both terms interchangeably.

CDSs are used primarily to risk mitigate or trade the credit risk associated with senior unsecured bonds of a specific reference entity. Reference entities usually are financial institutions, corporate borrowers and governments. CDSs are in theory not intended to reference leveraged loans because they do not, among other things, adequately account for the 'secured' feature of these loans. As a result, credit derivatives on this asset class were generally not available until recently, or only on a bespoke basis. This is noteworthy if one considers that leveraged loans constitute the primary funding source for sub-investment grade borrowers.

LCDSs provide the opportunity to trade the credit risk associated with leveraged loans. Thus, they complement 'traditional' CDS. In June 2006, the International Swaps and Derivatives Association (ISDA) published standard documentation for single-name US LCDS. An updated version of this documentation became available in May 2007. In July 2007, ISDA published standard documentation for single-name European LCDSs, which was updated in March 2008. While LCDSs had been traded on a bespoke basis before, such documentation was seen as a prerequisite for a further evolution of the LCDS market, much as comparable language was for the CDS market.

Motivation for Using LCDS[2]

The benefits of LCDS are in many ways analogous to those of CDS. Direct access to syndicated secured loan issuances (that is, access through the primary market) is, by definition, reserved for syndicate members. Further, secondary market trading of these loans often is thin, despite having developed strongly in recent years. LCDS mitigate these issues as they provide access to syndicated secured loans without use of the cash market. This is of particular interest to managers of synthetic collateralised loan obligations (CLOs), hedge funds, insurance companies and other institutional investors who seek efficient, tax- and cost-saving ways to invest in these loans, but may not be able to participate directly in syndicated lending due to regulatory restrictions and banking monopoly laws. Thus, these investor groups may be seen as natural sellers of credit risk protection.

Loan syndicate members, on the other hand, are natural buyers of credit risk protection. They are interested in shifting credit risk from their balance sheets, particularly in light of the regulatory standards set forth by Basel II. These require banks, among other things, to match their credit risk exposure arising from investments in debt-like instruments by a certain amount of own equity that depends on the degree of that instrument's risk. This 'risk weighting' is particularly high for leveraged loans, tying up banks' equity when investing in those loans. With credit protection in place (that is, purchase of LCDS), banks can hedge their positions and thus reduce risk weightings without actually having to sell their loans. This benefits existing client relationships and is particularly advantageous if secondary market trading of these loans is illiquid.

Further, LCDS enable investors to pursue trading strategies that require short positions in leveraged loans. Shorting loans is generally not possible in the cash market. However, investors can now hold such a position by entering into an LCDS as protection buyers.

It was expected that LCDS would become a widely accepted derivative instrument in the long term. However, the 2007–2008 recession had a negative impact on the market; in the second half of 2008, the LCDS market dried up almost completely. While it remains uncertain when liquidity will return, as the global economy recovers and bank lending volumes increase again, the demand and liquidity in LCDS should return concurrently.

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[2] Many of the points mentioned here are also discussed in Bartlam and Artmann (2007a) and Fitch (2006).

LEVERAGED LOANS AND HIGH-YIELD BONDS COMPARED

LCDS are in many ways similar to CDS, yet they possess some distinct features that set them apart. The main differences arise as a result of the underlying being a leveraged loan instead of a bond that in turn has significant consequences for the documentation aspects of LCDS. In this section, we compare the typical characteristics of leveraged loans and high-yield bonds. The comparison of these two debt instruments is of particular relevance since a sub-investment grade company may have both of them outstanding. Consequently, LCDS as well as CDS may exist for a particular reference entity *at the same time*. When comparing these two instruments, some knowledge of the respective underlying is required.

Definition of 'High-yield Bond' and 'Leveraged Loan'

High-yield bonds are bonds with a sub-investment grade rating; that is, BB+ or lower according to the rating methodologies of Fitch and S&P and Ba1 or lower according to that of Moody's. The definition of *leveraged loan* is a little less clear-cut. Although not used uniformly, a leveraged loan generally is a loan with a sub-investment grade rating and/or a certain spread, and sometimes a certain debt/EBITDA ratio of the borrower. S&P, for instance, calls a loan 'leveraged' if it is rated sub-investment grade or if it is rated investment grade, but pays interest of at least LIBOR + 125 bps. Bloomberg uses a hurdle rate of LIBOR + 250 bps. Together, we refer to leveraged loans and high-yield bonds as 'high-yield debt'.

Origination Process and Private versus Public Information

Leveraged loans may be arranged either between a borrower and a single lending bank, or, more commonly, between a borrower and a syndicate of lending banks. In the latter case, one (or more) of the lending banks acts as lead arranger. Before any other lending banks are involved, the lead arranger conducts detailed due diligence on the borrower. Also, lead arranger and borrower agree on the basic transaction terms such as size of the loan, interest rate, fees, loan structure, covenants and type of syndication. These terms are documented in a 'loan agreement'. Based on the information received in the due diligence process, the lead arranger prepares an information memorandum, also called 'bank book', which is used to market the transaction to other potential lending banks or institutional investors.

Together, the lead arranger and the other lenders constitute the primary market. If the transaction is an 'underwritten syndication', the lead arranger guarantees the borrower that the entire amount of the loan will be placed at a predefined price. If the loan is undersubscribed at that price, the lead arranger is forced to absorb the difference. If the transaction is a 'best efforts syndication', the lead arranger tries to place the loan at the predefined terms but will, if investor demand is insufficient, adjust these terms to achieve full placement. Alternatively, the lead arranger may cancel the transaction. In recent years, it has become market custom to use 'market-flex language' that allows the lead arranger to adjust the pricing of the loan to steer investor demand. Market-flex language has made best efforts syndications the rule.

The information memorandum typically includes historical and forward-looking financials of the borrower, an industry overview, and the terms and conditions of the transaction. The exact content and form of the information memorandum is at the discretion of the lead arranger. Some of the information included in the document, such as forward-looking financials, will be private information not available in the public domain. Anyone with access to such private information is not permitted to trade the borrower's public securities for a certain period of time. Loans are therefore *private debt instruments* and the information transmitted between the borrower and the lending syndicate is considered confidential. Up until the early 1990s, this was not much of an issue as syndicate members used to hold leveraged loans until maturity and were rarely transferred to outsiders.

The origination process for high-yield bonds is organised by a lead arranger and a group of dealers. The transaction terms agreed between lead arranger/dealers and the borrower are set out in the 'bond indenture'. Based on the information received in the due diligence process, the lead arranger prepares a prospectus. An advanced draft of such document, commonly referred to as a 'red herring', is used to market the bonds to investors. The lead arranger or any of the dealers may invest in the bonds in the primary market as initial purchasers. At the issuance stage, they act as underwriters or as placement agents. If they act as underwriters, they are obliged to purchase from the borrower all those bonds that could not be placed with investors. If they act as placement agents, they are obliged to use best efforts to place the bonds with investors, but if they are not able to do so, they have no obligation to purchase the remainder. If the lead arranger or dealers have acquired bonds on the primary market, they may either hold on to these bonds or sell them on the secondary market.

For public bond offerings, the content of the prospectus is subject to detailed legal and regulatory requirements. In practice, the prospectus includes similar information as the information memorandum used in leveraged loan transactions, but typically lacks forward-looking financials and other information that is not available in the public domain. Exchange-listed bonds are therefore *public debt instruments* and can be traded much more easily than leveraged loans.[3]

Priority

Leveraged loans are usually secured by particular assets of the borrower. These assets are listed in the loan agreement and may comprise *all* tangible and intangible assets of the borrower. This means that in the event of default, lenders can take possession of these assets, liquidate them and use the proceeds to satisfy their claims in the order of priority stipulated in the loan agreement. This happens before claims of any unsecured lenders are satisfied. High-yield bonds, on the other hand, are mostly senior unsecured securities (less frequently, high-yield bonds are senior secured, senior subordinated or junior subordinated). This means that the rights of investors in such bonds are not satisfied out of a pool of secured assets, ring-fenced in the event of default of the borrower. Instead, unsecured creditors' claims are satisfied out of the other, general assets of the borrower, available for distribution to all its unsecured creditors ahead of any distribution to equity holders. If the assets are not sufficient to repay the borrower's obligations to all unsecured creditors, repayment of claims will be apportioned.

Structure of Leveraged Loans

Leveraged loans typically consist of a revolving credit facility or 'revolver' and 'term loans'. The term loans are usually tranched into an amortising term loan (term loan A), provided by the syndicate banks, and institutional tranches (term loans B, C and D), provided by institutional investors. In the US, amortising term loans have become increasingly rare as institutional investors are now the primary buyers of leveraged loans. The term loan D may represent a further subdivision, called 'second lien tranche', which is subordinated to term loans A, B and C, called 'first lien tranches', but ranks senior to all other debt of the borrower. Historically, this structure has produced significantly higher recovery rates of first lien tranches compared to second lien tranches.

The term loan A is usually repaid on an amortising basis on scheduled repayment dates during its life, whereas term loans B, C and D are mostly subject to bullet repayment; that is, a one-off repayment on the maturity date. Once repaid, term loans cannot be re-borrowed. This is the principal

[3] Not all bonds are listed on an exchange. Unlisted bonds are private debt instruments and may be more difficult to trade.

		Lien	Lender	Repayment
Revolving credit facility			Banks	Discretionary
Term loans	**A**	First lien		Amortising
	B			
	C		Institutional investors	Bullet
	D	Second lien		

FIGURE 11.1 Typical structure of leveraged loans.

difference compared to the revolving credit facility, usually provided by syndicate lenders, which allows the borrower to borrow, repay and re-borrow funds during the life of the loan in accordance with predetermined conditions. In addition to interest on borrowed funds, borrowers are charged a commitment fee on unused funds. Revolvers are often used to fund working capital and capital expenditure requirements that can fluctuate significantly over time. This is shown at Figure 11.1.

Coupon Payments

Leveraged loans pay floating rate coupons. These are composed of LIBOR (or another inter-bank rate, depending on the loan's currency) plus a certain spread (that is, risk premium) and are typically payable quarterly. Often, the spread of leveraged loans is not fully fixed, but moves according to a pricing grid predefined in the loan agreement: if the borrower's credit condition improves, the spread decreases and vice versa.

Coupons of high-yield bonds are mostly fixed rate and are payable semi-annually or annually. Less frequently, high-yield bonds are zero coupon bonds or pay floating rate coupons. The latter became more popular in 2004 and 2005 when interest rates where generally rising.

Maturity and Prepayment

Leveraged loans commonly mature between 7 to 10 years after issuance. The *effective* life of leveraged loans, however, tends to be significantly shorter as the borrower is typically allowed to prepay or 'call' the loan at any time at no or limited premium. High-yield bonds commonly have a maturity of 7 to 10 years, as well, but are not callable at all during the first half of their life and only at a premium price thereafter. Usually, this price is par plus 50% of the coupon in the first year the bond can be called, declining linearly to par until maturity. Less frequently, high-yield bonds are convertible into the borrower's equity or contain a put provision that allows lenders to demand early prepayment.

Covenants

Loan agreements and bond indentures usually list a series of covenants that set certain limits within which borrowers must operate their business. Generally speaking, covenants are intended to prevent borrowers from taking action that comes at the expense of lenders, such as further increasing financial leverage. Also, covenants provide an early warning if the borrower's credit condition deteriorates and allow lenders to take pre-emptive measures and influence borrowers' behaviour. Lenders usually check adherence to covenants on a quarterly basis. In the worst case, a covenant breach can trigger a technical default and the loan or bond becomes due and payable immediately. Fitch (2007b) and Moody's (2007) show that tight covenants indeed provide a meaningful protection of enterprise value and ultimately lead to higher recovery rates on defaulted obligations. Generally, covenant packages tend to be more comprehensive for lower rated borrowers.

Several types of covenants exist. Affirmative covenants require the lender to take certain action, such as paying interest in a timely manner. Negative covenants, on the other hand, *prohibit* the lender from taking certain action, such as selling assets, issuing further debt that ranks *pari passu* or senior or making major acquisitions. Financial covenants stipulate certain risk measures or performance metrics that the borrower must not exceed or has to achieve, respectively. Of these, five major types exist. Coverage covenants specify a certain minimum ratio of cash flow or earnings to expenses, interest or other charges. Leverage covenants specify a maximum ratio of debt to equity or cash flow. Current ratio covenants specify a minimum ratio of current assets to current liabilities. Tangible-net-worth covenants specify a minimum level of net tangible assets. Capital expenditure covenants require the borrower to limit capital expenditures to a certain amount.

Covenants can be either incurrence or maintenance covenants. Incurrence covenants prohibit the borrower to actively breach a covenant. Maintenance covenants are significantly stricter: They require the borrower to actively avoid that a covenant is breached. For instance, if a leverage covenant demands a certain maximum debt-to-cash-flow ratio and this ratio is exceeded because the borrower's cash flow worsens, this would constitute a breach of a maintenance covenant, but not of an incurrence covenant. A breach of the latter would only occur if the maximum ratio is exceeded due to a particular action of the borrower; for instance, the issuance of additional debt.

Leveraged loans are generally subject to maintenance covenants whereas high-yield bonds are issued with incurrence-based covenants.

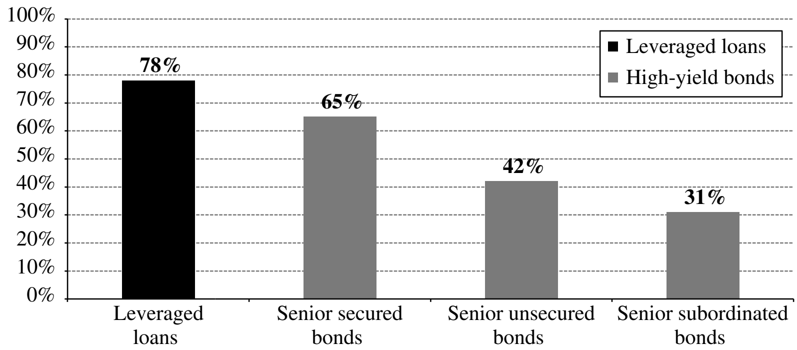

FIGURE 11.2 Average recovery rates of US leveraged loans and high-yield bonds, January 1998–September 2003.
Source: Prudential Investment Management (2006).

Historical Recovery Rates

The higher priority of leveraged loans and their more restrictive covenant packages efficiently limit lenders' credit risk exposure. As a result, historical recovery rates of leveraged loans are significantly higher than those of high-yield bonds.

As Figure 11.2 shows, lenders were able to recover 78% of the notional amount of defaulted US leveraged loans between January 1998 and September 2003. During the same period, the recovery rate of senior unsecured high-yield bonds was 42%, a little more than half of that value. As one would expect, the recovery rate of senior secured (senior subordinated) bonds was higher (lower) than that of senior unsecured bonds. Other studies confirm these figures: Moody's (2004) finds that North American recovery rates of leveraged loans are on average about 39% higher than those of similarly rated high-yield bonds. Fitch (2007a) finds that the average recovery rate of US senior unsecured and senior secured high-yield bonds between 2000 and 2006 was 39% and 71% respectively.

Secondary Market Trading

It is desirable for the pricing of derivatives that the price of the respective underlying can be observed. Secondary market trading volumes of listed high-yield bonds can be significant. Leveraged loans, however, are OTC instruments and trade less liquid. However, their trading volumes have increased substantially in recent years, particularly in the US where several factors have contributed to this development since the early 1990s. First, non-bank investors such as CLOs, hedge funds, pension funds and insurance companies have entered the loan market on a large scale. When selling to these investors, syndicate members have to provide at least some basic information on the loan, such as detail on interest rates, covenants and collateral, based on which its value can be assessed. The Loan Syndications and Trading Association (LSTA) and the Loan Pricing Corporation (LPC) operate databases that make available this information and thus greatly contribute to the tradability of leveraged loans. Second, transfer provisions in syndicated loan agreements have over time been scaled down in recognition of increased trading activity and the fact that many loans are now originated to be securitised. Transfer provisions may require the borrower's consent to a transfer of loans from one investor to the other and therefore hamper secondary market trading. Third, trade journalism focusing on the loan market has added to the information available in the public domain.

Table 11.2 is an overview of the discussion in this section.

TABLE 11.2 Summary of typical terms of leveraged loans and high-yield bonds.

	Leveraged loans	High-yield bonds
Origination	• Through single bank or syndicate	• Through lead arranger(s) and dealers
Information	• Private instrument, especially in Europe	• Public instrument (unless not listed)
Priority	• Senior secured	• Mostly senior unsecured
Facilities	• Revolver, amortising term loan (becoming less common), institutional term loans	• N/A
Principal repayment	• Amortising term loan: scheduled dates, institutional term loans: bullet	• Bullet
Coupon	• Floating rate, paid quarterly	• Mostly fixed rate, paid semi-annually or annually, less often floating rate or zero-coupon
Maturity	• 7 to 10 years	• 7 to 10 years
Call protection	• None or very limited	• Not callable during first half of life, callable at premium price thereafter
Covenants	• Maintenance-based	• Incurrence-based
Secondary market trading	• Weak to strong	• Mostly weak but improving

STANDARD DOCUMENTATION FOR SINGLE-NAME LCDS AND CDS

The organisations most closely involved in providing a framework for standardised LCDS trading are ISDA and MarkIt. ISDA provides standard documentation for OTC derivatives in general and CDS and LCDS in particular. MarkIt administrates the LCDS indices and has developed a standardised process to identify suitable reference obligations, as well as an auction mechanism to settle US LCDS and CDS. In this section, we review the standard documentation for single-name LCDS and CDS published by these organisations. We concentrate on those features we deem relevant to develop a good understanding of the product, leaving aside some of the more technical aspects. Full details are available from the original documents and all quotes are from these documents.

Structure of the Standard Documentation for CDS and LCDS

Participants in the OTC derivatives market generally conclude their transactions under the 'Master Agreement' published by ISDA. It serves as an umbrella bilateral contract between parties and is currently available in the form of the 1992 and the 2002 edition.[4] Its terms and conditions comprise, among other things, provisions relating to payment netting and early termination, general representations and covenants. In the 'Schedule',[5] which is part of the Master Agreement, parties may modify these terms and conditions, and chose to apply or not apply certain elections. In addition to the Master Agreement, ISDA has published separate sets of definitions relevant for particular types of derivatives. Each set of definitions incorporates a 'Confirmation', which parties use to document the agreed details of a particular transaction. As a result of this architecture, the Master Agreement, together with each possible set of definitions and the associated Confirmation, is capable of covering a wide range of derivative instruments.

Credit derivatives are one class of derivatives that can be covered by the Master Agreement. The 2003 Credit Derivatives Definitions[6] is the relevant set of definitions for documenting credit derivative transactions. In our following discussion, we refer to the Master Agreement and the 2003 Credit Derivatives Definitions together as 'CDS Standard Terms'. CDS Standard Terms apply to both the US and the European CDS market.

[4] ISDA (1992 and 2002a).
[5] ISDA (2002b).
[6] ISDA (2003).

The 2003 Credit Derivatives Definitions are equally applicable to LCDS transactions. However, given the particularities of the leveraged loan market and the special nature of leveraged loans as reference obligations under LCDS, amendments to the Credit Derivatives Definitions became inevitable. In the US, the standard LCDS set of definitions was first published by ISDA in June 2006 in the form of the 'Syndicated Secured Loan Credit Default Swap Standard Terms Supplement and Confirmation'.[7] The documentation was revised in May 2007.[8] The revision, among other things, introduced an auction mechanism for physical settlement of LCDS. In the following discussion we refer to the Master Agreement, the 2003 Credit Derivatives Definitions and the 2007 US set of LCDS definitions together as 'US LCDS Standard Terms'.

In Europe, ISDA published the 'Standard Terms Supplement for Use With Credit Derivative Transactions on Leveraged Loans and Confirmation', in July 2007.[9] This set of definitions was revised in March 2008.[10] In our following discussion we refer to the Master Agreement, the 2003 Credit Derivatives Definitions and the 2008 European set of LCDS definitions together as 'European LCDS Standard Terms'. Figure 11.3 provides an overview of mentioned documents.

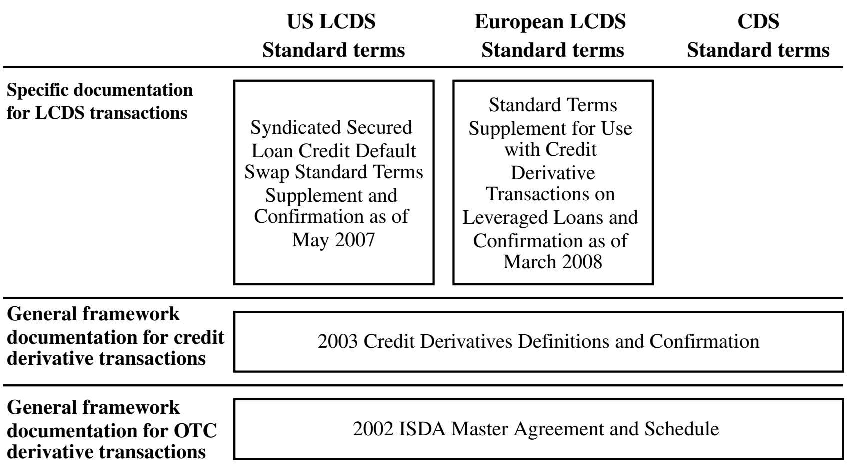

FIGURE 11.3 Structure of the standard documentation for LCDS and CDS as published by ISDA.

[7] ISDA (2006a and 2006b).
[8] ISDA (2007a and 2007b).
[9] ISDA (2007c and 2007d).
[10] ISDA (2008a and 2008b).

Investors' Requirements Regarding LCDS Standard Terms[11]

Earlier we mentioned some possible objectives of investors who participate in the LCDS market. In some cases, these objectives diverge and consequently investors' preferences with regard to some LCDS Standard Terms are not always identical. In particular, two quite distinct investor groups exist: the first seeks a tool for *trading* the credit risk associated with syndicated secured loans, the second is primarily interested in *hedging* such risk. Members of the first group, often managers of synthetic CLOs, hedge funds and other institutional investors, are concerned with liquidity and ease of transfer. They want LCDS to reflect the *general* credit risk associated with a particular Reference Entity. This in turn means that the LCDS should continue even if the Reference Entity repays certain of its obligations that are Reference Obligations under the LCDS. Members of the second group, such as financial institutions, often seek an efficient hedging tool that fulfils the requirements of Basel II. They desire to use LCDS to hedge away the credit risk associated with a *specific* loan, which they, as syndicate members, have on their books. If the Reference Entity repays the loan, there is no longer a risk to be hedged and the LCDS should terminate, too. Also, they require the inclusion of 'Restructuring' as a credit event, or otherwise the hedge would not provide full capital relief according to the rules and regulations of Basel II.

This divergence in investors' objectives has left its mark on some of the LCDS Standard Terms such as those referring to the Reference Entity, the Reference Obligation, credit events, settlement procedures and early contract termination. Generally speaking, US LCDS Standard Terms are more 'trader-friendly', due to the traditionally strong position of the institutional investor base in the US, whereas European LCDS Standard Terms are more 'hedger-friendly', or at least provide some flexibility that recognises the particular requirements of banks that still play a dominant role in the European syndicated loan market. The remainder of this section is dedicated to a more detailed review of (i) US versus European Standard Terms as well as (ii) LCDS versus CDS Standard Terms.

Reference Entity and Reference Obligation

Under US LCDS Standard Terms, parties specify a particular Reference Entity in the Confirmation. Parties then have the choice between either (i)

[11] Many of the points mentioned here are also discussed in Bartlam and Artmann (2007a and 2007b). They are referenced and repeated with permission.

stipulating as Reference Obligation a particular loan or tranche of a loan issued by that Reference Entity, or (ii) electing 'Secured List' and specifying a 'Designated Priority' that is either 'first lien', 'second lien' or 'third lien'. In the case of (ii), which is the market standard, the Reference Obligation is the loan that is specified as the currently applicable Reference Obligation in the 'Relevant Secured List' published by MarkIt.

The procedure for filling and keeping up-to-date the Relevant Secured List is described in the 'Syndicated Secured Loan Polling Rules'[12] as last published by MarkIt in December 2007. In short, this procedure is as follows. Any of the participants eligible for loan polling, called 'Specified Dealers'[13] or any of their affiliates may request MarkIt, currently the 'Secured List Publisher',[14] to initiate a poll with respect to a particular loan. If a poll has been initiated, MarkIt asks Specified Dealers whether the loan in question (i) is currently outstanding (also applicable to unfunded lending commitments), (ii) arises under a syndicated loan agreement, and (iii) has a priority of at least third lien. Specified Dealers are also asked to specify the loan's priority (first to third lien). If a quorum of Specified Dealers affirms questions (i) to (iii), that quorum's specification of the loan's priority is recorded. For a particular Reference Entity, MarkIt then composes the Relevant Secured List, which details the syndicated secured loans issued by that Reference Entity together with their priority as ascertained by previous polls. Finally, for each Reference Entity and for each of the three priorities, MarkIt, in consultation with Specified Dealers, selects one loan as Reference Obligation (if one or more loans of a given priority exist). This process is repeated whenever required, so that the Relevant Secured Lists are up to date with the currently outstanding loans of Reference Entities. The Reference Obligation thusly specified is then applicable under a US LCDS if 'Secured List' and a Designated Priority, but no specific Reference Obligation is stipulated.

A similar procedure, called 'Syndicated Secured Dispute Resolution', comes into effect if any of the parties disputes that the Reference Obligation satisfies the 'Syndicated Secured' characteristic. A loan is Syndicated Secured if it is an 'obligation [. . .] i) that arises under a syndicated loan agreement and ii) that [. . .] trades as a loan of the Designated Priority [. . .] in the primary or secondary loan market'.

[12] MarkIt (2007a).

[13] Many of the large international banks active in credit derivatives trading are Specified Dealers. The composition of Specified Dealers may change. Rules for polling eligibility are specified in MarkIt (2007a), pA-1.

[14] The Secured List Publisher is appointed by Specified Dealers. See ISDA (2007a), Sec1.

This means that unfunded revolvers or letter of credit commitments can be valid Reference Obligations.

Based on the Syndicated Secured Loan Polling Rules and the Syndicated Secured Dispute Resolution, Specified Dealers and not necessarily parties decide whether a loan is Syndicated Secured and what its Designated Priority is and determine the then current Reference Obligation for a particular Reference Entity. This process introduces consistency and certainty with regard to the legal interpretation of 'syndicated' and 'secured', and creates a standardised product where the Reference Obligation of a particular Reference Entity and Designated Priority is consistent across the market.

Under European LCDS Standard Terms, the determination of the Reference Obligation is by way of identifying in the Confirmation a specific loan agreement of the Reference Entity, the 'Reference Credit Agreement'. Further, parties have the option to specify a particular 'tranche or facility which constitutes a loan' under the Reference Credit Agreement that also 'may comprise of a credit facility with an undrawn commitment'. If only a Reference Credit Agreement is specified, 'each tranche or facility which constitutes a loan under the Reference Credit Agreement' is a Reference Obligation. The Reference Entity itself is not directly specified, but is automatically defined as 'any person [. . .] who is a borrower' under the Reference Obligation. One point to note here is that European LCDS Standard Terms, in contrast to US LCDS Standard Terms, do not explicitly require the Reference Obligation to be syndicated or secured. European LCDS Standard Terms are however intended to be used for leveraged loans that are, as discussed earlier, virtually always syndicated and secured.

The basic structure of US LCDS Standard Terms and European LCDS Standard Terms is thus quite different. US LCDS Standard Terms emphasise the general credit risk associated with the Reference Entity and are thus *Reference Entity-based*. European LCDS Standard Terms focus on the credit risk associated with a particular Reference Obligation of a Reference Entity and are rather *Reference Obligation-based*. The different requirements of market participants, being trading or hedging, have thus found their expression in the way LCDS Standard Terms have been drafted.

A CDS, on the other hand, can be set up either as a Reference Entity- or Reference Obligation-based contract. Under CDS Standard Terms, parties specify a particular Reference Entity in the Confirmation. Also, they may specify a Reference Obligation, but are not required to do so. If they do not, there is no Reference Obligation. This may seem peculiar, but a particular Reference Obligation is not necessarily required to determine (i) whether a credit event has occurred or (ii) what obligations are permissible deliverable obligations in physical delivery.

Substitute Reference Obligation and Contract Cancellation

As discussed earlier, leveraged loans may generally be prepaid at no or limited premium. This prompts the question as to what happens to an LCDS if its Reference Obligation is repaid. US LCDS Standard Terms are designed to avoid, if possible, a cancellation of the LCDS in the event that the Reference Obligation ceases to exist. For that end, they dispose of a substitution mechanism that comes into effect if parties have either (i) specified a particular Reference Obligation that has been repaid or terminated or, which, in the opinion of the 'Calculation Agent',[15] has been materially reduced or fails to satisfy the Syndicated Secured characteristic discussed earlier, or (ii) stipulated 'Secured List' and the Relevant Secured List is withdrawn. A withdrawal of the Relevant Secured List only occurs if none of its constituents remain. If, on the other hand, the Relevant Secured List just changes, but still lists one or more loans of the Reference Entity, this will not trigger the substitution mechanism.

In either case, the Calculation Agent will commence the search for a 'Substitute Reference Obligation', which has to satisfy the Syndicated Secured characteristic. If such a loan is found, it replaces the prior Reference Obligation and the LCDS continues to exist. Only if such a loan cannot be found will the LCDS cancel. Parties may dispute that the Substitute Reference Obligation satisfies the Syndicated Secured characteristic in which case a Syndicated Secured Dispute Resolution comes into effect.

European LCDS Standard Terms are designed to avoid cancellation as well. However, parties have the flexibility to tie the LCDS more closely to the fate of a particular loan. In the LCDS Confirmation, 'Continuity' applies by default, but parties can stipulate that it shall not. If Continuity applies and the Reference Obligation is repaid in full, the Calculation Agent will determine whether a refinancing has occurred and if so, whether there is a 'Successor Credit Agreement' to the Reference Credit Agreement. Each tranche or facility under the Successor Credit Agreement that is secured is a Substitute Reference Obligation. This substitution mechanism avoids legal uncertainty, and the LCDS will only terminate if no Successor Credit Agreement (and therefore no Substitute Reference Obligation) exists or if no refinancing has occurred. If Continuity does not apply and the Reference Obligation is repaid in full, the LCDS terminates. A termination of the LCDS is associated with zero costs for parties.

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[15] In the Confirmation, parties specify a Calculation Agent. The Calculation Agent takes on certain administrative tasks with regard to an LCDS or CDS transaction. Often, the Calculation Agent is the protection seller.

Determining whether or not a Successor Credit Agreement exists requires information that is, at least in the European leveraged loan market, private information only shared between syndicate members. As a result, European LCDS Standard Terms include provisions that allow either of the parties to determine that there is a Successor Credit Agreement if the Calculation Agent does not dispose of the relevant private information. If neither the Calculation Agent nor parties have such information and are therefore unable to make such determination, the European LCDS will terminate at zero costs for parties. Hence, issues associated with a possible lack of public information are shifted on to parties.

An earlier draft of the European LCDS Standard Terms did not foresee substitution of the Reference Obligation, but stipulated cancellation in any event, should the Reference Obligation cease to exist. This original specification of terms reflected the particular needs of market participants, such as banks, intending to use LCDS primarily as a hedging product. In contrast, European LCDS Standard Terms as they stand now should also appeal to investors who are concerned with taking a view on the credit risk associated with a particular borrower rather than with a particular loan of that borrower. Such specification should generally result in improved liquidity and ease of transfer, and is comparable to US LCDS Standard Terms that, as mentioned earlier, have a strong focus on trader-friendliness.

Amortisation of leverage loans (specifically of the term loan A) has no effect on the LCDS under US or European LCDS Standard Terms unless such amortisation leads to full repayment of the Reference Obligation.

If, under CDS Standard Terms, a Reference Obligation is specified and is redeemed in whole or has been materially reduced, the Calculation Agent commences the search for a Substitute Reference Obligation. The CDS does not terminate early in any event and even if no Substitute Reference Obligation is found, the protection buyer continues to pay the premium until the day on which the CDS expires ('Scheduled Termination Date'). CDS Standard Terms are thus quite different from LCDS Standard Terms in that CDS contracts *never* cancel.

Credit Events

To determine whether a Credit Event has occurred, it is necessary to define what circumstances cause it, but also which of the Reference Entity's obligations must be affected by such circumstances. It is not always the Reference Obligation that must be affected. Rather, Standard Terms require parties to specify one (or more) 'Obligation(s)' of the Reference Entity by stipulating one 'Obligation Category' and one or more 'Obligation Characteristics'. It is this Obligation that is used to decide whether a Credit Event has occurred or not. The Obligation can be, but does not have to be, restricted to the Reference Obligation.

Obligation Categories as set out in the 2003 Credit Derivatives Definitions are:

- 'Payment': 'any obligation (whether present or future, contingent or otherwise) for the payment or repayment of money, including, without limitation, Borrowed Money'. Payment is the broadest of all Obligation Categories;
- 'Borrowed Money': 'any obligation (excluding an obligation under a revolving credit arrangement for which there are no outstanding, unpaid drawings in respect of principal) for the payment or repayment of Borrowed Money';
- 'Reference Obligations Only': 'any obligation that is a Reference Obligation';
- 'Bond': any bond that is included in Borrowed Money;
- 'Loan': any loan that is included in Borrowed Money. According to the definition of Borrowed Money, this does not include undrawn revolvers or letter of credit commitments;
- 'Bond or Loan': either Bond or Loan as defined above.

Obligation Characteristics as set out in the 2003 Credit Derivatives Definitions apply with respect to the chosen Obligation Category unless such category is 'Reference Obligations Only'. Obligation Characteristics are:

- 'Not Subordinated': The Obligation must not be subordinated to the most senior Reference Obligation or, if no Reference Obligation is specified in the Confirmation, Obligations must be 'unsubordinated Borrowed Money Obligations', which effectively are funded senior unsecured obligations;
- 'Specified Currency': The Obligation must be payable in the currencies specified in the Confirmation;
- 'Not Sovereign Lender': the Obligation must not be primarily owed to a sovereign or supranational organisation, including obligations generally referred to as 'Paris-Club debt';
- 'Not Domestic Currency': The Obligation must be payable in any currency other than the domestic currency;
- 'Not Domestic Law': The Obligation must not be governed by the laws of the jurisdiction of the Reference Entity;
- 'Listed': The Obligation must be quoted, listed or exchange-traded;

- 'Not Domestic Issuance': At the time of issuance, the Obligation must not have been intended for sale primarily on the domestic market of the Reference Entity.

The 2003 Credit Derivatives Definitions stipulate six possible credit events. Whether or not one has occurred will be tested, with the exception of Bankruptcy, with respect to the Obligation(s) (that is, those obligations that are of the stipulated Obligation Category and satisfy all of the stipulated Obligation Characteristics). The credit events are:

- 'Bankruptcy': The Reference Entity has become insolvent or is unable to pay its debts or is dissolved or liquidated other than under a merger or consolidation;
- 'Obligation Acceleration': An Obligation of the Reference Entity has become due and payable due to occurrence of default or a similar condition;
- 'Obligation Default': An Obligation of the Reference Entity has become capable of being declared due and payable due to the occurrence of a default or a similar condition;
- 'Failure to Pay': After the expiration of any applicable grace period, the Reference Entity fails to make payments when due and payable under an Obligation;
- 'Repudiation/Moratorium': An authorised person of the Reference Entity or a Governmental Authority repudiates or rejects the validity of an Obligation of the Reference Entity or declares a moratorium, standstill, roll-over or deferral with regard to such Obligation;
- 'Restructuring': With regard to an Obligation one or more of the following occurs: 'i) a reduction in the rate or amount of interest payable [. . .]; ii) a reduction in the amount of principal or premium payable at maturity or at scheduled redemption dates; iii) a postponement or other deferral of a date or dates for either a) the payment of accrual of interest or b) the payment of principal or premium;' iv) an adverse change in the ranking or priority of the Obligation; or v) certain changes in the currency of any payment of interest or principal. However, these criteria only apply if they result 'from deterioration in the creditworthiness or financial condition of the Reference Entity'. Also, to avoid that a Restructuring Credit Event is triggered by a bilateral renegotiation of Obligation terms between the borrower and a single lender, the Obligation further has to be 'held by more than three holders that are not affiliates of each other [and at least two-thirds of these holders are] required to consent to the event which constitutes a Restructuring Credit Event'.

Under US LCDS Standard Terms, credit events are always Bankruptcy and Failure to Pay. The Obligation Category is always Borrowed Money without any specific Obligation Characteristics. This means that a Credit Event can be triggered by almost any obligation of the Reference Entity (with the notable exception of undrawn revolvers).

Under European LCDS Standard Terms, credit events are always Bankruptcy, Failure to Pay and Restructuring. The Obligation Category is always Reference Obligations Only without any Obligation Characteristics. Thus, if Failure to Pay or Restructuring occurs in a loan other than the Reference Obligation, this would not trigger a credit event. This is different from US LCDS and again shows the Reference Obligation-based approach of European LCDS.

The main reason for the inclusion of Restructuring in European LCDS Standard Terms (in contrast to US LCDS Standard Terms) is that European LCDSs were originally designed as a hedging product. As mentioned, the inclusion of Restructuring means that banks can obtain the maximum capital relief under Basel II when using LCDS to hedge the credit risk associated with a particular loan. The definition of 'Restructuring' has been amended for use in European LCDS Standard Terms to reflect the secured nature of leverage loans. In addition to the criteria mentioned above, Restructuring is triggered in the event of release or discharge of all security of the Reference Obligation, unless (i) such security is immediately replaced or (ii) the proceeds of the release or discharge are used to repay secured debt with a priority or ranking equal or senior to the Reference Obligation.

Under CDS Standard Terms, parties elect in the Confirmation the credit events that shall apply to a particular transaction. For US and European CDS transactions, it has however become market convention not to include Obligation Acceleration and Obligation Default. Typically, Repudiation/Moratorium is only used if the Reference Entity is a Sovereign Lender. Thus, frequently used credit events are Bankruptcy, Failure to Pay and Restructuring. Also, parties may elect *one* of the six Obligation Categories and *any* of the Obligation Characteristics that Obligations *each* need to satisfy. In practice, Borrowed Money is the Obligation Category commonly chosen and it is market convention not to specify any Obligation Characteristics.[16] 'Obligation' is thus generally defined as under US LCDS Standard Terms.

Figure 11.4 summarises the above discussion. As illustrated, LCDS Standard Terms do not foresee that parties choose the specifications of Credit Event, Obligation Category and Obligation Characteristics. European

[16] See Merrill Lynch (2006).

	US LCDS	European LCDS	CDS
Credit Events			
Bankruptcy	Mandatory	Mandatory	Eligible and Common
Obligation Acceleration			Eligible but Less Common
Obligation Default			Eligible but Less Common
Failure to Pay	Mandatory	Mandatory	Eligible and Common
Repudiation/Moratorium			Eligible but Less Common
Restructuring		Mandatory	Eligible and Common
Obligation Category			
Payment			Eligible but Less Common
Borrowed Money	Mandatory		Eligible and Common
Reference Obligations Only		Mandatory	Eligible but Less Common
Bond			Eligible but Less Common
Loan			Eligible but Less Common
Bond or Loan			Eligible but Less Common
Obligation Characteristics			
None	Mandatory	Mandatory	Eligible and Common
Not Subordinated			Eligible but Less Common
Specified Currency			Eligible but Less Common
Not Sovereign Lender			Eligible but Less Common
Not Domestic Currency			Eligible but Less Common
Not Domestic Law			Eligible but Less Common
Listed			Eligible but Less Common
Not Domestic Issuance			Eligible but Less Common

Mandatory Eligible and Common Eligible but Less Common

FIGURE 11.4 Credit events, obligation category and obligation characteristics under LCDS and CDS standard terms.

LCDS Standard Terms are Reference Obligation-based in that Credit Events are only triggered if they occur in the Reference Obligation, but not in any other obligation of the Reference Entity. US LCDS Standard Terms, on the other hand, are Reference Entity-based. A Failure to Pay Credit Event is triggered if it occurs in any Borrowed Money Obligation (that is, almost any obligation) of the Reference Entity. CDS Standard Terms provide parties with a maximum of flexibility. In practice, however, specifications are comparable to US LCDS. The only noteworthy exception is Restructuring, which currently is not eligible under US LCDS Standard Terms (if the large US banks should move towards Basel II in the aftermath of the credit crisis, this might change).

Settlement

If a Credit Event occurs, certain settlement procedures come into effect. These may be physical settlement, cash settlement or a 'Credit Event Auction'.

When the CDS was first developed, it was primarily intended to serve as a tool for hedging the credit risk associated with a cash instrument. The protection buyer was thus typically long the Reference Obligation, which made physical settlement a natural choice. Following a credit event, the protection buyer could simply pass the Deliverable Obligation on to the protection seller, who in turn paid the full notional amount.

For several reasons, physical settlement no longer meets the requirements of all market participants. As protection buyers often do not hold the Deliverable Obligation, they have to source it on the secondary market, should a credit event occur. If secondary market trading is illiquid, which frequently is the case, this is problematic. Further, the total notional of outstanding CDS may exceed that of the Deliverable Obligation. This effectively means that Deliverable Obligations may have to be 'recycled' a number of times until all CDS have been settled across the market. This scarcity of the Deliverable Obligation may cause artificially high prices and an increase in volatility, as was observed when CDS on Delphi Corp. and Dana Corp. were settled in 2005 and 2006 respectively. The impact of the 2007–2008 financial crisis, including the Lehman collapse, was an increased frequency of credit events, such that physical settlement became less preferred and cash settlement more common.

Cash settlement avoids the issues of physical settlement but raises some others. Protection buyers are not required to deliver a Deliverable Obligation and in turn only receive the difference of par and the residual value of the Reference Obligation, multiplied by the notional amount. The issue here is the determination of the fair residual value.

In theory credit event auctions mitigate the issues of physical and cash settlement. They are effectively a hybrid of the two in that they determine a fair price at which all CDS are cash settled, but also allow market participants to buy or sell the Reference Obligation at that price. The first credit event auction was held in June 2005 to settle CDS referencing Collins & Aikman Corp. Since then, auctions have been used to settle CDS on a number of credit events, including for the Lehman default which fixed the settlement price at 11 cents on the dollar.[17] Credit event auctions are administrated by MarkIt and Creditex, a provider of credit derivatives execution services.

Under US LCDS Standard Terms, the default settlement procedure is a Credit Event Auction, the general terms of which are outlined in the 'LCDS Auction Rules and LCDS Auction Settlement Terms' as published by ISDA and CDS IndexCo in May 2007 and updated in September 2007.[18] A customised version of this documentation, containing auction-specific terms such as auction date, maximum quotation spread and quotation size is published for each particular auction.

Credit Event Auctions follow a two-staged process. In the first stage, 'Dealers'[19] submit bid and ask prices (expressed as per cent of the notional amount) for the Deliverable Obligations with a maximum bid–ask spread and a fixed quotation size as specified in the applicable LCDS Auction Settlement Terms. Also, Dealers have the choice to submit physical settlement requests. MarkIt then sorts bid prices in descending and ask prices in ascending order. Touching or crossing bid and ask prices are deleted and the average of the best half of the remaining bid and ask prices, respectively, is calculated. For bid prices, 'best' means 'highest' and for ask prices, 'best' means lowest. This average, rounded to the nearest 1/8th, constitutes the 'Inside Market Midpoint' (IMM), which is used in the second stage of the auction. In addition, a 'Limit Offer Cap', defined as the greater of par and the highest submitted ask price, is determined.

Physical settlement requests reflect dealers' desire to buy or sell the Reference Obligation. They are not associated with a particular price but refer to a particular volume and can simply be tallied to determine whether open interest is to buy or to sell and which notional amount, respectively. Next, MarkIt publishes the results of this first stage of the auction on http://www.creditfixings.com and auction participants are given two to three hours to digest the information.

In the second stage of the auction, the 'Final Auction Price' is determined. Suppose open interest is to sell, this happens as follows: dealers may submit limit bids with an associated quotation size. Total available bids then consist of (i) bids submitted in the second stage as just mentioned, (ii) bids submitted in the first stage that did not touch or cross with asks, and (iii) touching or crossing bids submitted in the first stage. Points (i) and (ii) are carried forward at what they are and (iii) is carried forward at the

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[17] See http://www.creditfixings.com.

[18] CDS IndexCo and ISDA (2007a and 2007b).

[19] Many of the large international banks active in credit derivatives trading are Dealers. See ISDA (2007a), Exhibit A.

IMM. Total available bids are then sorted in descending order and, starting from the top, are used to match open interest to sell. If there are not enough bids to match, the Final Auction Price is set to zero. If, on the other hand, there are enough bids to match, the smaller of the last bid used to match and the IMM plus a certain 'Cap Amount', as defined in the LCDS Auction Settlement Terms, constitutes the Final Auction Price. A common Cap Amount is 100 bps.

If open interest is to buy, the procedure is similar: dealers may submit limit asks with an associated quotation size. Total available asks then consist of (i) asks submitted in the second stage as just mentioned, (ii) asks submitted in the first stage that did not touch or cross with bids and (iii) touching or crossing asks submitted in the first stage. Again, (i) and (ii) are carried forward at what they are and (iii) is carried forward at the IMM. Total available asks are then sorted in ascending order and, starting from the top, are used to match open interest to buy. If there are not enough asks to match, the Final Auction Price is the Limit Offer Cap. If, on the other hand, there are enough asks to match, the greater of the last ask used to match and the IMM minus the Cap Amount constitutes the Final Auction Price.

In both scenarios, the IMM in conjunction with the Cap Amount is used to avoid that large off-market limit orders (that is, extraordinarily high bids if open interest is to sell and extraordinarily low asks if open interest is to buy) are submitted to manipulate the market. The Final Auction Price is then the price at which (i) all LCDS cash settle and (ii) physical settlement requests are matched.

The first Credit Event auction applied to LCDS occurred in October 2007 to settle LCDS outstanding on Movie Gallery, Inc., a US video store chain that had failed to make an interest payment on its first lien loans. The terms of this auction are available in CDS IndexCo and ISDA (2007c); MarkIt (2008a) provides an ex-post summary of the auction process.

Under US LCDS Standard Terms, the majority of credit events are expected to be settled through Credit Event Auctions. However, physical settlement applies as a fall-back option if a Credit Event Auction is not held at all or not in time, or does not result in a valid Final Auction Price.

Figure 11.5 illustrates the physical settlement process. For the sake of clarity it should be noted that the physical settlement process may be initiated at any date *prior* to the Scheduled Termination Date.

Settlement under a Credit Event Auction applies even if the physical settlement process has been initiated if either (i) the auction is announced prior to the Delivery Date, (ii) the Event Determination Date occurs before the Final Auction Price is determined and (iii) prior to the Scheduled Termination Date, the auction administrator determines that a Credit Event has occurred.

Under European LCDS Standard Terms, physical settlement applies by default and the process is as under US LCDS Standard Terms. However,

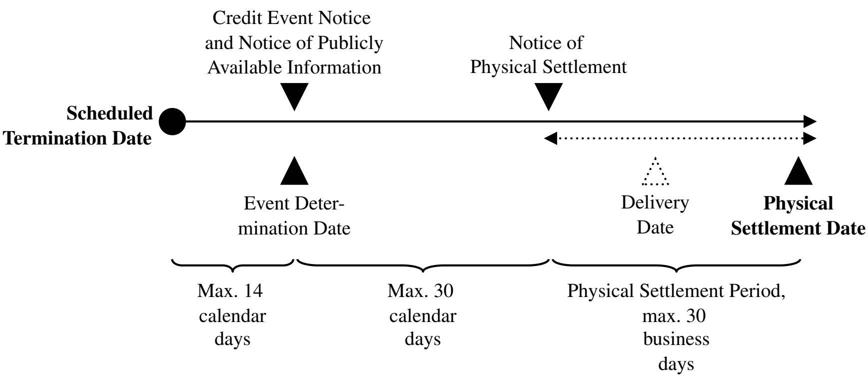

FIGURE 11.5 Latest possible physical settlement date under US LCDS Standard Terms.

parties can stipulate 'Cash Settlement Only' in the LCDS Confirmation instead. Also, cash settlement applies if physical settlement was elected, but the Deliverable Obligation has not been delivered or cannot be delivered by a particular point in time. In cash settlement, the Calculation Agent attempts to obtain quotations for the Reference Obligation from dealers[20] and these quotations are used to determine the residual value of the Reference Obligation. The protection seller then has to pay the nominal value multiplied by par minus the residual value, should that figure be positive.

Under CDS Standard Terms, parties can elect either physical or cash settlement. However, following the ISDA "Big Bang" and SNAC protocol in 2009, physical settlement is no longer practiced (see Chapter 2). In theory, they may specify whether a Notice of Publicly Available Information shall be a condition to settlement. If it is not, the Event Determination Date is just the date on which the Credit Event Notice is delivered. From there on until the Physical Settlement Date, the procedure for physical settlement is as under US LCDS Standard Terms only that parties may stipulate the length of the Physical Settlement Period.

For Cash Settlement, the procedure is as illustrated in Figure 11.6. The Event Determination Date is as under physical settlement. The Valuation Date is by default five business days after the Event Determination Date and the Cash Settlement Date is by default three business days after the Valuation Date.

Although not expressly stated in CDS Standard Terms, parties can also choose to settle under a Credit Event Auction, if such auction is announced. To do so, they have to communicate to ISDA that they adhere to the terms of the respective Credit Event Auction. The procedure is then very similar to the one for US LCDS described earlier.

[20] Dealers are selected by the Calculation Agent after consultation with parties.

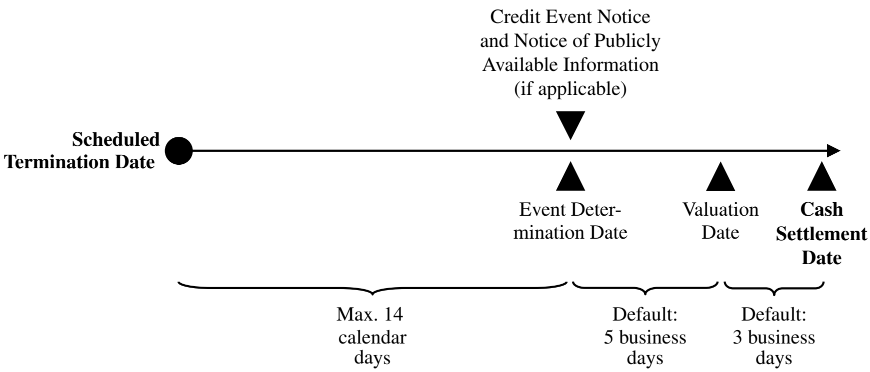

FIGURE 11.6 Latest possible cash settlement date under CDS Standard Terms.

Figure 11.7 below summarises above discussion. Credit Event Auctions are the default settlement procedure for US LCDS and eligible for CDS. Credit Event Auctions should avoid price distortions when large notional amounts need to be settled and result in a fair Final Auction Price that is consistent across the market. A revision of European LCDS Standard Terms is under way and Credit Event Auctions are expected to become the default settlement procedure for European LCDS as well.

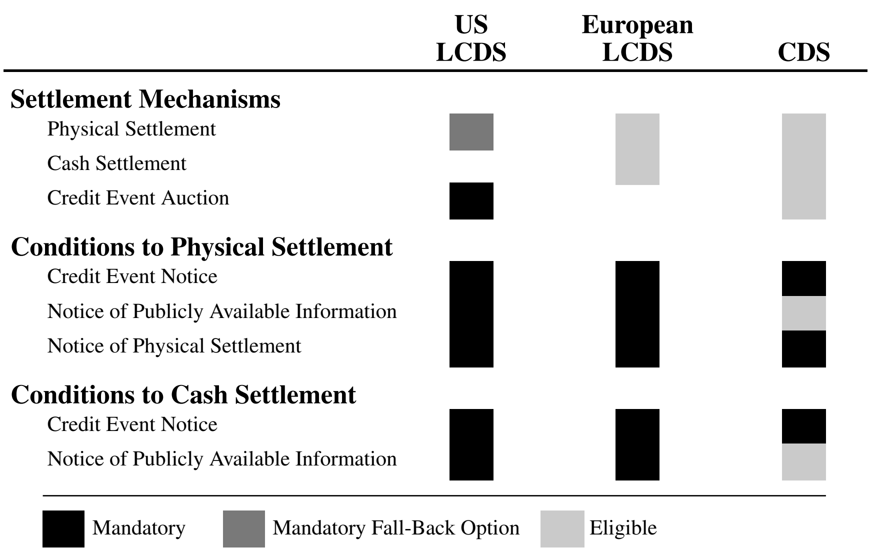

FIGURE 11.7 Settlement procedures and conditions to settlement under LCDS and CDS standard terms (pre-Big Bang).

Deliverable Obligations in Physical Settlement

As mentioned above, the residual value in cash settlement is determined with regard to the Reference Obligation. However, if physical settlement applies, Deliverable Obligations are generally not restricted to the Reference Obligation only. Reference Entities often have a great variety of outstanding obligations with very different market values. It is therefore quite important to precisely define which of these obligations are eligible Deliverable Obligations. The 2003 Credit Derivatives Definitions specify various 'Deliverable Obligation Categories' and 'Deliverable Obligation Characteristics' that determine whether an obligation is an eligible Deliverable Obligation. Deliverable Obligation Categories are identical to Obligation Categories mentioned earlier in our discussion of credit events. Similarly, Deliverable Obligation Characteristics comprise all Obligation Characteristics but include additionally:

- 'Not Contingent': there must not be any events that could cause a reduction of the notional amount of the Deliverable Obligation, other than repayment. This does not exclude convertible or exchangeable bonds;
- 'Assignable Loan' (applicable only if the Deliverable Obligation is a Loan): the Deliverable Obligation must be transferable at least to commercial banks or financial institutions without the consent of the Reference Entity;
- 'Consent Required Loan' (applicable only if the Deliverable Obligation is a Loan): the Deliverable Obligation may be a loan that can only be transferred with the consent of the Reference Entity;
- 'Direct Participation Loan' (applicable only if the Deliverable Obligation is a Loan): if the protection buyer provides the protection seller with the right to participate in a specific share of payments due under a loan, this constitutes an eligible Deliverable Obligation. If more than one of Assignable Loan, Consent Required Loan and Direct Participation Loan is specified, the Deliverable Obligation may be a loan that satisfies only one of these characteristics;
- 'Transferable': the Deliverable Obligation must be transferable to institutional investors without any contractual statutory or regulatory restriction. Transferable is applicable regardless of whether the Deliverable Obligation is a loan or not and is thus a more general characteristic than Assignable Loan;
- 'Maximum Maturity': the Deliverable Obligation must have a remaining maturity of no greater than the period specified in the Supplement (for LCDS) or the Confirmation (for CDS);

- 'Accelerated or Matured': the Deliverable Obligation must be payable at or before delivery;
- 'Not Bearer': the Deliverable Obligation must not be a bearer instrument.

Under US LCDS Standard Terms, the Deliverable Obligation Category is always Loan and Deliverable Obligation Characteristics are always Specified Currency, Not Contingent, Assignable Loan, Consent Required Loan and Maximum Maturity. The Maximum Maturity is always 30 years. Interest accrued on the Reference Obligation is not payable. In addition to the above, the Deliverable Obligation must satisfy the Syndicated Secured characteristic discussed earlier.[21] In practice, this means that often more than one Deliverable Obligation exists. These are generally those included in the Relevant Secured List for the Designated Priority, as they satisfy the Syndicated Secured characteristic. If parties disagree as to whether a particular loan satisfies this characteristic, a Syndicated Secured Dispute Resolution applies.

Under European LCDS Standard Terms, the Deliverable Obligation Category is always Reference Obligations Only and Deliverable Obligation Characteristics are not applicable. In addition, Deliverable Obligations are 'Senior Loans' which are loans 'secured by security interests over the same assets as secure [the Reference Obligation and have] a priority or ranking at least equal to the guarantees and other collateral relating to' the Reference Obligation. In practice, this means that should the Reference Entity default and should physical settlement apply, the protection buyer retains some flexibility: if for some reason the Reference Obligation or a loan of equal priority is not available for delivery (for example, if the protection buyer does not hold such loan and is not able to source it on the secondary market), a loan of higher priority can be delivered, albeit this option might of course be more expensive.

Under CDS Standard Terms, parties elect at their discretion one Deliverable Obligation Category and any number of Deliverable Obligation Characteristics that an obligation *each* needs to satisfy to be a Deliverable Obligation. By market convention, the Deliverable Obligation Category is usually 'Bond or Loan' and Deliverable Obligation Characteristics are mostly Not Subordinated, Specified Currency, Not Contingent, Assignable Loan, Consent Required Loan, Transferable, Maximum Maturity and Not Bearer. The Maximum Maturity is usually set at 30 years. Further, parties may stipulate whether interest that has accrued on the Deliverable Obligation shall be payable or not. Thus, CDS contracts are usually set up as

[21] A further mandatory but less important Deliverable Obligation Characteristic under US LCDS Standard Terms is 'Participation Loan'. See ISDA (2007a), S.4.

Reference Entity-based contracts in which multiple Deliverable Obligations can exist. The Not Subordinated characteristic effectively pegs the seniority of the Deliverable Obligations to that of the Reference Obligation.

Figure 11.8 summarises the above discussion. Under European LCDS Standard Terms, protection buyers are quite restricted in their choice of the Deliverable Obligation. It can either be the Reference Obligation itself or a

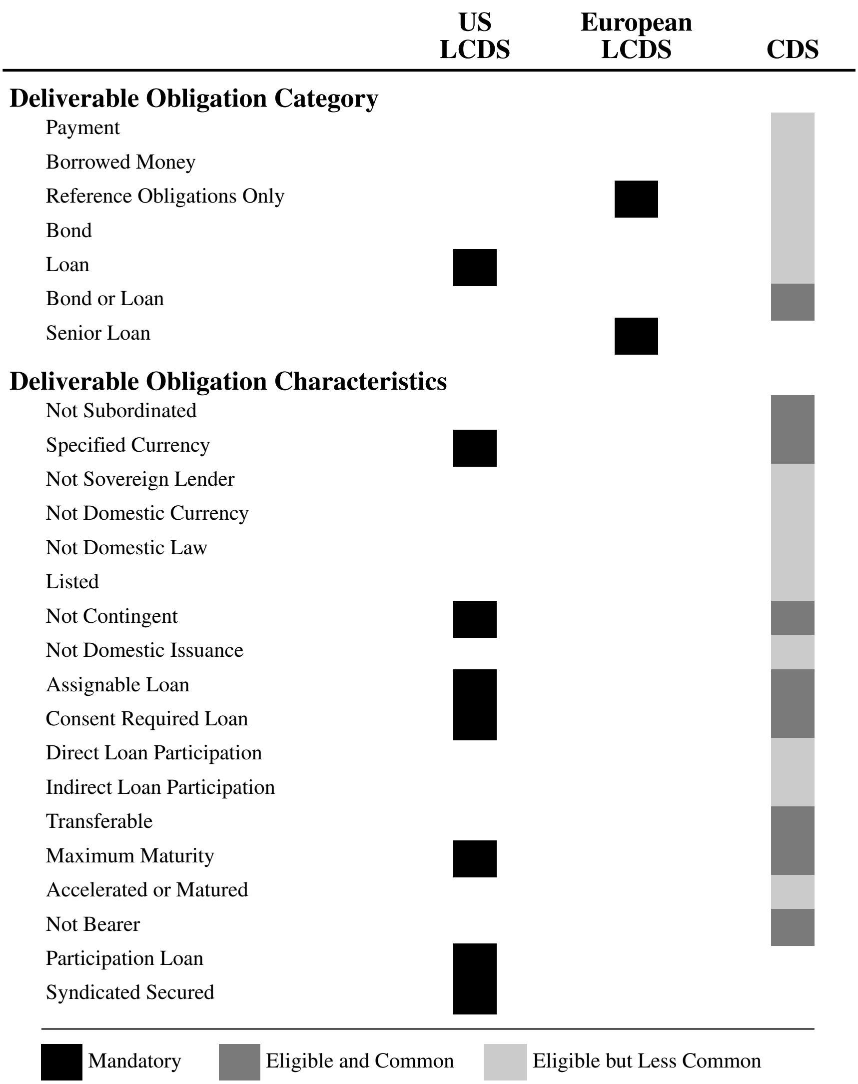

FIGURE 11.8 Deliverable obligation category and deliverable obligation characteristics under LCDS and CDS Standard Terms.

	US LCDS	European LCDS	CDS
Concept	▪ Reference Entity-based	▪ Reference Obligation-based	▪ Mostly used as Reference Entity-based
Reference Entity	▪ Sub-investment grade corporate	▪ Sub-investment grade corporate	▪ Corporates of all ratings
Reference/Deliverable Obligation			
Type	▪ Loan	▪ Loan	▪ Bond and/or loan
Priority	▪ Senior secured	▪ Senior secured	▪ Senior unsecured
Cancellation	▪ If no Substitute Reference Obligation is found	▪ If either (i) Continuity does not apply, (ii) no refinancing has occured or (iii) no Substitute Reference Obligation is found	▪ Never
Credit Events	▪ Bankruptcy, Failure to Pay	▪ Bankruptcy, Failure to Pay, Restructuring	▪ Bankruptcy, Failure to Pay, Restructuring
Settlement	▪ Physical Settlement, Credit Event Auction	▪ Physical Settlement, Cash Settlement	▪ Physical Settlement, Cash Settlement, Credit Event Auction

FIGURE 11.9 Summary of typical LCDS and CDS Standard Terms.

loan that ranks *pari passu* or senior. Under US LCDS Standard Terms, all syndicated secured loans of the Designated Priority may be delivered if they satisfy some additional characteristics. Under CDS Standard Terms, it is at the discretion of parties to define which obligations shall be deliverable. By market convention, Deliverable Obligations are however mostly senior bonds or loans.

Summary

Figure 11.9 gives an overview of the discussion in this chapter. The primary difference between LCDS and CDS is the nature of the underlying: LCDS reference leveraged loans whereas CDS mostly reference senior unsecured bonds. This means that Reference Entities in LCDS are almost always rated sub-investment grade, whereas those in CDS can also be rated investment grade. All else being equal, LCDS should trade at lower premia than CDS on the same Reference Entity as leveraged loans rank higher than high-yield bonds and come along with more restrictive covenant packages.

US LCDS and CDS are generally set up as Reference Entity-based contracts. This can be seen in the definitions of ‘Reference Obligation’, ‘Obligation’ and ‘Deliverable Obligation’, which are quite broad and usually not restricted to one specific obligation of the borrower. This effectively means that a credit event can occur with respect to several different obligations and that there can be more than one Deliverable Obligation. European LCDS, on the other hand, are Reference Obligation-based. A credit event usually can occur with respect to the Reference Obligation only and this obligation usually is the Deliverable Obligation.

Credit events are similar for LCDS and CDS, but differ when it comes to how restructuring is handled. Restructuring is included under European LCDS Standard Terms but not under US LCDS Standard Terms, and is optional under CDS Standard Terms. Together, the definitions of 'Obligation' and 'Credit Event' determine the probability that an LCDS or CDS are affected by a default. *Ceteris paribus*, this probability is the higher the broader these two terms are defined. For example, under European LCDS Standard Terms the inclusion of restructuring increases the probability that a default is triggered, but the fact that such a Credit Event has to occur with respect to the Reference Obligation reduces it. Strictly speaking, the default probability might thus be different for LCDS and CDS that reference the same borrower, if definitions deviate.

As cancellation generally is disadvantageous to protection sellers, it is further important to understand under which conditions LCDS cancel. By default, US and European LCDS Standard Terms cancel only if no Substitute Reference Obligation exists. Mostly, this happens if the Reference Entity prepays all of its leveraged loans at the same time; for instance, because it has been upgraded to investment grade or because it has been acquired by an investment grade company and therefore does not, by definition, use leveraged loans as a funding source anymore. Under European LCDS Standard Terms, parties may however stipulate that the LCDS cancels also if just the Reference Obligation is prepaid. Such a contract specification will naturally make a cancellation more likely. A CDS, on the other hand, never cancels.

The main concern regarding settlement is to prevent price distortions as they occurred in earlier instances. Credit event auctions, which are mandatory for US LCDS, eligible for CDS and foreseen for European LCDS, should avoid these and result in a fair Final Auction Price at which parties can settle physically or in cash, at their discretion.

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Structured Credit Products: Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

PART II

Structured Credit Products and Synthetic Securitisation

Structured products is the generic term used to refer to a wide variety of capital market instruments. They include bonds issued as part of a securitisation, such as asset-backed securities (ABS) and mortgage-backed securities (MBS), which are well established and were first introduced during the 1970s. A more recent product is the collateralised debt obligation (CDO), which is also well established, the first such deal being introduced in 1988. Structured products include various classes of instruments that are also called *hybrid products*, combinations of two or more basic products such as vanilla bonds and interest rate swaps, or vanilla bonds linked to external references or benchmarks. The literature on this subject is large and in-depth.

In Part II of the book, we examine *structured credit products*. These are products that combine securitisation technology with credit derivative instruments. As such, they are also examples of *synthetic securitisation*: synthetic because they replicate the economic effects of securitisation without the actual 'true sale' event, which is the building block of traditional securitisation.

For background information, we present an introduction to traditional securitisation. This is then followed by a detailed look at the main synthetic securitisation products, which are synthetic collateralised debt obligations (also known as *collateralised synthetic obligations* or *CSOs*) and synthetic MBS transactions. We also look at synthetic conduits and repack structures. In the chapter on synthetic CDOs we consider the impact of the 2007–08 credit and liquidity crunch on these products.

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CHAPTER 12

An Introduction to Securitisation

The second part of this book examines *synthetic securitisation*. This is a generic term covering structured financial products that use credit derivatives in their construction. In fact another term for the products we discuss in Part II could be 'hybrid structured products'. However, because the economic impact of these products mirrors some of those of traditional securitisation instruments, we use the term 'synthetic securitisation'. To fully understand this, we need to be familiar with traditional or *cash flow* securitisation as a concept, and this is what we discuss now. Readers who are familiar with the subject may wish to proceed directly to Chapter 13.

The motivations behind the origination of synthetic structured products sometimes differ from those of cash flow ones, although sometimes they are straight alternatives. Both product types are aimed at institutional investors, who may or may not be interested in the motivation behind their origination (although they will—as prudent portfolio managers—be interested in the name and quality of the originating institution). Both techniques aim to create disintermediation and bring the seekers of capital, and/or risk exposure, together with providers of capital and risk exposure.

In this chapter we introduce the basic concepts of securitisation and look at the motivation behind their use, as well as their economic impact. We illustrate the process with a brief hypothetical case study. We then move on to discuss a more advanced synthetic repackaging structure.

THE CONCEPT OF SECURITISATION

Securitisation is a well-established practice in the global debt capital markets. It refers to the sale of assets, which generate cash flows from the institution that owns the assets, to another company that has been specifically set up for the purpose of acquiring them, and the issuing of notes by this second company. These notes are backed by the cash flows from the original assets. The technique was introduced initially as a means of funding for US mortgage banks. Subsequently, the technique was applied to other assets such as credit card payments and equipment leasing receivables. It has also been employed as part of asset/liability management, as a means of managing balance sheet risk.

Securitisation allows institutions such as banks and corporations to convert assets that are not readily marketable—such as residential mortgages or car loans—into rated securities that are tradable in the secondary market. The investors that buy these securities gain exposure to these types of original assets that they would not otherwise have access to. The technique is well established and was first introduced by mortgage banks in the United States during the 1970s. The synthetic securitisation market was established much more recently, dating from 1997. The key difference between cash and synthetic securitisation is that in the former market, as we have already noted, the assets in question are actually sold to a separate legal company known as a special purpose vehicle (SPV). This does not occur in a synthetic transaction, as we shall see.

Sundaresan (1997, p. 359) defines securitisation as

> *. . . a framework in which some illiquid assets of a corporation or a financial institution are transformed into a package of securities backed by these assets, through careful packaging, credit enhancements, liquidity enhancements and structuring.*

The process of securitisation creates a*sset-backed securities*. These are debt instruments that have been created from a package of loan assets on which interest is payable, usually on a floating basis. The asset-backed market was developed in the US and is a large, diverse market containing a wide range of instruments. Techniques employed by investment banks today enable an entity to create a bond structure from virtually any type of cash flow. Assets that have been securitised include loans such as residential mortgages, car loans and credit card loans. The loans form assets on a bank or finance house balance sheet, which are packaged together and used as backing for an issue of bonds. The interest payments on the original loans form the cash flows used to service the new bond issue. Traditionally, mortgage-backed bonds are grouped in their own right as mortgage-backed securities (MBS), while all other securitisation issues are known as asset-backed bonds or ABS.

EXAMPLE 12.1 SPECIAL PURPOSE VEHICLES

The key to undertaking securitisation is the special purpose vehicle or SPV. They are also known as special purpose entities (SPE) or special purpose companies (SPC). They are distinct legal entities that are the ‘company’ through which a securitisation is undertaken. They act as a form of repackaging vehicle, used to transform, convert or create risk structures that can be accessed by a wider range of investors. Essentially they are the legal entity to which assets such as mortgages, credit card debt or synthetic assets such as credit derivatives are transferred, and from which the original credit risk/reward profile is transformed and made available to investors. An originator will use SPVs to increase liquidity and to make liquid risks that cannot otherwise be traded in any secondary market.

An SPV is a legal trust or company that is not, for legal purposes, linked in any way to the originator of the securitisation. As such it is *bankruptcy-remote* from the sponsor. If the sponsor suffers financial difficulty or is declared bankrupt, this will have no impact on the SPV, and hence no impact on the liabilities of the SPV with respect to the notes it has issued in the market. Investors have credit risk exposure only to the underlying assets of the SPV.[1]

To secure favourable tax treatment SPVs are frequently incorporated in offshore business centres such as Jersey or the Cayman Islands, or in areas that have set up SPV-friendly business legislation such as Dublin or the Netherlands. The choice of location for an SPV is dependent on a number of factors as well as taxation concerns, such as operating costs, legal requirements and investor considerations.[2] The key issue is taxation; however, the sponsor will wish all cash flows both received and paid out by the SPV to attract low or no tax. This includes withholding tax on coupons paid on notes issued by the SPV.

(*continued*)

[1] In some securitisations, the currency or interest-payment basis of the underlying assets differs from that of the overlying notes, and so the SPV will enter into currency and/or interest rate swaps with a (bank) counterparty. The SPV would then have counterparty risk exposure.

[2] For instance, investors in some European Union countries will only consider notes issued by an SPV based in the EU, so that would exclude many offshore centres.

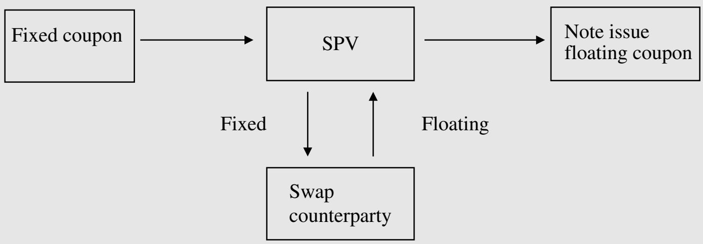

FIGURE 12.1 Asset swap package securitised and economic effect sold on by SPV.

SPVs are used in a wide variety of applications and are an important element of the market in structured credit products. An established application is in conjunction with an asset swap, when an SPV is used to securitise the asset swap so that it becomes available to investors who cannot otherwise access it. Essentially the SPV will purchase the asset swap and then issue notes to the investor, who gain an exposure to the original asset swap albeit indirectly. This is illustrated in Figure 12.1.

The most common purpose for which an SPV is set up is a cash flow securitisation, in which the sponsoring company sells assets off its balance sheet to the SPV, which funds the purchase of these assets by issuing notes. The revenues received by the assets are used to pay the liability of the issued overlying notes. Of course, the process itself has transformed previously untradable assets such as residential mortgages into tradable ones, and freed up the balance sheet of the originator.

SPVs are also used for the following applications:

- converting the currency of underlying assets into another currency more acceptable to investors, by means of a currency swap;
- issuing credit-linked notes (CLNs). Unlike CLNs issued by originators direct, CLNs issued by SPVs do not have any credit-linkage to the sponsoring entity. The note is linked instead to assets that have been sold to the SPV, and its performance is dependent on the performance of these assets. Another type of credit-linked SPV is when investors select the assets that (effectively) collateralise the CLN and are held by the SPV. The SPV then sells credit protection to a swap counterparty, and on occurrence of a credit event the underlying securities are sold and used to pay the SPV liabilities;
- they are used to transform illiquid into liquid ones. Certain assets such as trade receivables, equipment lease receivables or even

more exotic assets such as museum entry-fee receipts are not tradable in any form, but can be made into tradeable notes via securitisation.

For legal purposes an SPV is categorised as either a Company or a Trust. The latter is more common in the US market, and its interests are represented by a Trustee, which is usually the Agency services department of a bank such as Deutsche Bank or Citibank, or a specialist Trust company such as Wilmington Trust. In the Euromarkets SPVs are often incorporated as companies instead of Trusts.

REASONS FOR UNDERTAKING SECURITISATION

The driving force behind securitisation has been the need for banks to realise value from the assets on their balance sheet. Typically these assets are residential mortgages, corporate loans and retail loans such as credit card debt. Let us consider the factors that might lead a financial institution to securitise part of its balance sheet. These might be the following:

- if revenues received from assets remain roughly unchanged but the size of assets has decreased, there will be an increase in the return on equity ratio;
- the level of capital required to support the balance sheet will be reduced, which again can lead to cost savings or allow the institution to allocate the capital to other, perhaps more profitable, business;
- to obtain cheaper funding: frequently the interest payable on asset-backed securities is considerably below the level payable on the underlying loans. This creates a cash surplus for the originating entity.

In other words, the main reasons that a bank securitises part of its balance sheet is for one or all of the following reasons:

- funding the assets it owns;
- balance sheet capital management;
- risk management and credit risk transfer.

We shall now consider each of these in turn.

Funding

Banks can use securitisation to: (i) support rapid asset growth; (ii) diversify their funding mix and reduce cost of funding; and (iii) reduce maturity mismatches.

The market for asset-backed securities (ABS) is large, with an estimated size of $1,000 billion invested in ABS issues worldwide.[3] Access to this source of funding enables a bank to grow its loan books at a faster pace than if they were reliant on traditional funding sources alone. For example, in the UK a former building society-turned-bank, Northern Rock plc, has taken advantage of securitisation to back its growing share of the UK residential mortgage market. Unfortunately, it developed an over-reliance on securitised funding to the detriment of its retail deposit funding base, with disastrous consequences during the 2007 crash.

Securitising assets also allows a bank to diversify its funding mix. Banks generally do not wish to be reliant on a single or a few sources of funding, as this can be high-risk in times of market difficulty. Banks aim to optimise their funding between a mix of retail, inter-bank and wholesale sources. Securitisation has a key role to play in this mix. It also enables a bank to reduce its funding costs. This is because the securitisation process de-links the credit rating of the originating institution from the credit rating of the issued notes. Typically, most of the notes issued by SPVs will be higher rated than the bonds issued directly by the originating bank itself. While the liquidity of the secondary market in ABS is frequently lower than that of the corporate bond market, and this adds to the yield payable by an ABS, it is frequently the case that the cost to the originating institution of issuing debt is still lower in the ABS market because of the latter's higher rating.

Finally, there is the issue of maturity mismatches. The business of bank asset-liability management (ALM) is inherently one of maturity mismatch, since a bank often funds long-term assets such as residential mortgages, with short-term asset liabilities such as bank account deposits or inter-bank funding. This can be reduced via securitisation, as the originating bank receives funding from the sale of the assets, and the economic maturity of the issued notes frequently matches that of the assets.

Balance Sheet Capital Management

Banks use securitisation to improve balance sheet capital management. This provides: (i) regulatory capital relief; (ii) economic capital relief; and (iii) diversified sources of capital.

[3] Source: CSFB, *Credit Risk Transfer*, 2 May 2003.

As stipulated in the Bank for International Settlements (BIS) capital rules,[4] also known as the Basel rules, banks must maintain a minimum capital level for their assets, in relation to the risk of these assets. Under Basel I, for every \$100 of risk-weighted assets, a bank must hold at least \$8 of capital; however, the designation of each asset's risk-weighting is restrictive. For example, with the exception of mortgages, customer loans are 100% risk-weighted regardless of the underlying rating of the borrower or the quality of the security held. The anomalies that this raises, which need not concern us here, are being addressed by the Basel II rules that became effective from 2008. However, the Basel I rules, which have been in place since 1988 (and effective from 1992), were a key driver of securitisation. As an SPV is not a bank, it is not subject to Basel rules and it therefore only needs such capital that is economically required by the nature of the assets they contain. This is not a set amount, but is significantly below the 8% level required by banks in all cases. Although an originating bank does not obtain 100% regulatory capital relief when it sells assets off its balance sheet to an SPV, because it will have retained a 'first-loss' piece out of the issued notes, its regulatory capital charge will be significantly reduced after the securitisation.[5]

To the extent that securitisation provides regulatory capital relief, it can be thought of as an alternative to capital raising, compared with the traditional sources of Tier 1 (equity), preferred shares, and perpetual loan notes with step-up coupon features. By reducing the amount of capital that has to be used to support the asset pool, a bank can also improve its return-on-equity (ROE) value. This is received favourably by shareholders.

Of course, under accounting consolidation rules, it is harder to obtain capital relief under most securitisation transactions. We must look to other benefits of this process.

Risk Management

Once assets have been securitised, the credit risk exposure on these assets for the originating bank is reduced considerably and, if the bank does not retain a first-loss capital piece (the most junior of the issued notes), it is removed entirely. This is because assets have been sold to the SPV. Securitisation can also be used to remove non-performing assets from banks' balance sheets. This has the dual advantage of removing credit risk and removing a potentially negative sentiment from the balance sheet, as well as freeing up regulatory capital. Further, there is a potential upside from

[4] For further information see Choudhry (2007).
[5] We discuss first-loss later on.

securitising such assets, if any of them start performing again, or there is a recovery value obtained from defaulted assets, the originator will receive any surplus profit made by the SPV.

Benefits of Securitisation to Investors

Investor interest in the ABS market has been considerable from the market's inception. This is because investors perceive ABSs as possessing a number of benefits. Investors can:

- diversify sectors of interest;
- access different (and sometimes superior) risk-reward profiles;
- access sectors that are otherwise not open to them.

A key benefit of securitisation notes is the ability to tailor risk-return profiles. For example, if there is a lack of assets of any specific credit rating, these can be created via securitisation. Securitised notes frequently offer better risk-reward performance than corporate bonds of the same rating and maturity. While this might seem peculiar (why should one AA-rated bond perform better in terms of credit performance than another just because it is asset-backed?), this often occurs because the originator holds the first-loss piece in the structure.

A holding in an ABS also diversifies the risk exposure. For example, rather than invest $100 million in an AA-rated corporate bond and be exposed to 'event risk' associated with the issuer, investors can gain exposure to, say, 100 pooled assets. These pooled assets will have lower concentration risk. That, at least, was the theory. As the 2007–08 crash showed, in some cases diversification actually increased concentration risk.

THE PROCESS OF SECURITISATION

We now look at the process of securitisation, the nature of the SPV structure and issues such as credit enhancements and the cash flow 'waterfall'.

The securitisation process involves a number of participants. In the first instance there is the *originator*, the firm whose assets are being securitised. The most common process involves an *issuer* acquiring the assets from the originator. The issuer is usually a company that has been specially set up for the purpose of the securitisation, which is the SPV and is usually domiciled offshore. The creation of an SPV ensures that the underlying asset pool is held separate from the other assets of the originator. This is done so that in the event that the originator is declared bankrupt or insolvent, the assets

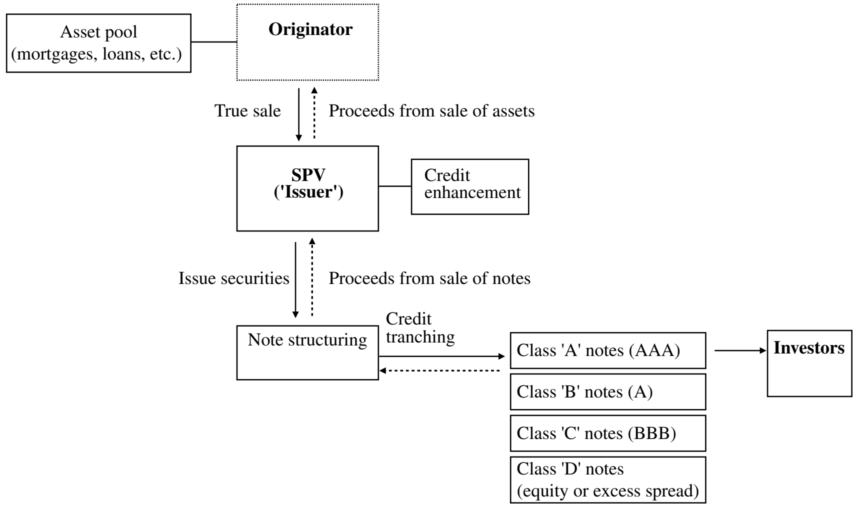

FIGURE 12.2 The securitisation process.

that have been transferred to the SPV will not be affected. This is known as being bankruptcy-remote. Conversely, if the underlying assets begin to deteriorate in quality and are subject to a ratings downgrade, investors have no recourse to the originator.

By holding the assets within an SPV framework, defined in formal legal terms, the financial status and credit rating of the originator becomes almost irrelevant to the bondholders. The process of securitisation often involves *credit enhancements*, in which a third-party guarantee of credit quality is obtained, so that notes issued under the securitisation are often rated at investment grade and up to AAA-grade.

The process of structuring a securitisation deal ensures that the liability side of the SPV—the issued notes—carries a lower cost than the asset side of the SPV. This enables the originator to secure lower cost funding that it would not otherwise be able to obtain in the unsecured market. This is a tremendous benefit for institutions with lower credit ratings.

Figure 12.2 illustrates the process of securitisation in simple fashion.

Mechanics of Securitisation

Securitisation involves a ‘true sale’ of the underlying assets from the balance sheet of the originator. This is why a separate legal entity, the SPV, is created to act as the issuer of the notes. The assets being securitised are sold on to the balance sheet of the SPV. The process involves:

- undertaking 'due diligence' on the quality and future prospects of the assets;
- setting up the SPV and then effecting the transfer of assets to it;
- underwriting of loans for credit quality and servicing;
- determining the structure of the notes, including how many tranches are to be issued, in accordance with originator and investor requirements;
- the rating of notes by one or more credit rating agencies;
- placing of notes in the capital markets.

The sale of assets to the SPV needs to be undertaken so that it is recognised as a true legal transfer. The originator obtains legal counsel to advise it in such matters. The credit rating process considers the character and quality of the assets, and also whether any enhancements have been made to the assets that will raise their credit quality. This can include *over-collateralisation,* which is when the principal value of notes issued is lower than the principal value of assets, and a liquidity facility provided by a bank.

A key consideration for the originator is the choice of the underwriting bank, which structures the deal and places the notes. The originator awards the mandate for its deal to an investment bank on the basis of fee levels, marketing ability and track record with assets being securitised.

SPV Structures

There are essentially two main securitisation structures, amortising (pass-through) and revolving. A third type, the master trust, is used by frequent issuers.

Amortising Structures Amortising structures pay principal and interest to investors on a coupon-by-coupon basis throughout the life of the security, as illustrated in Figure 12.3. They are priced and traded based on expected maturity and weighted-average life (WAL), which is the time-weighted period during which principal is outstanding. A WAL approach incorporates various pre-payment assumptions, and any change in this pre-payment speed will increase or decrease the rate at which principal is repaid to investors. Pass-through structures are commonly used in residential and commercial mortgage-backed deals (MBS), and consumer loan ABS.

Revolving Structures Revolving structures revolve the principal of the assets; that is, during the revolving period, principal collections are used to purchase new receivables that fulfil the necessary criteria. The structure is used for short-dated assets with a relatively high pre-payment speed, such as credit card debt and auto-loans. During the amortisation period,

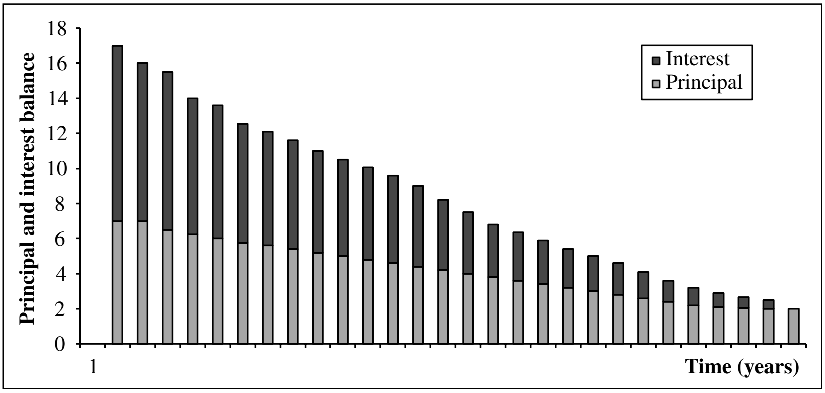

FIGURE 12.3 Amortising cash flow structure.

principal payments are paid to investors either in a series of equal instalments (*controlled amortisation*) or the principal is 'trapped' in a separate account until the expected maturity date and then paid in a single lump sum to investors (*soft bullet*).

Master Trust Frequent issuers under US and UK law use *master trust* structures, which allow multiple securitisations to be issued from the same SPV. Under such schemes, the originator transfers assets to the master trust SPV. Notes are then issued out of the asset pool based on investor demand. Master trusts are used by MBS and credit card ABS originators.

Securitisation Note Tranching

As illustrated in Figure 12.2, in a securitisation the issued notes are structured to reflect specified risk areas of the asset pool, and thus are rated differently. The senior tranche is usually rated AAA. The lower rated notes usually have an element of *over-collateralisation* and are thus capable of absorbing losses. The most junior note is the lowest rated or non-rated. It is often referred to as the *first-loss piece*, because it is impacted by losses in the underlying asset pool first. The first-loss piece is sometimes called the *equity piece* or equity note (even though it is a bond) and is usually held by the originator.

Credit Enhancement

Credit enhancement refers to the group of measures that can be instituted as part of the securitisation process for ABS and MBS issues so that the credit rating of the issued notes meets investor requirements. The lower the quality of the assets being securitised, the greater the need for credit enhancement. This is usually by some or all of the following methods:

- *Over-collateralisation:* where the nominal value of the assets in the pool are in excess of the nominal value of issued securities.
- *Pool insurance:* an insurance policy provided by a composite insurance company to cover the risk of principal loss in the collateral pool. The claims paying rating of the insurance company is important in determining the overall rating of the issue.
- *Senior/Junior note classes:* credit enhancement is provided by subordinating a class of notes ('class B' notes) to the senior class notes ('class A' notes). The class B note's right to its proportional share of cash flows is subordinated to the rights of the senior note holders. Class B notes do not receive payments of principal until certain rating agency requirements have been met, specifically satisfactory performance of the collateral pool over a predetermined period, or in many cases until all of the senior note classes have been redeemed in full.
- *Margin step-up:* a number of ABS issues incorporate a step-up feature in the coupon structure, which typically coincides with a call date. Although the issuer is usually under no obligation to redeem the notes at this point, the step-up feature was introduced as an added incentive for investors, to convince them from the outset that the economic cost of paying a higher coupon is unacceptable and that the issuer would seek to refinance by exercising its call option.
- *Excess spread:* this is the difference between the return on the underlying assets and the interest rate payable on the issued notes (liabilities). The monthly excess spread is used to cover expenses and any losses. If any surplus is left over, it is held in a reserve account to cover against future losses or (if not required for that), as a benefit to the originator. In the meantime the reserve account is a credit enhancement for investors.

All securitisation structures incorporate a *cash waterfall* process, whereby all the cash that is generated by the asset pool is paid in order of payment priority. Only when senior obligations have been met can more junior obligations be paid. An independent third party agent is usually employed to run 'tests' on the vehicle to confirm that there is sufficient cash available to pay all obligations. If a test is failed, then the vehicle will start to pay off the notes, starting from the senior notes. The waterfall process is illustrated in Figure 12.4.

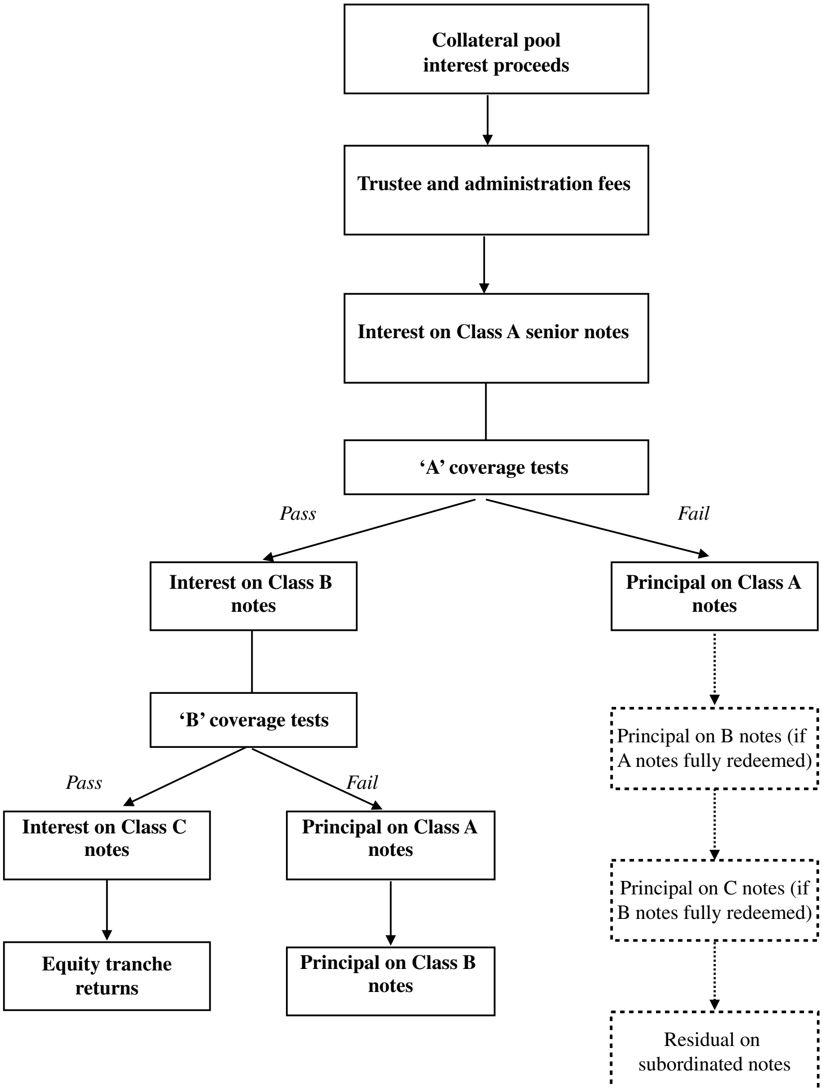

FIGURE 12.4 Cash flow waterfall (priority of payments).

Impact on Balance Sheet

Figure 12.5 on page 418 illustrates, by way of an hypothetical example, the effect of a securitisation transaction on the liability side of an originating bank's balance sheet. Following the process, selected assets have been

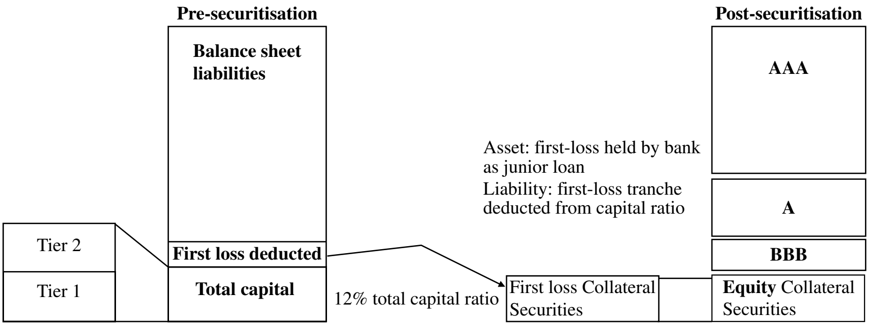

FIGURE 12.5 Regulatory capital impact of securitisation, original Basel I rules.

removed from the balance sheet, although the originating bank will usually have retained the first-loss piece. With regard to the regulatory capital impact, this first-loss amount is deducted from the bank's total capital position. For example, assume a bank has \$100 million of risk-weighted assets and a target Basel ratio of 12%,[6] and it securitises all \$100 million of these assets. It retains the first-loss tranche that forms 1.5% of the total issue. The remaining 98.5% will be sold on to the market. The bank will still have to set aside 1.5% of capital as a buffer against future losses, but it has been able to free itself of the remaining 10.5% of capital.

ILLUSTRATING THE PROCESS OF SECURITISATION

To illustrate the process of securitisation, we consider a hypothetical airline ticket receivables transaction, originated by a fictitious company called ABC Airways plc and arranged by the equally fictitious XYZ Securities Limited. The following illustrates the kind of issues that are considered by the investment bank that is structuring the deal.

Note that our example is far from a conventional or 'plain vanilla' securitisation, and is a good illustration of the adaptability of the technique and how it was extended to ever more exotic asset classes. However, one of the immediate impacts of the 2007–08 financial crisis was that transactions such as these were no longer closed, as investors became risk averse, and transactions after the crisis were limited to more conventional asset classes.

[6] The minimum is 8%, but many banks prefer to set aside an amount well in excess of this minimum required level. The norm is 12%–15% or higher.

Originator	ABC Airways plc
Issuer	'Airways No 1 Ltd'
Transaction	Ticket receivables airline future flow securitisation bonds 200m 3-tranche floating-rate notes, legal maturity 2010
	Average life 4.1 years
Tranches	Class 'A' note (AA), LIBOR plus [] bps[7]
	Class 'B' note (A), LIBOR plus [] bps
	Class 'E' note (BBB), LIBOR plus [] bps
Arranger	XYZ Securities plc

Due Diligence

XYZ Securities undertakes due diligence on the assets to be securitised. In this case, it examines the airline performance figures over the last five years, as well as modelling future projected figures, including:

- total passenger sales;
- total ticket sales;
- total credit card receivables;
- geographical split of ticket sales.

It is the future flow of receivables, in this case credit card purchases of airline tickets, that is being securitised. This is a higher risk asset class than say, residential mortgages, because the airline industry has a tradition of greater volatility of earnings than mortgage banks.

Marketing Approach

The present and all future credit card ticket receivables generated by the airline are transferred to an SPV. The investment bank's syndication desk seeks to place the notes with institutional investors across Europe. The notes are first given an indicative pricing ahead of the issue, to gauge investor sentiment. Given the nature of the asset class, during November 2002 the notes are marketed at around 3-month LIBOR plus 70–80 bps (AA note), 120–130 bps (A note) and 260–270 bps (BBB note).[8] The notes are 'benchmarked' against recent issues with similar asset classes, as well as the spread level in the unsecured market of comparable issuer names.

[7] The price spread is determined during the marketing stage, when the notes are offered to investors during a 'roadshow'.
[8] Plainly, these are pre-2007 crisis spreads!

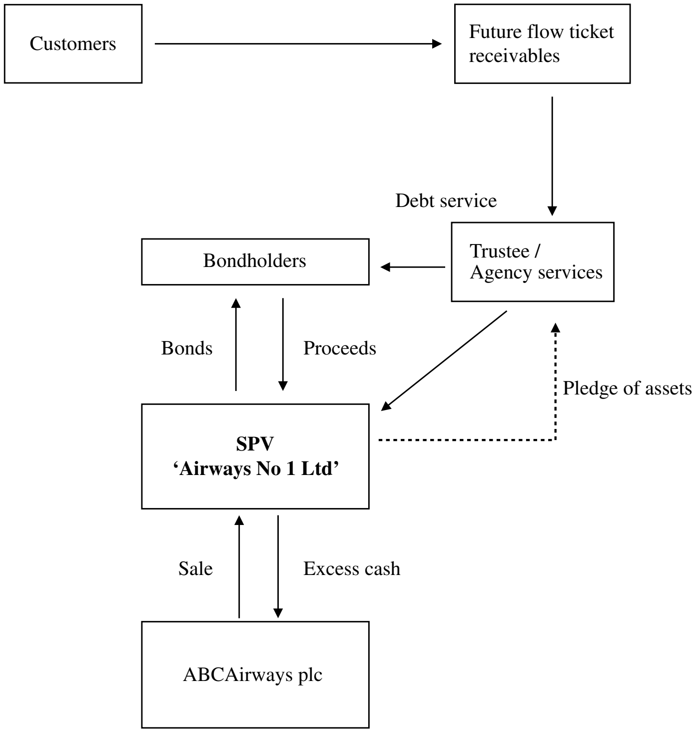

FIGURE 12.6 Airways No. 1 limited deal structure.

Deal Structure

The deal structure is shown at Figure 12.6. The process leading to the issue of notes is as follows:

- ABC Airways plc sells its future flow ticket receivables to an offshore SPV set up for this deal, incorporated as Airways No 1 Ltd;
- the SPV issues notes in order to fund its purchase of the receivables;
- the SPV pledges its right to the receivables to a fiduciary agent, the Security Trustee, for the benefit of the bondholders;
- the Trustee accumulates funds as they are received by the SPV;
- the bondholders receive interest and principal payments, in the order of priority of the notes, on a quarterly basis.

In the event of default, the Trustee will act on behalf of the bondholders to safeguard their interests.

Financial Guarantors

The investment bank decides whether or not an insurance company, known as a mono-line insurer, should be approached to 'wrap' the deal by providing a guarantee of backing for the SPV in the event of default. This insurance is provided in return for a fee.

Financial Modelling

XYZ Securities constructs a cash flow model to estimate the size of the issued notes. The model considers historical sales values, any seasonal factors in sales, credit card cash flows and so on. Certain assumptions are made when constructing the model; for example, growth projections, inflation levels and tax levels. The model considers a number of different scenarios, and also calculates the minimum asset coverage levels required to service the issued debt. A key indicator in the model is the debt service coverage ratio (DSCR). The more conservative the DSCR, the more comfort there is for investors in the notes. For a residential mortgage deal, this ratio may be approximately 2.5–3.0; however, for an airline ticket receivables deal, the DSCR is unlikely to be lower than 4.0. The model therefore calculates the amount of notes that can be issued against the assets, while maintaining the minimum DSCR.

Credit Rating

It is common for securitisation deals to be rated by one or more of the formal credit ratings agencies Moody's, Fitch or Standard & Poor's. A formal credit rating makes it easier for XYZ Securities to place the notes with investors. The methodology employed by the ratings agencies take into account both qualitative and quantitative factors, and differs according to the asset class being securitised. The main issues in a deal such as our hypothetical Airways No. 1 deal would be expected to include:

- corporate credit quality: these are risks associated with the originator, and are factors that affect its ability to continue operations, meet its financial obligations, and provide a stable foundation for generating future receivables. This might be analysed according to the following:
  1. ABC Airways' historical financial performance, including its liquidity and debt structure;
  2. its status within its domicile country; for example, whether or not it is state-owned;
  3. the general economic conditions for industry and for airlines;

4. the historical record and current state of the airline; for instance, its safety record and age of its aeroplanes;

- the competition and industry trends: ABC Airways' market share, the competition on its network;
- regulatory issues, such as the need for ABC Airways to comply with forthcoming legislation that will impact its cash flows;
- legal structure of the SPV and transfer of assets;
- cash flow analysis.

Based on the findings of the ratings agency, the arranger may re-design some aspect of the deal structure so that the issued notes are rated at the required level.

This is a selection of the key issues involved in the process of securitisation. Depending on investor sentiment, market conditions and legal issues, the process from inception to closure of the deal may take anything from three to 12 months or more. After the notes have been issued, the arranging bank no longer has anything to do with the issue; however, the bonds themselves require a number of agency services for their remaining life until they mature or are paid off (see Procter and Leedham 2004). These agency services include paying the agent, cash manager and custodian.

ABS STRUCTURES: A PRIMER ON PERFORMANCE METRICS AND TEST MEASURES[9]

This section is an introduction to the performance measures on the underlying collateral of the ABS and MBS product.

Growth of ABS/MBS

The MBS market first appeared when the US government-chartered mortgage agencies began issuing pass-through securities collateralised by residential mortgages to promote the availability of cheap mortgage funding for US home buyers. The pass-through market inevitably grew as it provided investors in the secondary mortgage market with a liquid

[9] This section was written by Suleman Baig, Structured Finance Department, Deutsche Bank AG, London. This section represents the views, thoughts and opinions of Suleman Baig in his individual private capacity. It should not be taken to represent the views of Deutsche Bank AG, or of Suleman Baig as a representative, officer or employee of Deutsche Bank AG.

instrument and the lenders an opportunity to move interest rate risk off their balance sheet. Consequently, the ABS market came about as US finance companies began applying similar securitisation techniques to non-mortgage assets with expected payment streams. However, while MBS investors had, through the 'Ginnie Mae' government issues, benefited from implicit Treasury guarantees, the ABS market offered investors, in addition to a differing portfolio dynamic, an exposure to more diversified credit classes.

During 2002–2007 the low interest rate environment and increasing number of downgrades in the corporate bond market made the rating-resilient ABS/MBS issuance an attractive source of investment for investors. Like all securitisation products, during this time ABS/MBS traded at yields that compared favourably to similar rated unsecured debt and as investors have sought alternatives to the volatile equity market. In 2003, issuance for the European securitisation market exceeded €157.7 billion.

While in the US it is auto-loan and credit card ABS that remain the prominent asset classes, alongside US-Agency MBS, in the European market the predominant asset class is Residential Mortgages (RMBS). RMBS accounted for over 55% of total issuance and over 90% of MBS in the European securitisation market in 2003. A buoyant housing market, particularly in the UK, drove high RMBS issuance. The Commercial MBS market benefited from the introduction of favourable insolvency coupled with the introduction of the euro, eliminating currency concerns among investors.

Collateral Types

ABS performance is largely dependent on consumer credit performance, and so, typical ABS structures include trigger mechanisms (to accelerate amortisation) and reserve accounts (to cover interest shortfalls) to safeguard against poor portfolio performance. Though there is no basic difference in terms of the essential structure between CDO and ABS/MBS, some differences arise by the very nature of the collateral and the motives of the issuer. The key difference arises from the underlying; a CDO portfolio will have 100–200 loans, for example, whereas ABS portfolios will often have thousands of obligors thus providing the necessary diversity in the pool of consumers.

We now discuss briefly some prominent asset classes.

Auto Loan Auto loan pools were some of the earliest to be securitised in the ABS market. Investors had been attracted to the high asset quality involved and the fact that the vehicle offers an easily sellable, tangible asset in the case of obligor default. In addition, since a car is seen as an 'essential purchase' and a short loan exposure (3–5 years) provides a disincentive to finance, no real pre-payment culture exists. Prepayment speed is extremely stable and losses are relatively low, particularly in the prime sector. This is an attractive feature for investors.

Performance Analysis The main indicators are Loss curves, which show expected cumulative loss through the life of a pool and so, when compared to actual losses, give a good measure of performance. In addition, the resulting loss forecasts can be useful to investors buying subordinated note classes. Generally, prime obligors will have losses more evenly distributed, while non-prime and sub-prime lenders will have losses recognised earlier and so show a steeper curve. In both instances, losses typically decline in the latter years of the loan.

The *absolute prepayment speed (ABS)*[10] is a standard measure for prepayments, comparing actual period prepayments as a proportion to the whole pool balance. As with all prepayment metrics, this measure provides an indication of the expected maturity of the issued ABS and essentially, the value of the implicit call option on the issued ABS at any time.

Credit Card For specialised credit card banks, particularly in the US, the ABS market became the primary vehicle to fund the substantial volume of unsecured credit loans to consumers. Credit card pools are differentiated from other types of ABS in that loans have no predetermined term. A single obligor's credit card debt is often no more than six months and so the structure has to differ from other ABS in that repayment speed needs to be controlled, either through scheduled amortisation or the inclusion of a revolving period (where principal collections are used to purchase additional receivables).

Since 1991, the Stand-alone Trust has been replaced with a Master Trust as the preferred structuring vehicle for credit card ABS. The Master Trust structure allows an issuer to sell multiple issues from a single trust and from a single, albeit changing, pool of receivables. Each series can draw on the cash flows from the entire pool of securitised assets with income allocated to each pro rata based on the invested amount in the Master Trust.

Consider the example structure represented by Figure 12.7. An important feature is excess spread, reflecting the high yield on credit card debt compared to the card issuer's funding costs. In addition, a financial guaranty is included as a form of credit enhancement given the low rate of recoveries and

[10] First developed by Credit Suisse First Boston.

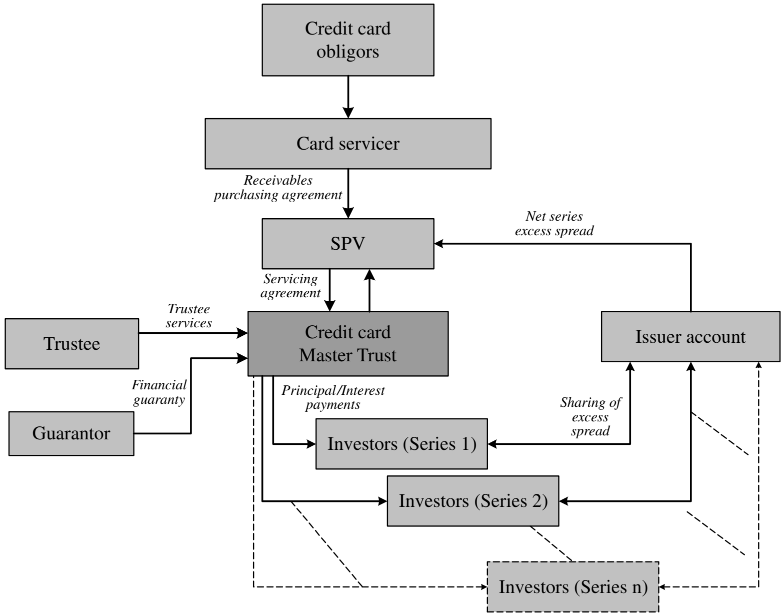

FIGURE 12.7 Master Trust Structure.

the absence of security on the collateral. Excess spread released from the trust can be shared with other series suffering interest shortfalls.

Performance Analysis for Credit Card ABS The *delinquency ratio* is measured as the value of credit card receivables overdue for more than 90 days as a percentage of total credit card receivables. The ratio provides an early indication of the quality of the credit card portfolio.

The *default ratio* refers to the total amount of credit card receivables written off during a period as a percentage of the total credit card receivables at the end of that period. Together, these two ratios provide an assessment of the credit loss on the pool and are normally tied to triggers for early amortisation and so require reporting through the life of the transaction.

The *monthly payment rate (MPR)*[11] reflects the proportion of the principal and interest on the pool that is repaid in a particular period. The ratings agencies require every non-amortising ABS to establish a minimum as an early amortisation trigger.

[11] This is not a prepayment measure since credit cards are non-amortising assets.

Mortgages The MBS sector is notable for the diversity of mortgage pools that are offered to investors. Portfolios can offer varying duration as well as both fixed- and floating-rate debt. The most common structure for agency-MBS is pass-through, where investors are simply purchasing a share in the cash flow of the underlying loans. Conversely, non-agency MBS (including CMBS), has a senior and a tranched subordinated class with principal losses absorbed in reverse order.

The other notable difference between RMBS and CMBS is that the CMBS is a non-recourse loan to the issuer as it is fully secured by the underlying property asset. Consequently, the debt service coverage ratio (DSCR) becomes crucial to evaluating credit risk.

Performance Analysis for MBS *Debt service coverage ratio (DSCR)*, which is Net operating income/Debt payments and so indicates a borrower's ability to repay a loan. A DSCR of less than 1.0 means that there is insufficient cash flow generated by the property to cover required debt payments.

The *weighted average coupon (WAC)* is the weighted coupon of the pool that is obtained by multiplying the mortgage rate on each loan by its balance. The WAC will therefore change as loans are repaid, but at any point in time when compared to the net coupon payable to investors, gives us an indication of the pool's ability to pay.

The *weighted average maturity (WAM)* is the average weighted (weighted by loan balance) of the remaining terms to maturity (expressed in months) of the underlying pool of mortgage loans in the MBS. Longer securities are by nature more volatile and so a WAM calculated on the stated maturity date avoids the subjective call of whether the MBS will mature and recognises the potential liquidity risk for each security in the portfolio. Conversely, a WAM calculated using the reset date will show the shortening effect of prepayments on the term of the loan.

The *weighted average life (WAL)* of the notes at any point in time is:

$$s = \sum t.\mathrm{PF}(s)$$

where

$\mathrm{PF}(s) = \text{Pool factor at } s$

$t = \text{actual}/365.$

We illustrate this measure below at Table 12.1 on page 427; PF refers to 'pool factor', which is assumed and is the repayment weighting adjustment to the notional value outstanding (O/S). The column 'IPD' is coupon payment date.

TABLE 12.1 Example of weighted average life (WAL) calculation.

IPD	Dates	Actual days (a)	PF(t)	Principal paid	O/S	a/365	PF(t)*(a/365)
0	21/11/2003	66	1.00		89,529,500.00	0.18082192	0.18082192
1	26/01/2004	91	0.94	5,058,824.00	84,470,588.00	0.24931507	0.23522739
2	26/04/2004	91	0.89	4,941,176.00	79,529,412.00	0.24931507	0.22146757
3	26/07/2004	91	0.83	4,823,529.00	74,705,882.00	0.24931507	0.20803536
4	25/10/2004	91	0.78	4,705,882.00	70,000,000.00	0.24931507	0.19493077
5	24/01/2005	91	0.73	4,588,235.00	65,411,765.00	0.24931507	0.18215380
6	25/04/2005	91	0.68	4,470,588.00	60,941,176.00	0.24931507	0.16970444
7	25/07/2005	91	0.63	4,352,941.00	56,588,235.00	0.24931507	0.15758269
8	24/10/2005	92	0.58	4,235,294.00	52,352,941.00	0.25205479	0.14739063
9	24/01/2006	90	0.54	4,117,647.00	48,235,294.00	0.24657534	0.13284598
10	24/04/2006	91	0.49	4,000,000.00	44,235,294.00	0.24931507	0.12318314
11	24/07/2006	92	0.45	3,882,353.00	40,352,941.00	0.25205479	0.11360671
12	24/10/2006	92	0.41	3,764,706.00	36,588,235.00	0.25205479	0.10300784
13	24/01/2007	90	0.37	3,647,059.00	32,941,176.00	0.24657534	0.09072408
14	24/04/2007	91	0.33	3,529,412.00	29,411,765.00	0.24931507	0.08190369
15	24/07/2007	92	0.29	3,411,765.00	26,000,000.00	0.25205479	0.07319849
16	24/10/2007	92	0.25	3,294,118.00	22,705,882.00	0.25205479	0.06392448
17	24/01/2008	91	0.22	3,176,471.00	19,529,412.00	0.24931507	0.05438405
18	24/04/2008	91	0.18	3,058,824.00	16,470,588.00	0.24931507	0.04586606
19	24/07/2008		-	16,470,588.00	-	-	-
						WAL	2.57995911

EXAMPLE 12.2 FORECASTING PREPAYMENT LEVELS

It is the time-weighted maturity of the cash flows that allows potential investors to compare the MBS with other investments with similar maturity. These tests apply uniquely to MBS since the principal is returned through the life of the investment on such transactions.

Forecasting prepayments is crucial to computing the cash flows of MBS. Though, the underlying payment remains unchanged, prepayments, for a given price, reduce the yield on the MBS. There are a number of methods used to estimate prepayments, two commonly used ones are the constant prepayment rate (CPR) and the Public Securities Association (PSA) method.

The CPR approach is:

$$\text{CPR} = 1 - (1 - \text{SMM})^{12}$$

where *single monthly mortality (SMM)* is the single-month proportional prepayment.

A SMM of 0.65% means that approximately 0.65% of the remaining mortgage balance at the beginning of the month, less the scheduled principal payment, will prepay that month.

The CPR is based on the characteristics of the pool and the current expected economic environment as it measures prepayment during a given month in relation to the outstanding pool balance.

The PSA (since merged and now part of the Securities Industry and Financial Markets Association or SIFMA), has a metric for projecting prepayment that incorporates the rise in prepayments as a pool seasons.

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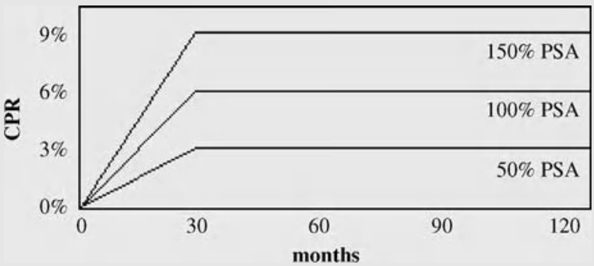
[12] The entire business model of a large number of banks as well as 'shadow banks' such as structured investment vehicles (SIVs) had depended on available liquidity from the inter-bank market, which was rolled over on a short-term basis such as weekly or monthly and used to fund long-dated assets such as RMBS securities that had much longer maturities and which themselves could not be realised in a liquid secondary market (once the 2007 credit crunch took hold). This business model unravelled after the credit crunch, with its most notable casualties being Northern Rock plc and the SIVs themselves, which collapsed virtually overnight. Regulatory authorities responded by requiring banks to take liquidity risk more seriously, with emphasis on longer term average tenor of liabilities and greater diversity on funding sources (for example, see the UK FSA's CP 08/22 document, at www.fsa.org). The author discusses bank liquidity management in *Bank Asset and Liability Management* (Wiley Asia 2007) and *The Principles of Banking* (Wiley Asia 2010).

A pool of mortgages is said to have 100%- PSA if its CPR starts at 0 and increases by 0.2% each month until it reaches 6% in month 30. It is a constant 6% after that. Other prepayment scenarios can be specified as multiples of 100% PSA. This calculation helps derive an implied prepayment speed assuming mortgages prepay slower during their first 30 months of seasoning.



For reference, PSA = [CPR/(.2) (m)] * 100
where

m = number of months since origination.

Summary of Performance Metrics

Table 12.1 lists the various performance measures we have introduced in this chapter, and the asset classes to which they apply.

SECURITISATION POST-CREDIT CRUNCH

Following the July–August 2007 implosion of the asset-backed commercial paper market, investor interest in ABS product dried up virtually completely. The growing illiquidity in the inter-bank market, which resulted in even large AA-rated banks finding it difficult to raise funds for tenors longer than one month, became acute following the collapse of Lehman Brothers in September 2008. To assist banks in raising funds, central banks starting with the US Federal Reserve and European Central Bank (ECB), and then the Bank of England (BoE), began to relax the criteria under which they accepted collateral from banks that raised terms funds from them. In summary, the central banks announced that ABS including MBS and other securitised products would now be eligible as collateral at the daily liquidity window.

TABLE 12.2 Summary of performance measures.

Performance measure	Calculation	Typical asset class
Public Securities Association (PSA)	PSA = [CPR/(.2) (months)]∗100	mortgages, home-equity, student loans
Constant prepayment rate (CPR)	1– (1 – SMM)12	mortgages, home-equity, student loans
Single monthly mortality (SMM)	Prepayment/Outstanding pool balance	mortgages, home-equity, student loans
Weighted average life (WAL)	$\sum$ (a/365).PF(s) Where PF(s)	mortgages
Weighted average maturity (WAM)	Weighted maturity of the pool	mortgages
Weighted average coupon (WAC)	Weighted coupon of the pool	mortgages
Debt service coverage ratio (DSCR)	Net operating income/Debt payments	commercial mortgages
Monthly payment rate (MPR)	Collections/Outstanding pool balance	all non-amortising asset classes
Default ratio	Defaults/Outstanding pool balance	credit cards
Delinquency ratio	Delinquents/Outstanding pool balance	credit cards
Absolute prepayment speed (ABS)	Prepayments/Outstanding pool balance	auto loans, truck loans
Loss curves	Show expected cumulative loss	auto loans, truck loans

As originally conceived, the purpose of these moves was to enable banks to raise funds, from their respective central bank, using existing ABS on their balance sheet as collateral. Very quickly, however, the banks began to originate new securitisation transactions, using illiquid assets held on their balance sheet (such as residential mortgages or corporate loans) as collateral in the deal. The issued notes would be purchased by the bank itself, making the deal completely in-house. These new purchased ABS tranches would then be used as collateral at the central bank repo window. We discuss these 'ECB-led' deals in this section.

Structuring Considerations

Essentially an ECB-deal is like any other deal, except that one has a minimum requirement to be ECB eligible. There are also haircut considerations and the opportunity to structure it without consideration for investors. To be eligible for repo at the ECB, deals had to fulfil certain criteria. These included:

(i) minimum requirements:
- public rating of triple-A or higher at first issue;
- only the senior tranche can be repo'd;
- no exposure to synthetic securities. The ECB rules stated that the cash flow in generating assets backing the ABSs must not consist in whole or in part, actually or potentially, of credit-linked notes (CLNs) or similar claims resulting from the transfer of credit risk by means of credit derivatives. Therefore, the transaction should expressly exclude any types of synthetic assets or securities;
- public presale or new issue report issued by the credit rating agency rating the transaction;
- bonds listed in Europe (for example, on the Irish Stock Exchange);
- book entry capability in Europe (for example, settlement in Euroclear, Clearstream);

(ii) haircut considerations:
- CLO securities denominated in euro will incur a haircut of 12% regardless of maturity or coupon structure;
- for the purposes of valuation, in the absence of a trading price within the past five days, or if the price is unchanged over that period, a 5% valuation markdown is applied. This equates to an additional haircut of 4.4%. The ECB will apply its own valuation to the notes, rather than accept the borrower's valuation;
- CLO securities denominated in US dollar will incur the usual haircuts, but with an additional initial margin of between 10% and 20% to account for FX risk;

(iii) other considerations:
- the deal can incorporate a revolving period (external investors normally would not prefer this);
- it can be a simple two-tranche set up. The junior tranche can be unrated and subordinated to topping up the cash reserve;
- it can be structured with an off-market interest rate swap, but penalties are imposed if it is an in-house swap provider;
- it must be rated by at least one rating agency (the BoE requires two ratings);
- there can be no in-house currency swap (this must be with an external counterparty).

The originator also must decide whether the transaction is to be structured to accommodate replenishment of the portfolio or whether the portfolio should be static. ECB transactions are clearly financing transactions for the bank, and as such the originating bank will retain the flexibility to sell or refinance some or all of the portfolio at any time should more favourable financing terms become available to it. For this reason there is often no restriction on the ability to sell assets out of the portfolio provided that the price received by the issuer is not less than the price paid by it for the asset (par), subject to adjustment for accrued interest. This feature maintains maximum refinancing flexibility and has been agreed to by the rating agencies.

Whether or not replenishment is incorporated into the transaction depends on a number of factors. If it is considered likely that assets will be transferred out of the portfolio (in order to be sold or refinanced), then replenishment enables the efficiency of the CDO structure to be maintained by adding new assets rather than running the existing transaction down and having to establish a new structure to finance additional/future assets. However, if replenishment is incorporated into the transaction the rating agencies carry out diligence on the bank to satisfy themselves on the capabilities of the bank to manage the portfolio. Also, the recovery rates assigned to a static portfolio are higher than those assigned to a managed portfolio. The decision on whether to have a managed or static transaction will have an impact on the documentation for the transaction and the scope of the banks obligations and representations.

Closing and Accounting Considerations: Case Study of ECB-led ABS Transaction

We provide here a case study of an in-house ABS transaction undertaken for ECB funding purposes. Although modelled on an actual deal, we have made the specific details hypothetical. However, this deal is not a typical in-house deal; it features an additional SPV as part of its structure, designed to allow the originator's parent group entity to use the vehicle for further issuances. Note that this structure does not feature a currency swap, because the overlying notes are issued in three separate currencies to match the currencies of the underlying assets. This was because a currency swap with an outside provider would add substantial costs to the deal, and an in-house currency swap was expressly forbidden under ECB eligibility rules.

Background To meet the dual objectives of securing term liquidity and cheap funding, and to benefit from the liquidity facility at the European Central Bank (ECB), XYZ BANK undertakes an ABS securitisation of XYZ BANK's balance sheet of approximately €2 billion of corporate loans. During 2008, such deals were undertaken by many banks throughout Europe. The transaction was conducted entirely in-house and all the notes issued were purchased by XYZ BANK. This was a funding transaction and not a revenue generation transaction.

We detail here the accounting treatment adopted by XYZ BANK on execution of the transaction and the capital adequacy issues arising therein.

Accounting Treatment As noted in the transaction structure, there will effectively be three legal entities directly influenced by the transaction:

1. XYZ BANK.
2. The Master Series Purchase Trust Limited ('the Trust').
3. The Master Series Limited 1 ('the Issuer').

The closing process of events is summarised as follows:

- A true (legal) sale of XYZ BANK assets between XYZ BANK and the Trust against cash.
- The Trust issues pass-through certificates that will be purchased by the Issuer for cash.
- The Issuer issues re-tranched pass-through ABS securities purchased by XYZ BANK for cash.

The transaction structure is illustrated at Figure 12.8.

All the above transactions occur simultaneously and in contemplation of one another. From an accounting perspective, the following questions were addressed as part of the closing process:

Would XYZ BANK be Required to Consolidate the Trust and the Issuer? The IAS 27 standard requires consolidation of all entities that are controlled (subsidiaries) by the reporting entity (XYZ BANK). The SIC-12 rule further explains consolidation of SPVs, when the substance of the relationship between an entity and the SPV indicates that the SPV is controlled by the

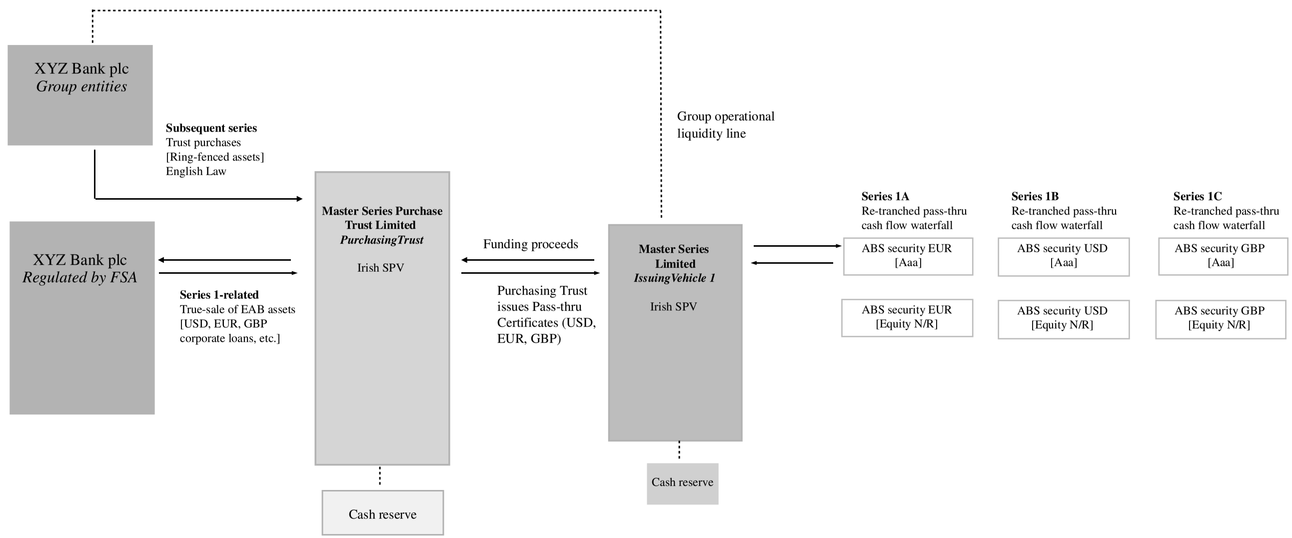


FIGURE 12.8 Transaction structure, in-house ECB-led securitisation.

entity. Given the above two standards, XYZ BANK would be required to consolidate the SPVs established due to following reasons:

- In substance, the activities of the SPVs are being conducted on behalf of XYZ BANK according to its specific business needs so that XYZ BANK obtains benefits from their operations.
- In substance, XYZ BANK has the decision-making powers to obtain the majority of the benefits of the activities of the SPVs albeit through an autopilot mechanism.
- In substance, XYZ BANK will have rights to obtain the majority of the benefits of the SPVs and will therefore be exposed to the risks inherent to the activities of the SPVs.
- In substance, XYZ BANK retains the majority of the residual risks related to the SPVs or its assets in order to obtain benefits from its activities.

Although share capital issued by both the Trust and the Issuer will be owned by third parties (the Charitable Trust ownership structure that is common in finance market SPV arrangements), the SIC-12 conditions would require XYZ BANK to consolidate them by virtue of having control over the SPVs.

Would the True (Legal) Sale Between XYZ BANK and the Trust meet the de-recognition Criteria? Although a true (legal) sale of the underlying assets will be achieved, a transfer can be recognised from an accounting perspective only when it meets the de-recognition criteria under IAS 39 rules. The decision whether a transfer qualifies for de-recognition is made by applying a combination of risks and rewards and control tests. De-recognition cannot be achieved merely by transferring the legal title to an asset to another party. The substance of the arrangement has to be assessed in order to determine whether an entity has transferred the economic exposure associated with the rights inherent in the asset.

In other words, an in-house transaction has no practical accounting or risk transfer impact and is recognized as such in its accounting and regulatory capital treatment.

Hence, XYZ BANK would continue to recognise the underlying loans on its balance sheet. This is primarily due to the fact the XYZ BANK will continue to retain substantially all the risks and rewards associated with the underlying loans by virtue of owning all the Notes issued by the SPV, without any intention of onward sale to a third party. This would include all tranches issued by the SPV irrespective of the rating or subordination. Furthermore, in case of a loss occurred on any of the underlying loans, XYZ BANK would indirectly be affected through either reduction in the interest payments or principal of the Notes held.

Detailed accounting Based on the above, the detailed accounting entries would be as follows, and under the following assumptions:

- The SPVs are consolidated under SIC 12.
- The transaction sale does not meet the de-recognition criteria under IAS 39.

On closing day, the accounting entries to be produced on day 1 of the transaction in the three individual entities would be as follows:

On legal sale of loans from XYZ BANK to the Trust

XYZ BANK	The Trust	The Issuer
Cash—Dr	Inter-company loan (loans and receivables)—Dr	N/A
Inter-company loan (loans and receivables)—Cr	Cash—Cr	N/A

On issue of pass through certificates by the Trust to the Issuer

XYZ BANK	The Trust	The Issuer
N/A	Cash—Dr	Notes issued by the Trust (loans and receivables)—Dr
N/A	Notes (financial liabilities at amortised cost)—Cr	Cash—Cr

On issue of Notes by the Issuer and acquisition by XYZ BANK

XYZ BANK	The Trust	The Issuer
Notes issued by the Issuer (loans and receivables) [see note below∗]—Dr	N/A	Cash—Dr
Cash—Cr	N/A	Notes (financial liabilities at amortised cost)—Cr

Although the Notes issued by the Issuer were listed on the Irish Stock Exchange, they could still be classified as 'loans and receivables' as they were not quoted in an active market. As per AG71 in the IAS 39 rules, a financial instrument is regarded as quoted in an active market if quoted prices are readily and regularly available from market sources and those prices represent actual and regularly occurring market transactions on an arm's-length basis. Since all the Notes issued by the Issuer were to be held by XYZ BANK and would not be traded, they are deemed to be not quoted in active market.

Therefore on Day 1, the balance sheets of each of entities would reflect the following on execution of the transaction, assuming a €2 billion transaction size:

XYZ BANK (Extract Only)	**The Trust**	**The Issuer**
Notes (investment in Issuer)—2bn	Assets	Assets
	Cash—X	Cash—X
	Inter-company loan to XYZ BANK—2bn	Notes issued by the Trust—2bn
	Total assets 2bn + X	Total 2bn + X
Liabilities	Liabilities	Liabilities
Inter-company borrowing from the Trust—2bn	Notes (Pass-thru certificates)—2bn	Liabilities Notes issued AAA—XXXm BBB—XXXm Non-rated sub-debt —XXXm Total—2bn
	Equity—X	Equity—X
	Total liabilities and equity—2bn + X	Total liabilities and equity—2bn + X

In XYZ BANK consolidated financial statements, all the above balances will net off except for cash balances held by the SPVs (if external) and the minority interest in Equity of the SPVs. The financial statements will effectively continue to reflect the underlying loans as 'loans and receivables' as they do at present. If the Notes issued by the Issuer were subsequently used as collateral for repo purposes, XYZ BANK would reflect third-party borrowing in its financial statements while disclosing the underlying collateral.

Swap As part of the proposed transaction, an interest rate swap (IRS) will be entered into between XYZ BANK and the Trust to manage the basis risk. Both the entities will mark-to-market the swap in their individual financial statements while in the XYZ BANK consolidated financial statements the balances will net off with zero mark-to-market impact.

Transaction Costs The transaction costs incurred by the Issuer on the issuance of Notes and the setup of the structure will be deducted from the fair value of the Notes issued on initial recognition in the financial statements of the Issuer. These costs would include the one-off fees including legal, rating agencies and so on. These would then form part of the effective interest rate calculations of the Notes issued and will be amortised through the profit or loss over the economic life of the Notes issued. The annual running costs would be accounted for in the profit and loss as and when occurred.

In the XYZ BANK consolidated financial statements, these transaction costs were reflected as an asset to be amortised over the economic life of the Notes issued. An asset has been defined 'as a resource controlled by the enterprise as a result of past events and from which future economic benefits are expected to flow to the enterprise'.

For XYZ BANK the objective of the structure was to secure term liquidity and cheap funding, and to benefit from the liquidity facility at the ECB. Therefore the expected future economic benefits flowing to XYZ BANK justified the recognition of these costs as an asset. The asset would be subject to impairment review on at least an annual basis.

Other Considerations

Capital Adequacy Assume that XYZ BANK prepares its regulatory returns on a solo consolidated basis. This allows elimination of both the major intra-group exposures and investments of XYZ BANK in its subsidiaries when calculating capital resource requirements. Therefore as described above for XYZ BANK consolidated financial statements, there would be no additional capital adequacy adjustments to arise subject to the treatment of costs incurred on the transaction. XYZ BANK would however be required to make a waiver application to its regulatory authority (in this case the UK's Financial Services Authority (FSA)under BIPRU 2.1

explaining the proposed transaction and its objectives. The key points FSA would consider in approval of the waiver request include:

- The control XYZ BANK will have over the subsidiaries/SPVs.
- The transferability of capital/assets from the subsidiaries to XYZ BANK.
- The total amount of capital/assets solo consolidated by XYZ BANK.

XYZ BANK would reflect the investment in Notes issued by the Issuer at 0% risk weighting to avoid double counting. Therefore, there would be no further capital charge on the Notes issued by the Issuer and held by XYZ BANK.

SPVs are not regulated entities and therefore would not be required to comply with the European Union Capital Requirements Directive.

EXAMPLE 12.3 AN IN-HOUSE DEAL: FAST NET SECURITIES LTD.

During 2007–2009 over 100 banks in the European Union undertook in-house securitisations in order to access the ECB discount window, as funding sources in the inter-bank market dried up.[12] It was widely believed that the UK banking institution Nationwide Building Society acquired an Irish banking entity during 2008 purely in order to be able to access the ECB's discount window (a requirement for which was to have an office in the euro-zone area).

One such public deal was Fast Net Securities 3 Limited, originated by Irish Life and Permanent plc. Figure 12.9 on page 440 shows the deal highlights.

Note that this transaction was closed in December 2007, a time when the securitisation market was essentially moribund in the wake of the credit crunch. An ABS note rated AAA could be expected to be marked-to-market at over 200 bps over LIBOR. Because the issued notes were purchased in entirety by the originator, who intended to use the senior tranche as collateral to raise funds at the ECB, the terms of the deal could be set at a purely nominal level; this explains the '40 bps over EURIBOR' coupon of the senior trance.

(*continued*)

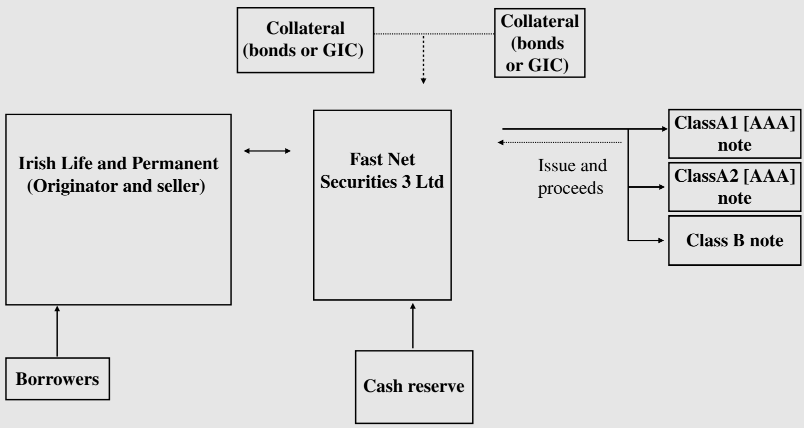


FIGURE 12.9 Fast Net Securities 3 Limited., structure diagram.
Source: S&P. Details reproduced with permission.

SECURITISATION: IMPACT OF THE 2007–2008 FINANCIAL CRISIS[13]

As recounted in the Prologue, following rapid growth in volumes during 2002–2006, in 2007 the securitisation market came to a virtual standstill as a direct impact of the sub-prime mortgage default and the crash in asset-backed commercial paper trading. Investors lost confidence in a wide range of parameters. The liquidity crunch in money markets led to the credit crunch in the economy and worldwide recession. Globalisation and integrated banking combined with the widespread investment in structured credit products to transmit the effects of US mortgage defaults worldwide. Economic growth collapsed, which suggests that the securitisation market, in the form of ABS such as collateralised debt obligations (CDOs), was a major contributor in magnifying the impact of poor-quality lending in the US mortgage market.

As a technique securitisation still retains its merits. It reduces barriers to entry and opens up a wide range of asset markets to investors who would never otherwise be able to access such markets. Due to its principal characteristics of tranching a pool of loans into different risk categories, it enables

[13] This section was co-written with Gino Landuyt, Europe Arab Bank plc.

cash-rich investors to participate in funding major projects, and this in the broadest sense. It widens the potential group of buyers and sellers due to its characteristics of diversification and customisation. As a result it increases liquidity and simultaneously reduces transaction costs. These benefits enabled both cash borrowers and cash investors to benefit from the technique.

In light of the decline in securitisation volumes since 2007, we consider the factors that contributed to the fall in confidence in the market.

Impact of the Credit Crunch

The flexibility and wide application of the securitisation technique, which were advantageous to banks that employed it, also contributed to its misuse in the markets. By giving banks the ability to move assets off the balance sheet, ABS became a vehicle by which low-quality assets such as sub-prime mortgages could be sold on to investors who had little appreciation of the credit risk they were taking on.

The Shadow Banking System In a classic banking regime there is no detachment between the borrower and the lender. The bank undertakes its own credit analysis, offers the loan to its client and monitors the client over the life of the loan. In securitisation however the link between the borrower and the bank is disconnected. The loan is packaged into different pieces and moved on to an unknown client base. As a consequence there is less incentive for the 'arranger' to be risk conscious.

This becomes a potential negative issue when banks set up a parallel circuit, now termed the 'Shadow Banking' system, where they are not bound by a regulatory regime that normal banks must adhere to. For instance, in a vanilla banking regime banks must keep a certain percentage of deposits against their loans, but this does not apply if they are funding themselves via the commercial paper market that is uninsured by a central bank's discount window.

As a consequence the shadow banks' major risk is when their commercial paper investors do not want to roll their investment anymore and leave the shadow bank with a funding problem. As a result, they might need to tap in at the outstanding credit lines of regulated banks or need to sell their assets at fire sale prices. This is what happened in the ABCP crash in August 2007.

The Amount of Leverage The shadow banking system in the form of special investment vehicles (SIVs) was highly leveraged. Typically, the leverage ratio was around 1:15. However, in some cases, as the search for yield in a bull market of tightening credit spreads intensified, the leverage ratios for some SIVs reached 1:40 and even 1:50. To put this into perspective, the hedge fund Long Term Capital Management (LTCM) was running a leverage of 1:30 at the time of its demise in 1998, which created significant disruption in the markets. In effect what happened in 2007–08 was hundreds of LTCMs all failing, all of which used a higher leverage ratio and were all setting up the same trade.

The leverage factor in some of the products reached very high levels. After CDOs more leverage was sought with CDO^2, which were CDO structures investing in other CDOs.

Transparency of Products Some products became extremely complex and started to look like a black box. They became difficult to analyse by outside parties wishing to make an assessment on the value of the investment. For instance, the mark-to-market value was not only related to credit spread widening of the tranche, but also changed in 'correlation risk' within the credit portfolio, which had different impacts on different tranches in the structure.

Credit Rating Agencies (CRA) The CRAs publicised their rating methodologies, which had the cachet of statistical logic but were not understood by all investors; moreover, they were in hindsight overly optimistic in issuing ratings to certain deals in which the models used assumed that the likelihood of a significant correction in the housing market on a(n) (inter) national scale was virtually zero. The favourable overall economic conditions and the continuous rise in home prices over the past decade provided near term cover for the deterioration in lending standards and the potential ramifications of any significant decline in asset prices.[14]

Accounting and Liquidity The liquidity of most of these assets was overestimated. As a consequence investors believed that AAA-rated securitised paper would have the same liquidity as plain vanilla AAA-rated paper and could therefore be easily funded by highly liquid commercial paper. A huge carry trade of long-dated assets funded by short-term liabilities was built up and once the first losses in the sub-prime market started to make an impact, SPVs had to start unwinding the paper. Fund managers realised that there was a liquidity premium linked to their paper that they had not taken into account.

[14] See SIFMA, *Survey on Restoring Confidence in the Securitisation Market,* December 2008.

The mark-to-market accounting rules accelerated the problem by creating a downward spiral of asset values as the secondary market dried up. Banks had to mark ABS assets at the 'market' price, unconnected with the default performance of the underlying portfolios; however, in a flight-to-quality environment all structured credit products became impossible to trade in the secondary market and values were marked down almost daily, in some cases to virtually zero. The accounting rules forced banks to take artificial hits to their capital without taking into account the actual performance of the pool of loans.

As a result of all this, and general investor negative sentiment, the new-issue securitisation market reduced considerably in size. As a technique though, it still offers considerable value to banks and investors alike, and its intelligent use can assist in general economic development.

CONCLUSION

In a recessionary environment brought on by a banking crisis and credit crunch, the investor instinct of 'flight-to-quality' will impact structured finance products such as ABS ahead of more plain vanilla instruments. Market confidence is key to the re-starting investments such as ABS. The potential benefits to banks and the wider economy of the securitisation technique in principle and how developed and developing economies could benefit from its application are undisputed. It remains incumbent on interested parties to initiate the first steps towards generating this renewed market confidence.

As financial markets regain momentum and as growth is restored, banks worldwide should still derive benefit from a tool that enables them to diversify funding sources. Banks that diversify their funding can also diversify their asset base, as they seek to reduce the exposure of their balance sheets to residential mortgage and real-estate assets. Securitisation remains a valuable mechanism through which banks can manage both sides of their balance sheet

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CHAPTER 13

Synthetic Collateralised Debt Obligations

In the previous chapter we looked at the basic concepts of traditional cash flow securitisation. Combining certain aspects of this technique with credit derivatives technology gives rise to so-called *synthetic securitisation*, also known as unfunded securitisation. In a synthetic transaction, the credit risk of a pool of assets is transferred from an originator to investors, but the assets themselves are not sold.[1] In certain jurisdictions, it may not be possible to undertake a cash securitisation due to legal, regulatory, cross-border or other restrictions. Or, it may be that the process simply takes too long under the prevailing market conditions. In such cases, originators use synthetic transactions, which employ some part of the traditional process allied with credit derivatives. However, if the main motivation of the originator remains funding concerns, then the cash flow approach must still be used. Synthetic transactions are mainly used for credit risk and regulatory capital reasons, and not funding purposes.

This chapter is an analysis of the synthetic collateralised debt obligation (CDO), or collateralised synthetic obligation (CSO). We focus on the key drivers of this type of instrument, from an issuer and investor point of view, before assessing the mechanics of the structures themselves. This takes the form of a case study-type review of selected innovative transactions. We begin with a brief introduction to the concept of

[1] Although the first synthetic transactions were 'balance sheet' deals, in which the originating bank transferred the credit risk of a pool of assets it held without actually selling them off its balance sheet, the fact that assets are not actually transferred means that the originator does actually have to own them in the first place. It may wish to transfer the credit risk for portfolio trading reasons. We look at this development of CSOs in this chapter too.

the collateralised debt obligation, a development of well-established securitisation techniques.

SECURITISATION AND THE COLLATERALISED DEBT OBLIGATION

A *cash flow* CDO is a structure that is represented by an issue of notes that has interest and principal payments linked to the performance of the underlying assets of the vehicle. These underlying assets act as the *collateral* for the issued notes, hence the name. There are many similarities between CDOs and other asset-backed securities (ABS), which pre-dated them. The key difference between CDOs and other ABS and multi-asset repackaged securities is that the collateral pool is generally (though not always) actively managed by a collateral portfolio manager. This pool can be either bank loans, bonds, or a mixture of both loans and bonds. Pure loan structures are known as collateralised loan obligations (CLOs) and pure bond structures are known as collateralised bond obligations (CBO). A mixed pool of assets would be a CDO.

Generally, CDOs feature a multi-tranche overlying note structure, with most or all of the notes being rated by one or more of the public credit ratings agencies. The priority of payment of the issued securities reflects the credit rating for each note, with the most senior note being the highest rated. In Europe, issued securities may pay a fixed or floating coupon, usually on a semi-annual, quarterly or monthly basis, with senior note issues rated from AAA to A and junior and mezzanine notes rated BBB to B. There may be unrated subordinated and *equity* pieces issued. The equity note is actually a bond, and represents the shareholding interest in the vehicle, its return is variable and linked to the performance of the collateral pool. Investors in the subordinated notes receive coupon after payment of servicing fees and the coupon on senior notes. The equity and subordinated note are the first-loss pieces and, as they carry the highest risk, have a higher expected return compared to that of the underlying collateral. In a CDO, the cash flows of the underlying assets are used to fund the liabilities of the overlying notes. As the notes carry different ratings, there is a *priority of payment* that must be followed, which is the cash flow waterfall. The waterfall was explained in Chapter 12.

In other words, cash flow CDOs are quite similar to traditional ABS, with the key difference being the nature of the underlying asset pool. Banks and financial institutions use CDOs to diversify their sources of funding, to manage portfolio risk and to obtain regulatory capital relief. Investors are attracted to the senior notes in a transaction because these allow them to earn relatively high yields compared to other asset-backed bonds of a similar credit rating.

THE SYNTHETIC CDO

Synthetic CDOs were introduced to meet differing needs of originators, where credit risk transfer is of more importance than funding considerations. Compared with conventional cash flow deals, which feature an actual transfer of ownership or *true sale* of the underlying assets to a separately incorporated legal entity, a synthetic securitisation structure is engineered so that the credit risk of the assets is transferred by the sponsor or originator of the transaction, from itself, to the investors by means of credit derivative instruments. The originator is therefore the credit protection buyer and investors are the credit protection sellers. This credit risk transfer may be undertaken either directly or via an special purpose vehicle (SPV). Using this approach, underlying or *reference* assets are not moved off the originator's balance sheet, so it is adopted whenever the primary objective is to achieve risk transfer rather than balance sheet funding. The synthetic structure enables removal of credit exposure without asset transfer, so may be preferred for risk management and regulatory capital relief purposes. For banking institutions it also enables loan risk to be transferred without selling the loans themselves, thereby allowing customer relationships to remain unaffected.

The first synthetic deals were observed in the US and Europe in 1997.

ASSESSING THE GENESIS OF THE SYNTHETIC CDO

The original cash flow-style CDO was a tool for intermediation. In this respect, it can be viewed as a (mini-) bank, albeit a more efficient tool for intermediation than a bank. Where a CDO-type structure differs from a bank is in the composition of its asset pool: unlike a bank, its asset pool is not diverse, but is tailored to meet the specific requirements of both the originator and the customer (investor). It is this tailoring that generates the economic efficiencies of the CDO. In an institutional scenario, as exists in a bank, assets are, in effect, priced at their lowest common denominator. Hence, a bank that has 10% of its assets held in the form of emerging market debt would be priced at a lower value than an equivalent institution that does not hold such risky assets. The CDO-structure's liabilities are also more tailored to specific needs, with a precise mix of equity holders, AAA-liabilities and so on.

We may view the CDO-type entity as similar to a banking institution and a tool for the intermediation of risk. A synthetic CDO may be viewed in similar terms, but in its case the analogy is more akin to that of an insurance company rather than a bank. This reflects the separation of funding from credit risk that is facilitated by the synthetic approach, and the resulting ability to price pure credit—a risk management mechanism that is analogous to how an insurance company operates in comparison to a bank. The investors in a synthetic CDO do not purchase the assets that are referenced in a vehicle, they merely wish an economic exposure to it. This is made possible through the use of credit derivatives in the CDO structure.

Combining securitisation technology with credit derivatives, into synthetic structures, was particularly suited to the European market, with its myriad of legal and securitisation jurisdictions. The traditional method of securitisation, involving selling assets into an SPV and used for balance sheet and risk management purposes, was viewed as less efficient than it had proved in the North American market. This was due to the differing circumstances prevailing in each market:

- In the US market, commercial banks were traditionally lower rated than their counterparts in Europe. Hence the funding element of a cash flow securitisation was a key motivating factor behind a deal, as the originator could secure lower funding costs by means of the securitisation.
- European banks, being higher rated than US banks, had less need of the funding side in a securitisation deal—compared to US banks, they obtained a greater share of their funding from their retail customer base. A significant portion of their funding was obtained at LIBOR-minus, compared to the LIBOR-flat funding of US banks.

So although European banks had an interest in transferring risk from their balance sheet, they had less need of the funding associated with traditional securitisation. A cash flow CDO was not as economic for originators in the European market because they did not have a need for funding, and so this approach had little or no benefit for them. However, banks still needed to reduce regulatory capital requirements and transfer credit risk. This led to the first static balance sheet synthetic CDO, known as BISTRO, which was originated by J.P. Morgan in 1997.[2]

The first synthetic CDOs were balance sheet driven; banks structured deals for regulatory capital management purposes. These deals reflected a desire by banks to shift their credit risk and by doing so, to manage capital more efficiently. Later deals followed an arbitrage model: they were originated by fund managers, who were perceived by investors as being more professional at managing risk. Hence the 'second generation' of CDO structures, which reflected the comparative advantage generated as insurance companies were

[2] See the exhibit on the BISTRO deal, referred to in the Case Studies section.

able to split up an overall 'pool' of risk and break it into separate pieces. These pieces were tailored to specific investor preferences. Compared to cash flow structures, synthetic structures separate the risk transfer element from the funding element. This mirrors what occurred in the early 1980s with interest rate swaps, shortly after these were introduced. Interest rate swaps also split the interest rate risk from the funding risk, as they were off-balance sheet instruments with no exchange of principal. This is the same case with credit derivatives and is precisely what has happened in the credit derivatives market.

Deal Motivations

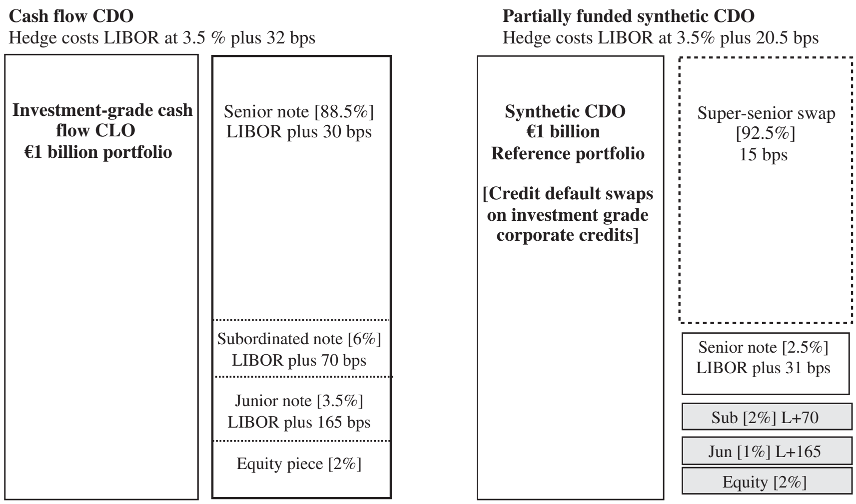
Differences between synthetic and cash CDOs are perhaps best reflected in the different cost–benefit economics of issuing each type. The motivations behind the issue of each type usually also differ.

A synthetic CDO is constructed out of the following:

- a short position in a credit default swap (CDS) (bought protection), by which the sponsor transfers its portfolio credit risk to the issuer (the SPV);
- a long position in a portfolio of CDS written on bonds or loans, the cash flow from which enables the issuer SPV to pay liabilities of overlying notes or CDS.

The originators of the first synthetic deals were banks that wished to manage the credit risk exposure of their loan books, without having to resort to the administrative burden of true sale cash securitisation. They are a natural progression in the development of credit derivative structures, with single name CDSs being replaced by portfolio default swaps. Synthetic CDOs can be 'de-linked' from the sponsoring institution, so that investors do not have any credit exposure to the sponsor itself. The first deals were introduced (in 1998) at a time when widening credit spreads and the worsening of credit quality among originating firms meant that investors were sellers of those cash CDOs that had retained a credit linkage to the sponsor. A synthetic arrangement also means that the credit risk of assets that are otherwise not suited to conventional securitisation may be transferred, while assets are retained on the balance sheet. Such assets include bank guarantees, letters of credit or cash loans that have some legal or other restriction on being securitised. For this reason, synthetic deals are more appropriate for assets that are described under multiple legal jurisdictions.

The economic advantage of issuing a synthetic versus a cash CDO can be significant. Put simply, the net benefit to the originator is the gain in regulatory capital cost, minus the cost of paying for credit protection on the



Regulatory capital relief
Cash CDO
Capital charge on assets reduces from 8% (100% RW) to 2% (equity piece only now 100% RW)
Regulatory capital relief is 6%
Synthetic CDO
Capital charge on assets reduces from 8% (100% RW) to 3.48% (equity piece plus super-senior swap at 20% RW)
Regulatory capital relief is 4.52%

FIGURE 13.1 Hypothetical generic cash flow and synthetic CDO comparative deal economics, 2004.

CDS side. In a partially funded structure, which combines cash notes and credit derivatives, a sponsoring bank obtains full capital relief when note proceeds are invested in 0% risk-weighted collateral such as Treasuries or gilts. The 'super-senior' swap portion carries a 20% risk weighting.[3] A synthetic deal would be cheaper—where CDSs are used, the sponsor pays a basis point fee, which for a AAA-rated security was in the range of 10–30 bps during 2002–2006, depending on the stage of the credit cycle. In a cash structure where bonds are issued, the cost to the sponsor is the benchmark yield plus the credit spread, which would be considerably higher when compared to the default swap premium. This is illustrated in the example shown at Figure 13.1, where we assume certain spreads and premiums in comparing a partially funded synthetic deal with a cash deal. These were spreads as at 2004, before the credit crunch. The assumptions are:

[3] This is as long as the counterparty is an OECD bank, which is invariably the case. It is called 'super-senior' because the swap is ahead of the most senior of any funded (note) portion.

- that the super-senior credit swap cost is 15 bps, and carries a 20% risk weight;
- the equity piece retains a 100% risk-weighting;
- the synthetic CDO invests note proceeds in sovereign collateral that pays sub-LIBOR.

Synthetic deals can be *unfunded*, *partially funded* or *fully funded*. An unfunded CDO is comprised wholly of CDSs, while fully funded structures are arranged so that the entire credit risk of the reference portfolio is transferred through the issue of credit-linked notes (CLNs). We discuss these shortly.

Within the European market, static synthetic balance sheet CDOs were the most common structure. The reasons that banks originated them were twofold:

- *capital relief:* banks can obtain regulatory capital relief by transferring lower yield corporate credit risk such as corporate bank loans off their balance sheet. Under Basel I rules, all corporate debt carries an identical 100% risk-weighting; therefore, with banks having to assign 8% of capital for such loans, higher rated (and hence lower yielding) corporate assets require the same amount of capital, but generate a lower return on that capital. A bank may wish to transfer such higher rated, lower yield assets from its balance sheet, and this can be achieved via a CDO transaction. The capital requirements for a synthetic CDO are lower than for corporate assets. For example, the funded segment of the deal is supported by high-quality collateral such as government bonds, and via a repo arrangement with an OECD bank, carries a 20% risk weighting, as does the super-senior element;
- *transfer of credit risk:* the cost of servicing a fully funded CDO, and the premium payable on the associated CDS, can be prohibitive. With a partially funded structure, the issue amount is typically a relatively small share of the asset portfolio. This substantially lowers the default swap premium. Also, as the CDO investors suffer the first loss element of the portfolio, the super-senior default swap can be entered into at a considerably lower cost than that on a fully funded CDO.

Deal Mechanics

A synthetic CDO is so-called because the transfer of credit risk is achieved 'synthetically' via a credit derivative, rather than by a 'true sale' to an SPV. Thus in a synthetic CDO, the credit risk of the underlying loans or bonds is transferred to the SPV using CDSs and/or total return swaps (TRSs).

However, the assets themselves are not legally transferred to the SPV, and they remain on the originator's balance sheet. Using a synthetic CDO, the originator can obtain regulatory capital relief[4] and manage the credit risk on its balance sheet, but it will not receive any funding. In other words, a synthetic CDO structure enables originators to separate credit risk exposure and asset funding requirements. The credit risk of the asset portfolio, now known as the reference portfolio, is transferred, directly or to an SPV, through credit derivatives. The most common credit contracts used are CDSs. A portion of the credit risk may be sold on as CLNs. Typically, a large majority of the credit risk is transferred via a super-senior CDS,[5] which is dealt with a swap counterparty but usually sold to mono-line insurance companies at a significantly lower spread over LIBOR compared with the senior AAA-rated tranche of cash flow CDOs. This is a key attraction of synthetic deals for originators. Most deals are structured with mezzanine notes sold to a wider set of investors, the proceeds of which are invested in risk-free collateral such as Treasury bonds or Pfandbriefe securities. The most junior note, known as the 'first-loss' piece, may be retained by the originator. On occurrence of a Credit Event among the reference assets, the originating bank receives funds remaining from the collateral after they have been used to pay the principal on the issued notes, less the value of the junior note.

A generic synthetic CDO structure is shown in Figure 13.2. In this generic structure, the credit risk of the reference assets is transferred to the issuer SPV and ultimately the investors, by means of the CDS and an issue of CLNs. In the default swap arrangement, the risk transfer is undertaken in return for the swap premium, which is then paid to investors by the issuer. The note issue is invested in risk-free collateral rather than passed on to the originator, in order to de-link the credit ratings of the notes from the rating of the originator. If the collateral pool is not established, a downgrade of the sponsor may result in a downgrade of the issued notes. Investors in the notes expose themselves to the credit risk of the reference assets, and if there are no credit events they will earn returns to at least equal the collateral assets and the default swap premium. If the notes are credit-linked, they will also earn excess returns based on the performance of the reference portfolio. If there are credit events, the issuer will deliver the assets to the swap counterparty and will pay the nominal value of the assets to the

[4] This is because reference assets that are protected by credit derivative contracts, and which remain on the balance sheet, attract a lower regulatory capital charge under Basel rules.

[5] So called because the swap is ahead of the most senior of any funded (note) portion, the latter being 'senior' means the swap must be 'super-senior'.

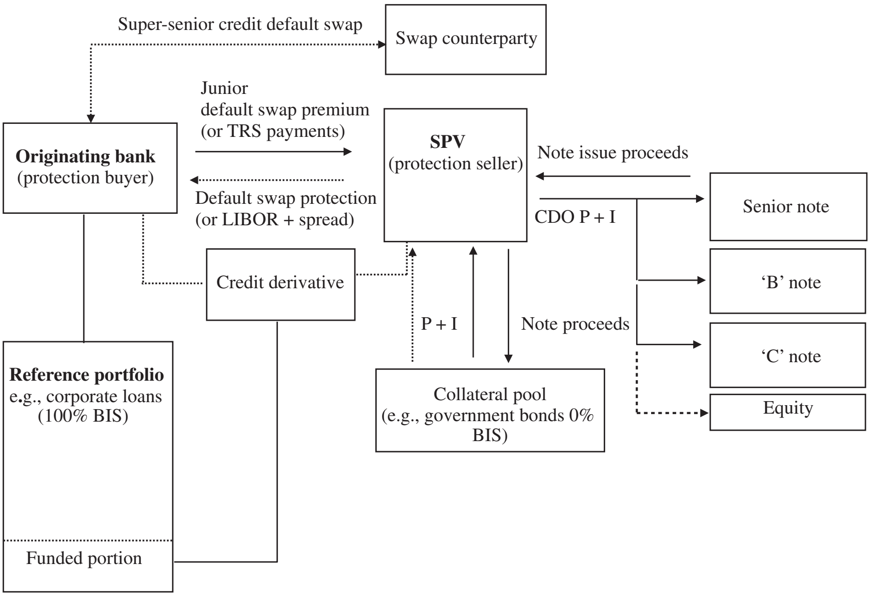


FIGURE 13.2 Generic synthetic CDO structure.

originator out of the collateral pool. CDS are unfunded credit derivatives, while CLNs are funded credit derivatives where the protection seller (the investors) fund the value of the reference assets upfront, and receive a reduced return on occurrence of a credit event.

EXAMPLE 13.1 CREDIT RISK TRANSFER

In simple terms, the protection buyer, which is usually the collateral manager of the CDO, enters into a CDS with the SPV, which is the junior default swap labelled in Figure 13.2. By buying protection on the reference entities, the CDO manager transfers the credit risk on these entities to the CDO investors, who are protection sellers. In return for taking on this risk, investors receive a premium from the protection buyer. Therefore, as shown in Figure 13.2, the return for investors is the coupon on the collateral securities together with the CDS premium.

The super-senior piece is unfunded and typically sold to a swap counterparty or mono-line insurer as a basket CDS, called the

(continued)

super-senior CDS. The credit risk on this piece is statistically very low, because it represents the most senior piece of the portfolio and is usually comprised of high-quality investment-grade credits. There is thus a very low probability that loss due to default will exceed the portion of the CDO that is funded, thereby eating into the super-senior piece, so this represents a very low risk, termed 'catastrophe risk' in an insurance company. Because the senior note is often AAA-rated, and the super-senior piece ranks above this, it is a higher quality risk than AAA risk.

SYNTHETIC CDO DEAL STRUCTURES

We now look in further detail at the various types of synthetic CDO structures.

Generic Concept

Synthetic CDOs have been issued in a variety of forms, labelled in generic form as arbitrage CDOs or balance sheet CDOs. Structures can differ to a considerable degree from one another, having only the basics in common with each other. The latest development is the *managed synthetic* CDO.

A synthetic arbitrage CDO is originated generally by collateral managers who wish to exploit the difference in yield between that obtained on the underlying assets and that payable on the CDO, both in note interest and servicing fees. The generic structure is as follows: an especially created SPV enters into a TRS with the originating bank or financial institution, referencing the bank's underlying portfolio (the reference portfolio). The portfolio is actively managed and is funded on the balance sheet by the originating bank. The SPV receives the 'total return' from the reference portfolio, and in return it pays LIBOR plus a spread to the originating bank. The SPV also issues notes that are sold into the market to CDO investors, and these notes can be rated as high as AAA as they are backed by high-quality collateral, which is purchased using the note proceeds. A typical structure is shown in Figure 13.3.

A balance sheet synthetic CDO is employed by banks that wish to manage regulatory capital. As before, the underlying assets are bonds, loans and credit facilities originated by the issuing bank. In a balance sheet CDO,

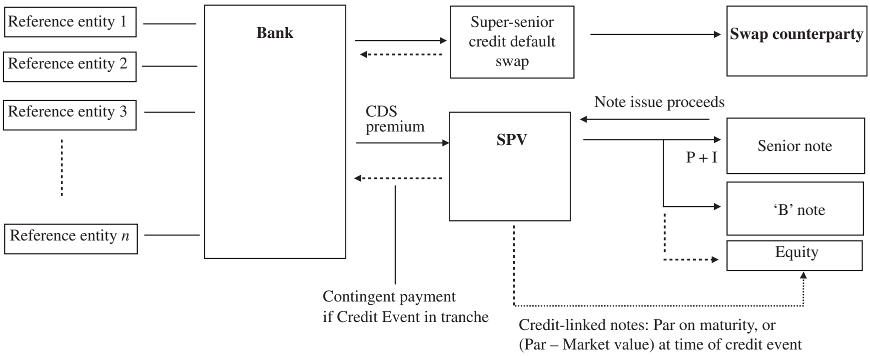


FIGURE 13.3 Synthetic arbitrage CDO structure.

the SPV enters into a CDS agreement with the originator, with the specific collateral pool designated as the reference portfolio. The SPV receives the premium payable on the default swap, and thereby provides credit protection on the reference portfolio. There are three types of CDO within this structure. A fully synthetic CDO is a completely *unfunded* structure, which uses CDSs to transfer the entire credit risk of the reference assets to investors who are protection sellers. In a *partially funded* CDO, only the highest credit risk segment of the portfolio is transferred. The cash flow that is needed to service the synthetic CDO overlying liability is received from the AAA-rated collateral that is purchased by the SPV with the proceeds of an overlying note issue. An originating bank obtains maximum regulatory capital relief by means of a partially funded structure, through a combination of the synthetic CDO and a super-senior swap arrangement with an OECD banking counterparty. A super-senior swap provides additional protection to that part of the portfolio, the senior segment, which is already protected by the funded portion of the transaction. The sponsor may retain the super-senior element or may sell it to a mono-line insurance firm or CDS provider.

Some commentators categorise synthetic deals using slightly different terms. For instance Boggiano, Waterson and Stein (2002) defined the following types:

- balance sheet static synthetic CDO;
- managed static synthetic CDO;
- balance sheet variable synthetic CDO;
- managed variable synthetic CDO.

As described by Boggiano *et al.* (2002), the basic structure is similar to that for a partially funded synthetic CDO. In fact there is essentially little difference between the first two types of deal, in the latter an investment manager rather than the credit swap counterparty selects the portfolio. However, the reference assets remain static for the life of the deal in both cases. For the last two deal types, the main difference is that an investment manager, rather than the originator bank, trades the portfolio of credit swaps under specified guidelines. This is arguably not a structural difference and so for the purposes of this book we consider them both as managed CDOs, which are described later.

Synthetic deals may be either static or managed. Static deals have the following advantages:

- there are no ongoing management fees to be borne by the vehicle;
- the investor can review and grant approval to credits that are to make up the reference portfolio.

The disadvantage is that if there is deterioration in credit quality of one or more names, there is no ability to remove or offset this name from the pool and the vehicle continues to suffer from it. During 2001, a number of high-profile defaults in the market meant that static pool CDOs performed below expectation. This explains partly the rise in popularity of the managed synthetic deal, which we discuss later.

Funded and Unfunded Deals

Synthetic deal structures are arranged in a variety of ways, with funded and unfunded elements to meet investor and market demand. A generic partially funded synthetic transaction is shown in Figure 13.4. It shows an arrangement whereby the issuer enters into two CDSs—the first with an SPV that provides protection for losses up to a specified amount of the reference pool,[6] while the second swap is set up with the OECD bank or, occasionally, an insurance company.[7]

A *fully funded* CDO is a structure where the credit risk of the entire portfolio is transferred to the SPV via CLNs. In a fully funded (or just 'funded') synthetic CDO, the issuer enters into the CDS with the SPV, which itself issues CLNs to the value of the assets on which the risk has been transferred. The proceeds from the notes are invested in risk-free government or agency debt such as gilts, bunds or Pfandbriefe, or in senior

[6] In practice, to date this portion has been between 5% and 15% of the reference pool.

[7] An 'OECD' bank, thus guaranteeing a 20% risk-weighting for capital ratio purposes, under Basel I rules.

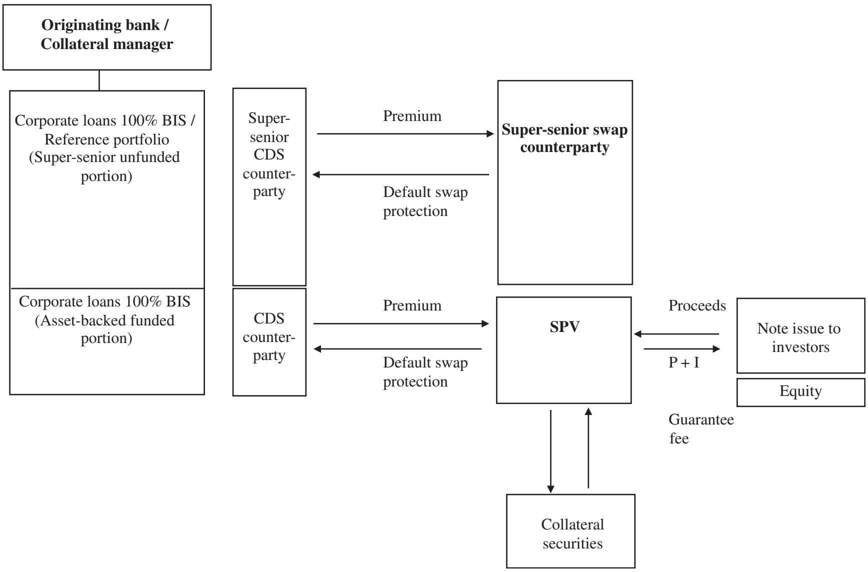


FIGURE 13.4 Partially funded synthetic CDO structure.

unsecured bank debt. Should there be a default on one or more of the underlying assets, the required amount of the collateral is sold and the proceeds from the sale are paid to the issuer to recompense for the losses. The premium paid on the CDS must be sufficiently high to ensure that it covers the difference in yield between that on the collateral and that on the notes issued by the SPV. The generic structure is illustrated in Figure 13.5.

Fully funded CDOs were relatively uncommon. One of the advantages of the partially funded arrangement is that the issuer pays a lower premium compared to a fully funded synthetic CDO, because it is not required to pay

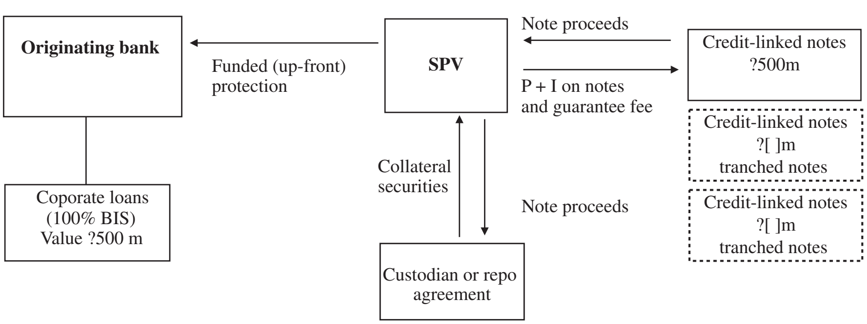


FIGURE 13.5 Fully funded synthetic balance sheet CDO structure.

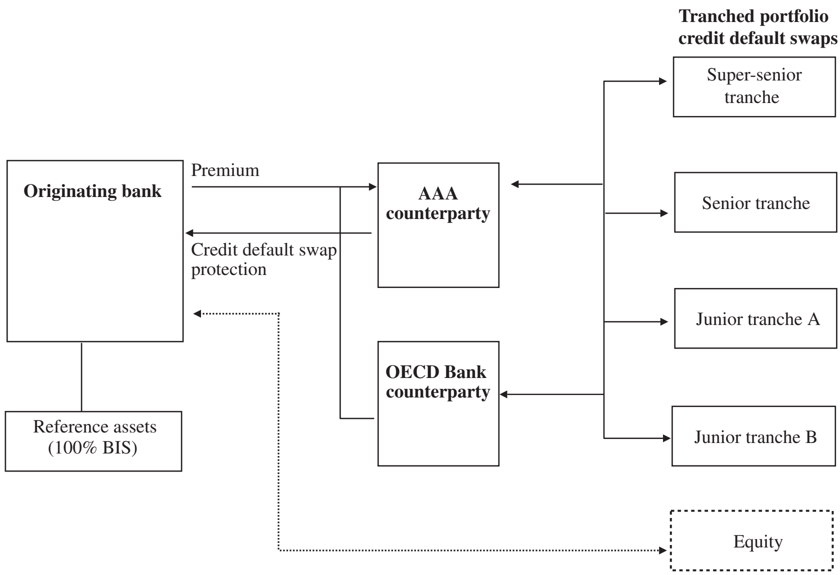


FIGURE 13.6 The fully synthetic or unfunded CDO.

the difference between the yield on the collateral and the coupon on the note issue (the unfunded part of the transaction). The downside is that the issuer receives a reduction in risk-weighting for capital purposes to 20% for the risk transferred via the super-senior default swap.

The fully *unfunded* CDO uses only CDSs in its structure. The swaps are rated in a similar way to notes, and there is usually an 'equity' piece that is retained by the originator. The reference portfolio is again commercial loans, usually 100% risk-weighted, or other assets. The credit rating of the swap tranches is based on the rating of the reference assets, as well as other factors such as the diversity of the assets and ratings performance correlation. The typical structure is illustrated in Figure 13.6. As well as the equity tranche, there is one or more junior tranches, one or more senior tranches and super-senior tranche. The senior tranches are sold on to AAA-rated banks as a portfolio CDS, while the junior tranche is usually sold to an OECD bank. The ratings of the tranches are typically:

- super-senior: AAA;
- senior: AA to AAA;
- junior: BB to A;
- equity: unrated.

The CDS are not single-name swaps, but are written on a class of debt. The advantage for the originator is that it can name the reference asset class to investors without having to disclose the name of specific loans. Default swaps are usually cash-settled and not physically settled, so that the reference assets can be replaced with other assets if desired by the sponsor.

Deal Term Sheet

In the markets, the first description of a transaction is usually provided in the deal term sheet, produced by the arranging bank. For illustrative purposes, we show at Appendix 13.1, a sample term sheet for a hypothetical deal, which we have called Scarab CDO I Limited. This term sheet is representative of what may be encountered in the market, although there is a wide discrepancy among these, with some being just one side of A4 paper, while others may be 40 or 50 pages long. The full legal description of the deal is given in the deal offering circular (OC). For full details of the legal and documentation aspects of a securitisation, see Garcia and Patel (2004).

EXAMPLE 13.2 THE FULLY UNFUNDED SYNTHETIC CDO

This example illustrates a fully unfounded deal, which can be either on balance sheet or source reference assets externally. Because it is fully unfunded, the liabilities of the deal structure are comprised purely of CDSs, and so it can also be structured with or without an SPV. Our example is of a hypothetical deal structure with the following terms:

Originator: Banking institution

Reference Portfolio: 900 m notional

80–100 corporate names sourced in the market

CDS tranching: Super-senior CDS 815 m notional

'Class A' CDS 35 m notional

'Class B' CDS 15 m notional

'Class C' CDS 20 m notional

'Class D' or Equity CDS 15 m notional

(*continued*)

The structure is illustrated in Figure 13.7.

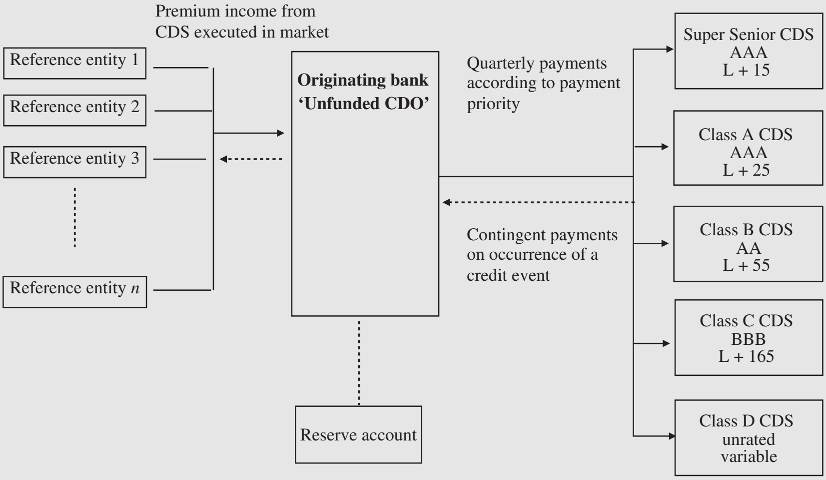


FIGURE 13.7 Fully unfunded synthetic CDO, structure diagram.

The key difference with this structure is that it can be arranged directly by the originating institution. There is no need to set up an SPV. In fact, this is also an on-balance sheet deal. The rating of the tranches is based on the loss allocation, with credit events among reference assets being set up so that the junior note suffers losses first. This follows traditional structured finance technology. However unlike traditional structures, the interest payments on the liability side are not subject to a waterfall; instead, they are guaranteed to investors. This increases the attraction of the deal. Thus, on occurrence of a credit event, interest payments are still received by investors. It is the notional amount, on which interest is calculated, that is reduced, thereby reducing the interest received. Losses of notional value above the Class D threshold eat into the Class C swap notional amount.

This is a version of an arbitrage deal, with the originating bank taking the role of a fund manager. It features the following:

- the bank selects the initial portfolio, using its credit skills to select credits in the market, which are referenced via CDSs. The bank sells protection on these assets; the premium received exceeds the premium paid on the liability side, which creates the arbitrage gain for the bank. The reduced premium payable on the liability side reflects the tranches arrangement of the liabilities;
- the reference assets are sourced by the bank on its own balance sheet, before the CDO itself is closed in the market;
- the bank has freedom to dynamically manage the portfolio during the life of the deal, taking a view on credits in line with its fundamental analysis of the market;
- trading profits are trapped in a 'reserve account', which is also available to cover trading losses and losses suffered due to credit events.

As part of the rating requirements for the deal, the originating bank follows certain eligibility constraints on which exposures it can take on. This can include restrictions on:

- reference entities being rated at investment grade by the ratings agencies;
- no single reference credit to have a total exposure of more than 10 million;
- the reference entity is incorporated in a specified list of countries;
- geographical and industrial concentration;
- a trading turnover limit of 20% of notional value per annum;
- a Moody's diversity score of at least 45 on closing and no lower than 42 during life of deal.[8]

In addition to the 'guaranteed' nature of interest payments for investors (subject to level of credit events), the principal advantage of this structure is that it may be brought to market very quickly. There is no requirement for the originator to set up an SPV, and no need to issue and settle notes. The originator can therefore take advantage of market conditions and respond quickly to investor demands for return enhancement and diversification.

THE MANAGED SYNTHETIC CDO

Managed synthetic CDOs are similar to the partially funded deals we described earlier, except that the reference asset pool of credit derivatives is actively traded by the sponsoring investment manager.[9] It is the maturing market in CDS, resulting in high liquidity in a large number of synthetic corporate credits, that has facilitated the introduction of the managed synthetic CDO. With this structure, originators can use credit derivatives to arbitrage cash and synthetic liabilities, as well as leverage off their expertise in credit trading to generate profit. The advantages for investors are the same as the advantages of earlier generations of CDOs, except that with active trading they are gaining a larger exposure to the skills of the investment manager. The underlying asset pool is again, a portfolio of CDS. However, these are now dynamically managed and actively traded, under specified guidelines. Thus, there is greater flexibility afforded to the sponsor, and the vehicle records trading gains or losses as a result of credit derivative trading. In most structures, the investment manager can only buy protection (short credit) in order to offset an existing sold protection default swap. For some deals, this restriction is removed and the investment manager can buy or sell credit derivatives to reflect its view.

Structure

The structure of the managed synthetic is similar to the partially funded synthetic CDO, with a separate legally incorporated SPV.[10] On the liability side, there is an issue of notes, with note proceeds invested in collateral or *eligible investments* that are made up of one or a combination of the following:

- a bank deposit account or guaranteed investment contract (*GIC*) which pays a pre-specified rate of interest;[11]

[9] These are also commonly known as collateralised synthetic obligations or CSOs within the market. *RISK* magazine has called them collateralised swap obligations, which handily also shortens to CSOs. Boggiano *et al* (2002) refer to these structures as managed variable synthetic CDOs, although the author has not come across this term in other literature.
[10] SPV is also referred to as a special purpose entity (SPE) or special purpose company (SPC).
[11] A GIC has been defined either as an account that pays a fixed-rate of interest for its term, or more usually an account that pays a fixed spread below LIBOR or EURIBOR, usually 3-month floating rolled over each interest period.

- risk-free bonds such as US Treasury securities, German Pfandbriefe or AAA-rated bonds such as credit-card ABS securities;
- a repo agreement with risk-free collateral;
- a liquidity facility with a AA-rated bank;
- a market-sensitive debt instrument, often enhanced with the repo or liquidity arrangement described above.

On the asset side, the SPV enters into CDSs and/or TRSs, selling protection to the sponsor. The investment manager (or 'collateral manager') can trade in and out of CDSs after the transaction has closed in the market.[12] The SPV enters into credit derivatives via a single basket CDS to one swap counterparty, written on a portfolio of reference assets, or via multiple single-name credit swaps with a number of swap counterparties. The latter arrangement is more common and is referred to as a *multiple dealer* CDO. A percentage of the reference portfolio is identified at the start of work on the transaction, with the remainder of the entities being selected during the ramp-up period ahead of closing. The SPV enters into the other side of the CDSs by selling protection to one of the swap counterparties on specific reference entities. Thereafter, the investment manager can trade out of this exposure in the following ways:

- buying credit protection from another swap counterparty on the same reference entity. This offsets the existing exposure, but there may be residual risk exposure unless premium dates are matched exactly or if there is a default in both the reference entity and the swap counterparty;
- unwinding or terminating the swap with the counterparty;
- buying credit protection on a reference asset that is outside the portfolio. This is uncommon as it leaves residual exposures and may affect premium spread gains.

The SPV actively manages the portfolio within specified guidelines, the decisions being made by the investment manager. Initially, the manager's opportunity to trade may be extensive, but this will be curtailed if there are losses. The trading guidelines will extend to both individual CDSs and at the portfolio level. They may include:

- parameters under which the investment manager (in the guise of the SPV) may actively close out, hedge or substitute reference assets using credit derivatives;

[12] This term is shared with other securitisation structures. When notes have been priced, and placed in the market, and all legal documentation signed by all named participants, the transaction has *closed*. In effect, this is the start of the transaction, and the note holders should receive interest payments during the life of the deal and principal repayment on maturity.

- guidelines under which the investment manager can trade credit derivatives to maximise gains or minimise losses on reference assets that have improved or worsened in credit quality or outlook.

The CDS is usually cash settled (after 2007), with physical settlement being less common in a managed synthetic deal. In a multiple dealer CDO, the legal documentation must be in place with all names on the counterparty dealer list, which may add to legal costs as standardisation may be difficult.

Investors who are interested in this structure are seeking to benefit from the following advantages compared to vanilla synthetic deals:

- active management of the reference portfolio and the trading expertise of the investment manager in the corporate credit market;
- a multiple dealer arrangement, so that the investment manager can obtain the most competitive prices for CDSs;
- under physical settlement, the investment manager (via the SPV) has the ability to obtain the highest recovery value for the reference asset.

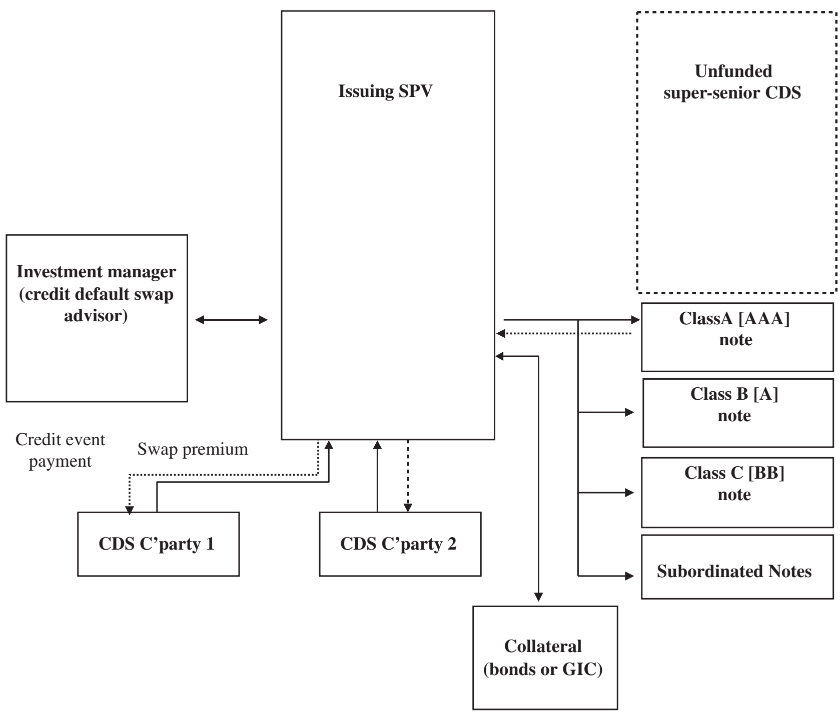


FIGURE 13.8 Generic managed synthetic CDO.

A generic managed synthetic CDO is illustrated at Figure 13.8.

Originators generally appoint third-party portfolio administrators for managed synthetic CDOs to look after the deal during its life, because they are the most complex CSOs. The portfolio administrator is responsible for running (among other things) the rating agency compliance tests, such as the waterfall tests, and reporting on the quality of the reference portfolio to investors.

THE SINGLE-TRANCHE SYNTHETIC CDO

One of the advantages offered to investors in the synthetic market is the ability to invest at maturities required by the investor, rather than at maturities selected by bond issuers. For example, Figure 13.9 illustrates that while the bond market provides assets at only selected points on the credit curve, synthetic products allow investors to access the full curve.

The flexibility of the CSO, enabling deal types to be structured to meet the needs of a wide range of investors and issuers, is well illustrated with the tailor-made or 'single-tranche CDO' structure.[13] This structure has been developed in response to investor demand for exposure to a specific part of a pool of reference credits. With this structure, an arranging bank creates a tailored portfolio that meets specific investor requirements with regard to:

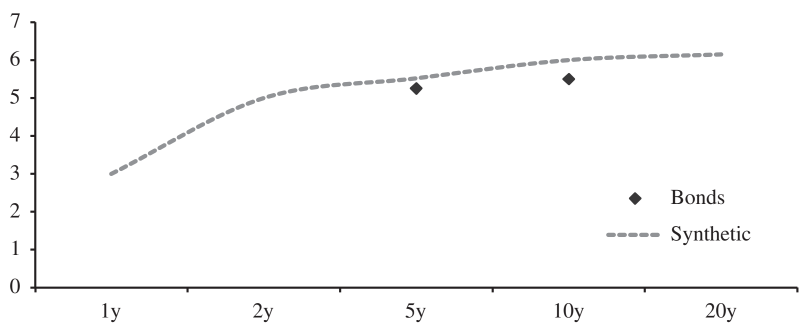


FIGURE 13.9 Hypothetical credit term structure.

[13] These deals have been arranged by a number of investment banks, including J.P. Morgan Chase, Bank of America, UBS Warburg and Credit Agricole Indosuez. They are known variously as *tailor-made CDOs*, *tranche-only CDOs*, *on-demand CDOs*, *iCDOs* and *investor-driven CDOs*, as well as single-tranche CDOs.

- portfolio size and asset class;
- portfolio concentration, geographical and industry variation;
- portfolio diversity and rating;
- investment term-to-maturity.

The structure is illustrated in Figures 13.10 and 13.11 on pages 467 and 468, respectively with and without an SPV issuer. Under this arrangement, there is only one note tranche. The reference portfolio, made up of CDSs, is dynamically hedged by the originating bank itself. The deal has been arranged to create a risk/reward profile for one investor only (or possibly multiple investors with identical requirements), who buys the single tranche note. This also creates an added advantage that the deal can be brought to market very quickly. The key difference with traditional CSOs is that the arranging bank does not transfer the remainder of the credit risk of the reference pool. Instead, this risk is dynamically managed, and hedged in the market using derivatives.

Note that many single-tranche CDOs were the result of 'reverse enquiry', that is they arose from investor demand.

Deal Structure

The investor in a single-tranche CDO makes a decision on the criteria of assets in the portfolio, and the subordination of the issued tranche. Typically, this will be at the mezzanine level; that is, covering the 4% to 9% loss level in the portfolio. This enables a favourable risk/return profile to be set up because a CDO tranche that is exposed to 4–9% losses has a very low historical risk of default (approximately equivalent to a Moody's A2 rating) and a high relative return given its tranching, around LIBOR plus 200 bps as at May 2003. This is the risk/return profile of the mezzanine piece.

Figure 13.12 on page 469 illustrates the default probability distribution for credit events in a CDO. Figure 13.13 shows the more specific distribution as applicable to the mezzanine tranche. We clarify this further with some hypothetical values for a capital structure and default distribution in Figure 13.14 on page 470.

Unlike a traditional CDO, a single-tranche CDO has a very simple cash flow 'waterfall'. Compared with Figure 12.4, which showed the waterfall for a cash CDO, a single-tranche waterfall will consist of only agency service and hedge costs, and the coupon of the single tranche itself.

Some of the issues the investor should consider when working with the arranging bank to structure the deal include:

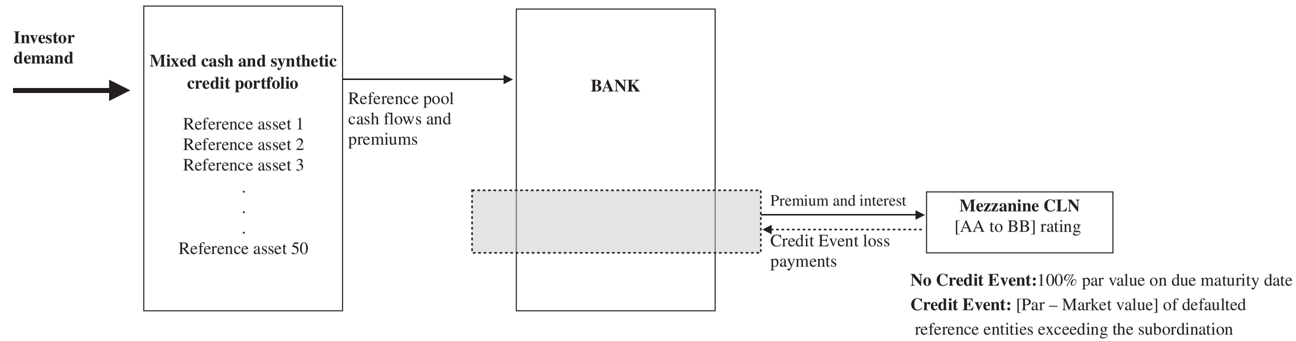


FIGURE 13.10 Single tranche CDO 1: issue direct from arranging bank.

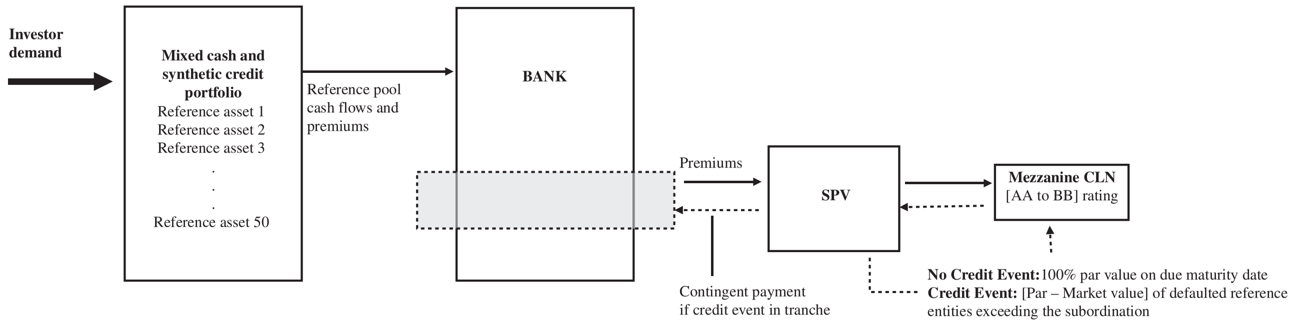


FIGURE 13.11 Single tranche CDO 2: issue via SPV.

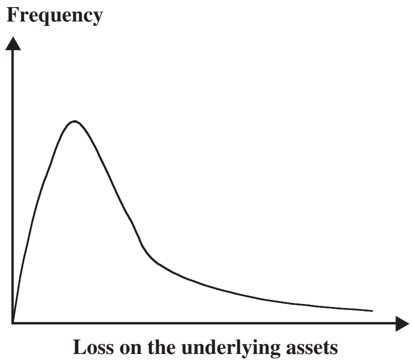


FIGURE 13.12 Credit loss distribution.

- the number of names in the credit portfolio, usually this ranges from 50 to 100 names;
- the geographical split of the reference names;
- the required average credit rating and average interest spread of the portfolio;
- the minimum credit rating required in the portfolio.

If the deal is being rated, as with any CDO type, the mix of assets needs to meet ratings agency criteria for diversity and average rating.

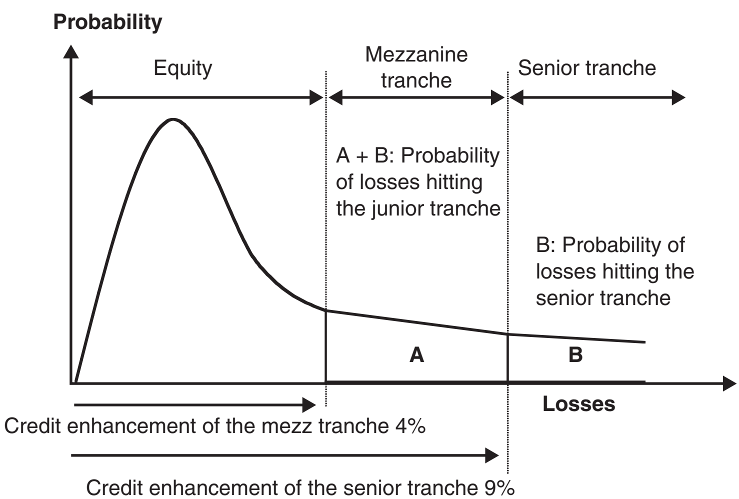


FIGURE 13.13 Expected loss distribution for tranched notes.

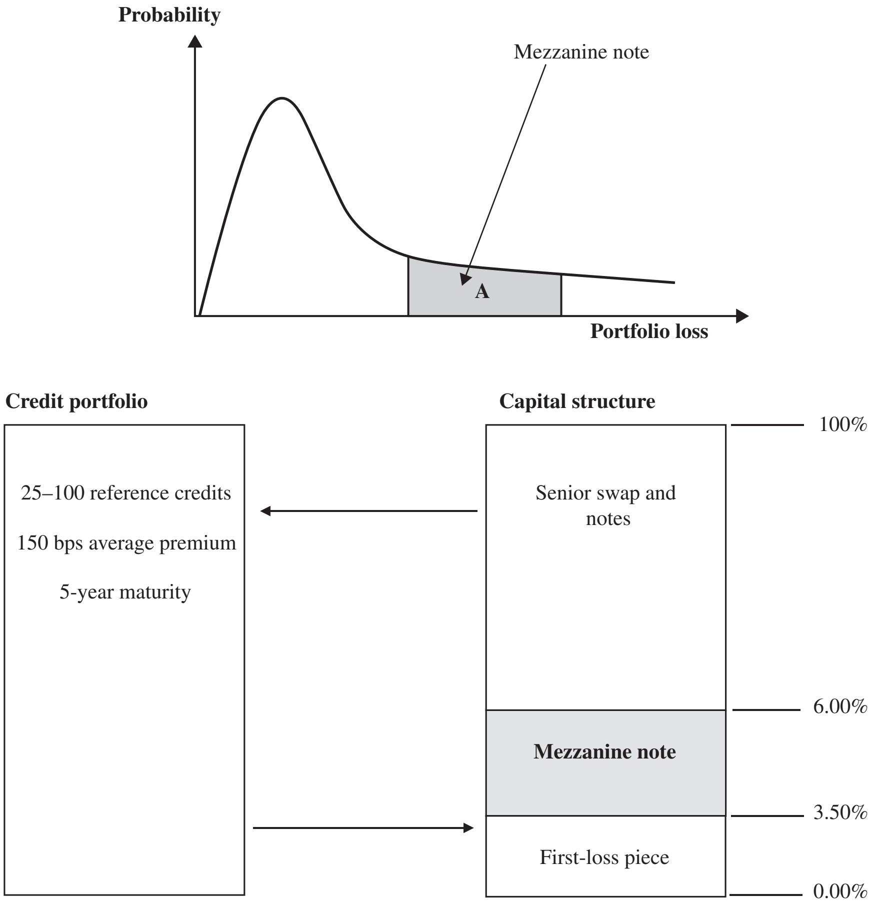


FIGURE 13.14 Capital structure distribution for single-tranche (mezzanine note) synthetic CDO. Mezzanine note loss probability shown above.

The *diversity score* of a portfolio is a measure of the diversity of a portfolio based on qualities such as industrial and geographical concentration. It can be defined as the number of equivalent uncorrelated assets in the pool.[14] We illustrate a hypothetical portfolio at Figure 13.15,

[14] Further background on Moody's diversity score is given at Appendix 10.2.

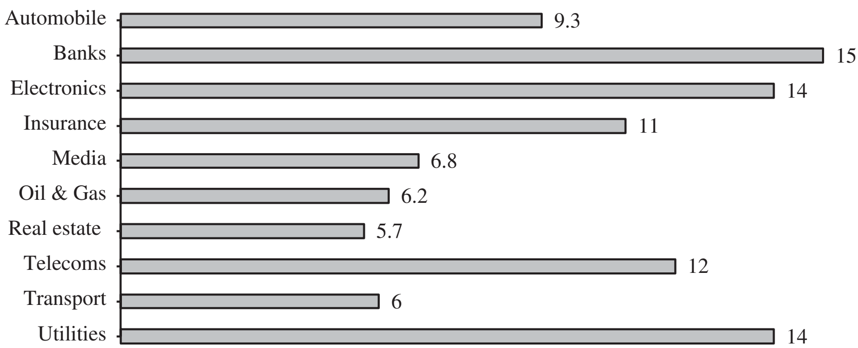


FIGURE 13.15 Hypothetical portfolio composition for generic single-tranche CDO.

which shows the composition of a generic portfolio for a single-tranche CDO.

The position and rating of the issued single-tranche is as required by the investor. The subordination of the note follows from the required rating of the investor. For instance, the investor may require an A2 rating for the note. The process followed involves:

- targeting the required rating on the issued tranche;
- setting the required return on the note, and hence determining where the tranche will lie;
- defining the percentage of first loss that must occur before the issued tranche is impacted by further losses;
- setting the size of the note issue, in line with investor requirements. For instance, if the investor wishes to place $20 million in the note, and the reference pool is $800 million nominal value, this implies a 2.5% tranche.

As with the previous synthetic CDOs, a single-tranche CDO can be either a static or a managed deal. In a managed deal, the investor can manage the portfolio and effect substitutions if this is part of its requirement. To facilitate this, the deal may be set up with one or more fund managers in place to deal when substitutions are required by the investor. Alternatively, an investor may leave trading decisions to a fund manager.

Table 13.1 is a summary of the differences between traditional and single-tranche synthetic CDOs.

TABLE 13.1 Differences between traditional and single tranche synthetic CDOs.

Characteristic	Single tranche	Traditional CSO
Type	Static, substitution, managed	Static, substitution, managed
Structure	A portfolio of reference credits, for which protection sold via a basket credit default swap	A portfolio of reference credits, for which protection sold via a basket credit default swap
	A specific tranche of the portfolio credit risk is transferred to a sole investor. Remaining risk stays with originator, and is delta-hedged	The portfolio risk is transferred in its entirety, through a tranched CDS and/or CLN arrangement, to market investors
	A bilateral arrangement	A syndicated securitisation arrangement
Portfolio	Between 20–100 reference credits diversified across geography, industry	Between 100–150 reference credits, diversified across geography, industry
	Typically investment grade	Can include investment-grade, high-yield, emerging market, special situations (sole AAA-rated, etc.)
	Can be customised to meet specific credit rating, foreign-exchange and interest rate requirements of investor	Can be customised at structuring stage but to meet needs of a wider group of investors. Will be marketed once general structure is known
Deal economics	Shorter time scale, increased deal volume	Longer time-scale to bring to market
	Greater opportunity to react to specific market conditions and capture arbitrage	Decreased ability to capture arbitrage opportunities as they arise

HYPOTHETICAL PRICING EXAMPLE

Figure 13.16 is a simplified illustration of a pricing example for a single-tranche CDO, with market rates as observed on Bloomberg during April 2003. We assume the portfolio is constituted as follows.

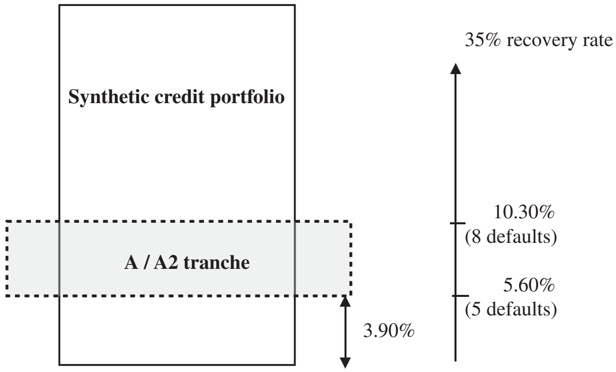


FIGURE 13.16 Single-tranche CDO illustrative pricing example.

Number of credits:	100
Size:	€8 million each
Nominal size:	€800 million
Diversity score:	48
Average rating:	BBB1/Baa1
Minimum rating:	BBB2/Baa3
Maturity:	5 years.

The originating bank structures a single-tranche CDO following investor interest with the following terms:

Subordination level:	3.90% (this means that five defaults are supported, assuming a 35% recovery rate)
Calculation of attachment point:	6th name default [6 × 8 million = 48 million 35% recovery rate = €31.2 million loss; 31.2/800 = 3.90%]
Attachment/detachment points:	3.90% – 5.85%
Tranche size:	€25 million
Expected rating:	A/A2
Spread:	Euribor + 1,220 bps.

EXAMPLE 13.3 CDO EQUITY NOTE

Equity is the most junior note in the capital structure of a CDO. For this reason it is also known as the 'first-loss' piece of the CDO, carrying the highest risk of payment delays and losses due to credit events or default. The equity, which is actually issued as a 'bond' with an international security number (known as an ISIN), receives any cash that is left over after all other liabilities and claims have been paid from the asset cash flows. These include management and servicing fees plus the senior debt liabilities. In a cash flow structure, the return to the equity holder is a function of defaults and payment delays of assets in the collateral portfolio. The level of trading or credit rating downgrades does not have an impact on the equity unless they affect the cash flows of the structure. The equity piece receives the residual cash flows generated by the structure, but there is a distinction between coupon cash flows and principal cash flows. The residual coupon is paid out as it is received, while the residual principal cash flows are not paid out until after all debt notes are paid off.

Given all this, we can see that CDO equity is a 'leveraged' exposure to credit risk, taken on by the equity investor. The holder of CDO equity, which is frequently the collateral manager or sponsor of the deal, will have a view that the cash flows generated by the underlying assets will be sufficient to bear expected credit losses and provide enough surplus to pay on the equity note. When assessing the expected returns therefore, the investor considers the expected level of defaults and how this will impact on the structure. This assessment must also take into account the leveraged nature of the structure, because of the large amount of the debt in the vehicle.

The timing, as well as extent, of defaults is critical to equity return. With a cash flow CDO the initial size of the excess net spread of assets over liabilities means that there is a 'front-loaded' pattern to equity cash receipts. Equity holders receive a significant part of return early in the deal, because the initial excess spreads are high, since defaults are unlikely to occur at the start of the deal and will not peak until later on in the deal's life. The later in life that defaults do occur, the greater will be the return to the equity holder.

CDO equity is not a straightforward bond and must be assessed carefully by investors due to their complexity. The structure of the

CDO and the quality of the collateral pool are very important issues for consideration, as is the extent of secondary market trading of the note (which will be low to start with). In addition, potential investors must consider what benchmark should be used as a comparison when assessing the return on the note, and what product can be used to hedge the equity note if needed.

CASE STUDIES

We consider four specific transactions that illustrate the progressive development of the synthetic CDO since inception. These are:

- BISTRO: the first static synthetic balance sheet CDO;
- ALCO1: a balance sheet deal arranged for credit risk management and regulatory capital purposes;
- Jazz I CDO: a managed synthetic 'hybrid' CDO;
- Leonardo Synthetic Plc: synthetic aviation securities CDS.

The managed synthetic CDO or CSO were originated by fund managers in 2001. Although they are, in effect, investment vehicles, the disciplines required to manage what is termed a 'structured credit product' is not necessarily identical to those required for a corporate bond fund. Investment bank arrangers suggest that a track record in credit derivatives trading is an essential prerequisite to being a successful CSO manager. There is an element of reputation risk at stake if a CDO suffers a downgrade. For example, during 2001 Moody's downgraded elements of 83 separate CDO deals, across 174 tranches, as underlying pools of investment-grade and high-yield corporate bonds experienced default.[15] Thus managing a CDO presents a high-profile record of a fund manager's performance.

In Europe, fund managers that have originated managed synthetic deals include Robeco, Cheyne Capital Management, BAREP Asset Management and AXA Investment Managers. In the second part of this chapter we look at three specific deals as case studies, issued in the European market during 2001 and 2002.

The deals discussed are innovative structures and a creative combination of securitisation technology and credit derivatives. They show how a portfolio manager can utilise vehicles of this kind to exploit its expertise in credit trading as well as provide attractive returns for investors. Managed

[15] Source: CreditFlux, April 2002.

synthetic CDOs also present fund managers with a vehicle to build on their credit derivatives experience.

BISTRO: The First Synthetic Securitisation

Generally viewed as the first synthetic securitisation, BISTRO was a J.P. Morgan vehicle brought to the market in December 1997. The transaction was designed to remove the credit risk on a portfolio of corporate credits held on J.P. Morgan's books, with no funding or balance sheet impact. The overall portfolio was \$9.7 billion, with \$700 million of notes issued, in two tranches, by the BISTRO SPV. The proceeds of the note issue were invested in US Treasury securities, which in turn were used as collateral for the CDS entered into between J.P. Morgan and the vehicle. This was a 5-year swap written on the whole portfolio, with J.P. Morgan as the protection buyer. BISTRO, the protection seller, paid for the coupons on the issued notes from funds received from the collateral pool and the premiums on the CDS. Payments on occurrence of credit events were paid out from the collateral pool.

Under this structure, J.P. Morgan transferred the credit risk on \$700 million of its portfolio to investors, and retained the risk on a first-loss piece and the residual piece. The first-loss piece was not a note issue, but a \$32 million reserve cash account held for the 5-year life of the deal. First losses were funded out of this cash reserve, which was held by J.P. Morgan. This is shown in Figure 13.17 on page 477.

The asset pool is static for the life of the deal. The attraction of the deal for investors included a higher return on the notes compared to bonds of the same credit rating and a bullet-maturity structure, compared to the amortising arrangement of other ABS asset classes.

The BISTRO deal featured:

- the credit risk exposure of a pool of assets being transferred without moving the assets themselves from the balance sheet;
- a resultant reduction of the credit exposure for the originator;
- no funding element for the originator: in other words, a securitisation deal that separated the liquidity feature from the risk transfer;
- the application of structured finance rating technology;
- unfunded liabilities that were nevertheless tranched, as in a traditional cash flow securitisation, so that these liabilities could be rated.

Investors in the deal, who were effectively taking on the credit risk of the assets on the originator's balance sheet, were attracted to the deal because:

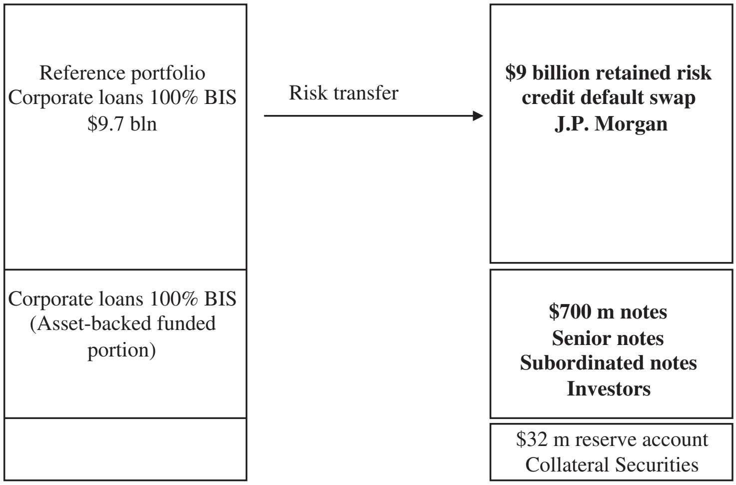


FIGURE 13.17 BISTRO deal structure.
Source: J.P. Morgan. Used with permission.

- the deal provided exposure to particular credits and a credit risk/return profile, but without a requirement for this exposure to be funded;
- the deal economics were aimed at a precise transfer of specifically packaged segments of risk, enabling the investor to realise greater value;
- the equity holder gained from a leveraged exposure, which meant the cost of this exposure was lowered.

The originating bank retained a comparative advantage on the funding, while the investor gained the required exposure to the credit risk. The investor, in effect, provided the comparative advantage because it is not subject to regulatory capital requirements. In summary, the deal was a 'win–win' transaction for both the bank and the investor. The investor—here typically a fund manager or insurance company—can price the risk very efficiently because it is an expert in the market. It also benefits from the cheap(er) funding that the bank is able to source.

ALCO 1 Limited

The ALCO 1 CDO was described as the first Asian market-rated synthetic balance sheet CDO from a non-Japanese bank.[16] It is a S$2.8 billion

[16] Source: Moody's.

TABLE 13.2 ALCO 1 note tranching.

Class	Amount	Percent	Rating	Interest rate
Super senior swap	S$2.450m	87.49%	NR	14 bps
Class A1	US$29.55m	1.93%	AAA	3m USD LIBOR + 50 bps
Class A2	S$30m	1.07%	Aaa	3m SOR + 45 bps
Class B1	US$12.15m	0.80%	Aa2	3m USD LIBOR + 85 bps
Class B2	S$20m	0.71%	Aa2	3m SOR + 80 bps
Class C	S$56m	2.00%	A2	5.20%
Class D	S$42m	1.50%	Baa2	6.70%

Source: Moody's. Used with permission.

structure sponsored and managed by the Development Bank of Singapore (DBS). The structure diagram is shown at Figure 13.18, and the capital structure at Table 13.2.

The structure allows DBS to transfer the credit risk on a S$2.8 billion reference portfolio of mainly Singapore corporate loans to an SPV, ALCO 1, using CDSs. As a result, DBS can reduce the risk capital it has to hold on the reference loans, without physically moving the assets from its balance sheet. The structure is a S$2.45 billion super-senior tranche—unfunded CDS—with a S$224 million notes issue and S$126 million first-loss piece retained by DBS. The notes are issued in six classes, collateralised by Singapore government T-bills and a reserve bank account, the 'GIC' account. There is also a currency and interest rate swap structure in place for risk hedging, and a put option that covers the purchase of assets by the arranger if the deal terminates before expected maturity date. The issuer enters into CDSs with a specified list of counterparties. The default swap pool is static, but there is a substitution facility for up to 10% of the portfolio. This means that under certain specified conditions, up to 10% of the reference loan portfolio may be replaced by loans from outside the vehicle. Other than this though, the reference portfolio is static.

Name	**ALCO 1 Limited**
Originator:	Development Bank of Singapore Ltd
Arrangers:	JPMorgan Chase Bank DBS Ltd
Trustee:	Bank of New York
Closing date:	15 December 2001
Maturity:	March 2009
Portfolio:	S$2.8 billion of CDSs
Reference assets:	199 reference obligations (136 obligors)
Portfolio administrator:	JPMorgan Chase Bank Institutional Trust Services

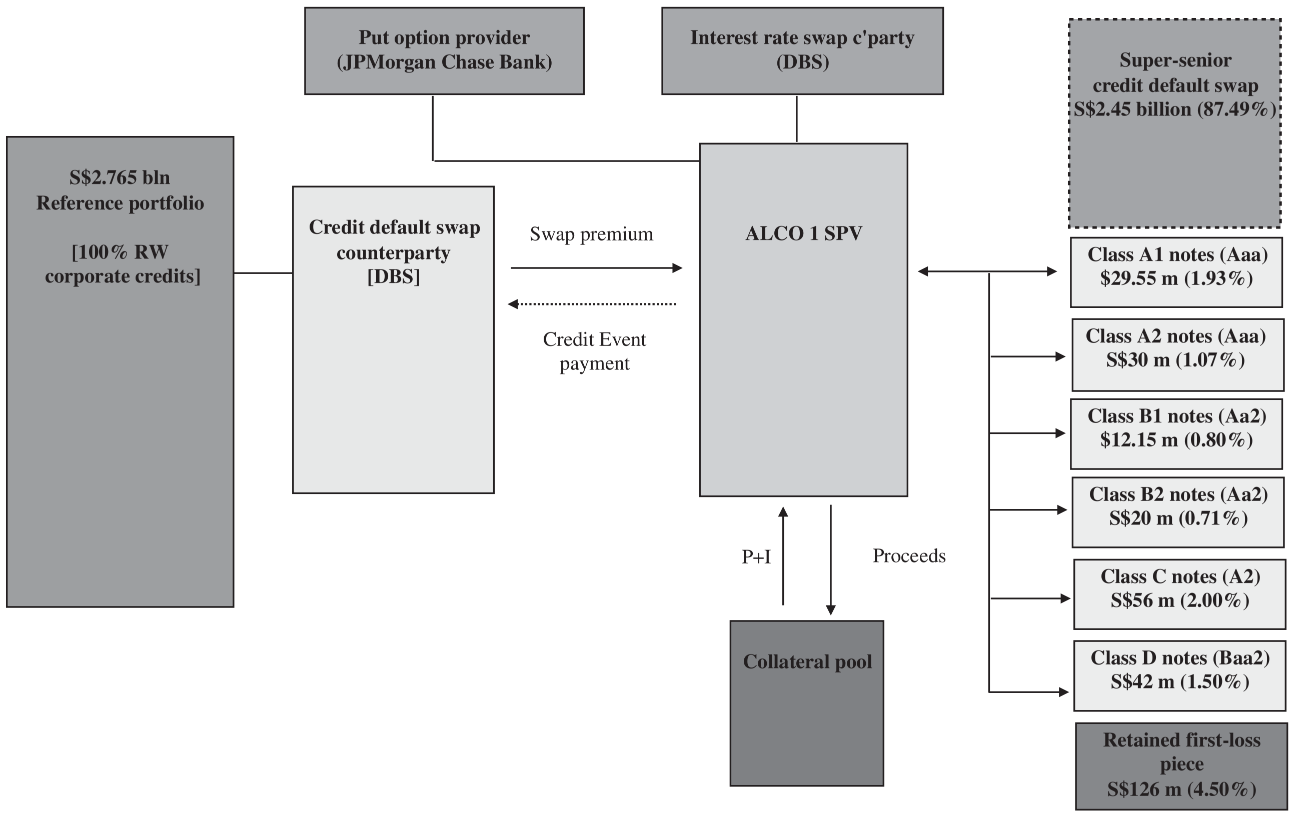


FIGURE 13.18 ALCO 1 deal structure.

As the first rated synthetic balance sheet deal in Asia, ALCO 1-type structures have subsequently been adopted by other commercial banks in the region. The principal innovation of the vehicle is the method by which the reference credits are selected. The choice of reference credits on which swaps are written must, as expected with a CDO, follow a number of criteria set by the ratings agency, including diversity score, rating factor, weighted average spread, geographical and industry concentration, among others.

Structure and Mechanics The issuer enters into a portfolio CDS with DBS as the CDS counterparty to provide credit protection against losses in the reference portfolio. The CDSs are cash-settled. In return for protection premium payments, after aggregate losses exceeding the S$126 million 'threshold' amount, the issuer is obliged to make protection payments to DBS. The maximum obligation is the S$224 million note proceeds value. As per market convention with securitised notes, further losses above the threshold amount are allocated to overlying notes in their reverse order of seniority. The note proceeds are invested in a collateral pool comprised initially of Singapore Treasury bills.

During the term of the transaction, DBS, as the CDS counterparty, is permitted to remove any eliminated reference obligations that are fully paid, terminated early or otherwise no longer eligible. In addition, DBS has the option to remove up to 10% of the initial aggregate amount of the reference portfolio, and substitute new or existing reference names.

For this structure, credit events are defined specifically as:

- failure to pay;
- bankruptcy.

Note how this differs from European market CDOs where the list of defined credit events is invariably longer, frequently including restructuring and credit rating downgrades.

The reference portfolio is an Asian corporate portfolio, but with a small percentage of loans originated in Australia. The portfolio is concentrated in Singapore (80%). The weighted average credit quality is Baa3/Ba1, with an average life of three years. The Moody's diversity score is low (20), reflecting the concentration of loans in Singapore. There is a high industrial concentration. The total portfolio at inception was 199 reference obligations among 136 reference entities (obligors). By structuring the deal in this way, DBS obtains capital relief on the funded portion of the assets, but at lower cost and with less administrative burden than a traditional cash flow securitisation, and without having to undertake a true sale of the assets.

Jazz CDO I BV

Jazz CDO I BV was an innovative CDO structure and one of the first *hybrid* CDOs introduced in the European market. A hybrid CDO combines elements of a cash flow arbitrage CDO and a managed synthetic CDO. Therefore, the underlying assets are investment grade bonds and loans, and synthetic assets such as CDSs and TRSs. The Jazz vehicle comprises a total of 1.5 billion of referenced assets, of which 210 million is made up of a note issue. Its hybrid arrangement enables the portfolio manager to take a view on corporate and bank credits in both cash and synthetic markets. Therefore a structure like Jazz bestows the greatest flexibility for credit trading on CDO originators. The vehicle is illustrated in Figure 13.19.

The main innovation of the structure is a design that incorporates both funded and unfunded assets, as well as funded and unfunded liabilities. This arrangement means that the portfolio manager is free to trade both cash and derivative instruments, thereby exploiting its experience and knowledge across the markets. At a time of increasing defaults in CDOs, during 2001 and 2002, static pool deals began to be viewed unfavourably by certain investors, because of the inability to offload deteriorating or defaulted assets. Jazz CDO I is an actively managed deal, and its attraction reflects to a great extent the perception with which the portfolio manager is viewed by investors. So the role of the portfolio manager is critical to the ratings analysis of the deal. This covered:

- experience in managing cash and synthetic assets;
- its perceived strength in credit research;
- previous experience in managing CDO vehicles;
- infrastructure arrangements, such as settlement and processing capability.

These factors, together with the traditional analysis used for static pool cash CDOs, were used by the ratings agencies when assessing the transaction.

Name:	Jazz CDO I BV
Manager:	AXA Investment Managers SA
Arranger:	Deutsche Bank AG
Closing date:	8 March 2002
Maturity:	February 2011
Portfolio:	1.488 billion
Reference assets:	Investment-grade synthetic and cash securities
Portfolio administrator:	JPMorgan Chase Bank

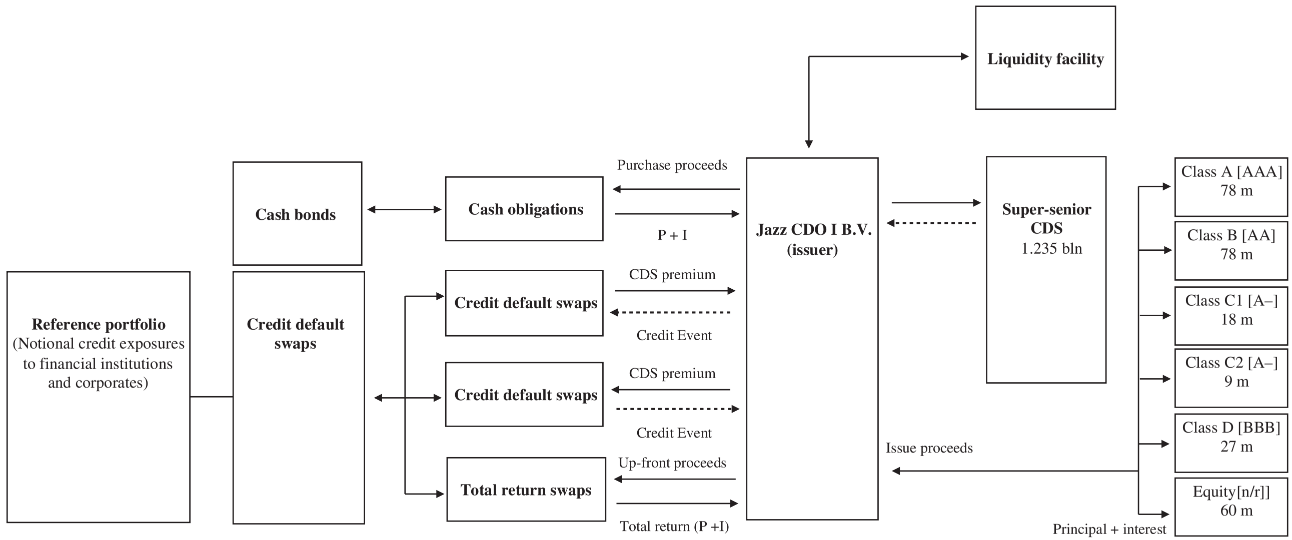


FIGURE 13.19 Jazz CDO 1 B.V. structure diagram.
Source: S&P. Used with permission.

Structure The assets in Jazz CDO I may be comprised of CDSs, TRSs, bonds and loans, at the manager's discretion. The asset mix is set up by:

- purchase of cash assets, funded by the proceeds of the note issue and the liquidity facility;
- selling protection via CDSs;
- buying protection via CDSs;
- entering into TRSs, whereby the total return of the reference assets is received by the vehicle in return for a payment of LIBOR plus spread (on the notional amount). This is funded via the liquidity facility.

The liability side of the structure is a combination of:

- the super-senior CDS;
- issued notes and equity piece (see Figure 13.21).

However, the asset and liability mix can be varied by the portfolio manager at its discretion, and can be expected to change over time. In theory the asset pool can comprise 100% cash bonds or 100% CDSs; in practice, we should expect to see a mixture as shown in Figure 13.21.

The TRS and the Jazz I CDO As noted in Chapter 3, the TRS used as part of the Jazz I CDO structure is a funded TRS. The generic TRS is an unfunded credit derivative. The TRS arrangement was shown at Figure 3.16 and we have reproduced it here in Figure 13.20.

Liquidity Facility A liquidity facility of € 1.7 billion is an integral part of the structure. It is used as a reserve to cover losses arising from CDS

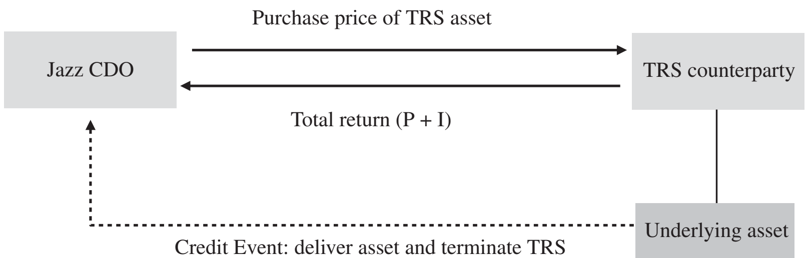


FIGURE 13.20 Total return swap as used in Jazz 1 CDO B.V.

trading, occurrence of credit events, and to fund any purchases when the mix of cash versus synthetic assets is altered by the manager. This includes the purchase of bonds and the funding of TRSs. The facility is similar to a revolving credit facility and is provided by the arrangers of the transaction.

If the manager draws on the liquidity facility, this is viewed as a funded liability, similar to an issue of notes, and is in fact senior in the priority of payments to the overlying notes and the super-senior CDS.

Trading Arrangements Hybrid CDOs are the latest development in the arena of managed synthetic CDOs. The Jazz CDO structure enables the portfolio manager to administer credit risk across cash and synthetic markets. The cash market instruments that may be traded include investment-grade corporate bonds, structured finance securities such as ABS or MBS, and corporate loans. The portfolio manager may buy and sell both types of assets; that is, it may short credit in accordance with its view. In other words, the restriction that exists with the Blue Chip deal is removed in Jazz CDO. Therefore, the portfolio manager can buy protection in the credit derivative market as it wishes, and not only to offset an existing long credit position (sold protection). The only rules that must be followed when buying protection are that:

- the counterparty risk is of an acceptable level;
- there are sufficient funds in the vehicle to pay the credit derivative premiums.

The manager may trade where existing assets go into default, or where assets have either improved or worsened in credit outlook (to take or cut a trading profit/loss). Another significant innovation is the ability of the vehicle to enter into *basis trades* in the credit market. An example of such a trade is to buy a cash bond and simultaneously purchase protection on that bond in the CDS market. Similar to trades undertaken in the exchange-traded government bond futures market, this is an arbitrage-type strategy where the trader seeks to exploit price mismatches between the cash and synthetic markets.

The various combinations of trades that may be entered into are treated in different ways for counterparty risk and regulatory capital. For an offsetting position in a single name, the options are to use:

- only CDS to cancel out an exposure, when both CDSs are traded with the same counterparty: this is netted out for risk purposes;

- CDSs only, but with different counterparties: there will be a set-aside for counterparty risk requirement exposure;
- a CDS and cash bond: regarded as a AAA-rated asset for capital purposes.

The Offering Circular for the deal lists a number of trading guidelines that must be followed by the manager. These include a limit of 20% by volume annual turnover level.

Leonardo Synthetic CDO

The Italian capital market witnessed a number of innovative transactions early in the development of synthetic structured products. The Leonardo Synthetic plc deal is one such transaction. Closing in June 2001, it was an early example of a balance sheet synthetic CDO, as well as the first synthetic securitisation of aircraft financing and aviation industry loans and letters of credit. The originator, IntesaBCI, sought to transfer the credit risk on a revolving pool of loans made to clients in connection with aircraft purchases and leases. This transfer was effected partly by a CDS between the originator and a swap counterparty (Merrill Lynch), and partly by a combination of funded and unfunded credit derivatives issued by the SPV for the transaction.

The terms of the deal are summarised below:

Originator (and Servicer):	IntesaBCI
Issuer:	Leonardo Synthetic plc
Structure:	CDSs and CLNs
Trustee:	Deutsche Bankers Trust
Reference portfolio:	Aviation industry loans and letters of credit
Notional value:	US$1 billion
Secured liability proportion:	97%
Unsecured liability proportion:	3%
Collateral (Classes 'A' and 'B'):	Italian government bonds
Collateral (Class 'C'):	Cash deposit at account bank

The transaction structure is shown at Figure 13.21 below, while the note tranching is shown at Table 13.3 on page 486.

The proceeds of the CLN issue was invested in Italian government bonds, which act as collateral to support the Class 'A' and 'B' notes. The junior Class 'C' notes are collateralised by a bank account deposit.

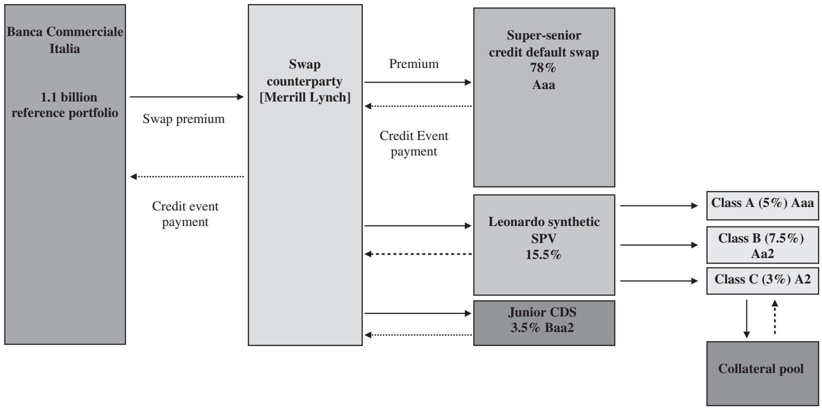


FIGURE 13.21 Leonardo synthetic CDO.

A feature of the structure is that a credit event is described as being related specifically to the reference obligations of the named corporates. Investors therefore acquire an exposure only to the corporate obligors themselves, mainly airlines, and not to the issuer SPV. They do not have an exposure to the issuer itself.

Credit events are defined as bankruptcy of a reference entity, and failure to pay, only. There is a 5-year revolving period during which loans can be replaced, as they drop out of the reference portfolio for redemption, prepayment and other reasons. Substitute loans must meet pre-specified criteria. The first 3% of losses in the portfolio are covered by the equity holder, losses beyond this threshold level are allocated first to the junior CDS, and then to the Class 'C' CLN and so on.

TABLE 13.3 Leonardo synthetic CDO tranche summary.

Class	Amount	Percent	Issue price	Rating	Coupon
	USD m			EURIBOR 3m 1	
Senior swap	[780]	78	n/a	Aaa	Premium 12 bps
A	55	5.0	100	Aaa	[26]
B	82.5	7.5	100	Aa2	[35]
C	33	3.0	100	A2	[67]
Junior CDS	[35]	3.5	n/a	Baa2	Premium 124 bps
[First loss]	33	3.0	100	NR	Excess

Source: Moody's. Reproduced with permission.

The transaction was designed to remove the credit risk of an initial pool of 127 reference loans and letters of credit, made to 32 borrowers by IntesaBCI. It also resulted in lowering of regulatory capital. It was a groundbreaking deal in the European market, and was typical of the innovation in the market for structured credit pioneered in Italy.

LIQUIDITY, DEFAULTS AND CREDIT RATING: INTERRELATED BEASTS DURING THE MARKET CRISIS OF 2007

Events in the financial markets during 2007–2008 made newsworthy the traditionally conservative and un-volatile world of the money markets. The impact of the increased delinquency rate in the US sub-prime mortgage market was felt in Europe and Asia, thanks largely to the popularity of risk-transfer vehicles such as asset-backed commercial paper (ABCP) conduits and collateralised debt obligations (CDO) with investors worldwide. Initially this took the form of a liquidity squeeze as speculation grew as to which banks might be affected by the sub-prime fallout; however, it then turned into a form of credit squeeze, specifically associated with structured finance vehicles, as investors' 'flight-to-quality' made them wary of all ABCP paper and asset-backed (such as CDO) securities.

Market Events

The widening of credit spreads was startling, both with respect to the speed at which it happened and the extent of the spread change. ABCP paper rated A–1+/P–1/F–1+ that had traded at LIBOR plus 4–5 bps in June 2007 was now being issued, at only short maturities, at LIBOR plus 55–65 bps. All conduit types were viewed as one; no distinction was made as to the type of vehicle or to underlying asset quality. On the other hand, US T-bill yields dropped from 4.75% at the beginning of August 2007 to 2.91% just three weeks later. This change in sentiment brought the money markets to the forefront of the 'crisis'. The negative sentiment was strongest in the sector of structured finance securities.

ABCP conduits, and their cousins the structured investment vehicle (SIV), together with CDOs, exist in different forms and represent different risk-reward profiles for investors. The SIV mechanism was deemed unviable after investors shunned it and they were all taken on to bank balance sheets or otherwise lapsed into administration. What was *always* important before the crisis broke—the importance of understanding underlying asset quality, the impact of defaults and correlation on rating and the sensitivity of note pricing to external factors—became imperative in the wake of the crisis. If anything, the resulting recession served to underline how vital it is for investors to be aware of exactly what it is they are buying. One area of surprise for unsophisticated investors during 2007 was how AAA-rated tranches of CDOs were downgraded after a handful of downgrades in the underlying portfolio. But an understanding of rating agency methodology would have served to tell them that this was entirely possible. An AAA-rated structured finance security is not the same as a AAA-rated US Treasury.

Impact of Defaults on (Implied) Tranche Rating

To fully understand the implication of default probability and default correlation on rating (and valuation) methodology we have to understand how even one default in an underlying asset pool will affect the senior tranche in terms of mark-to-market price and implied rating. We bear in mind the standard rating methodology that is applied to structured finance securities, which states that sufficient sub-ordination will obtain the credit rating required for senior tranches of a CDO. Once defaults start to affect the underlying portfolio, the super-senior or senior tranches (originally AAA) will be marked down even if an amount of subordination is still intact because the level of subordination has dropped.

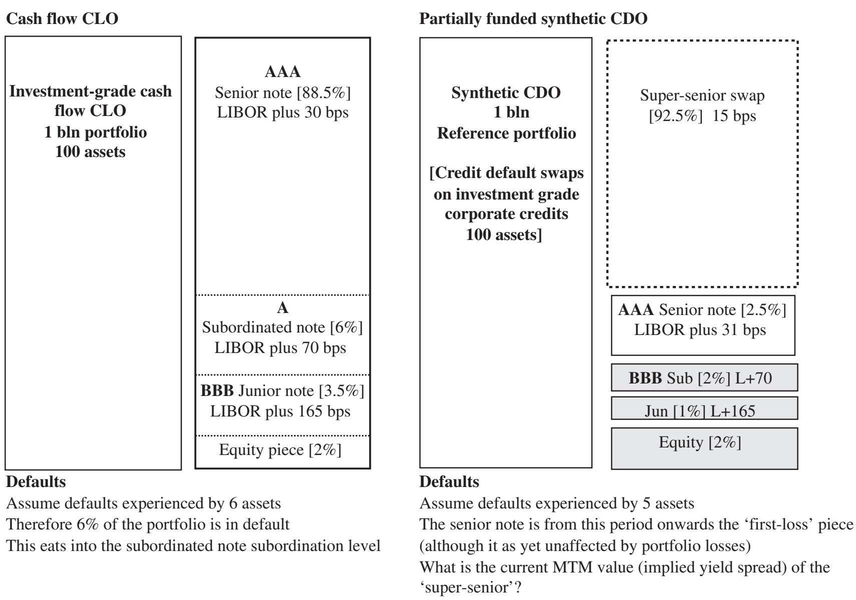


FIGURE 13.22 Subordination and impact on tranche rating.

Consider the two structures below (see Figure 13.22), one a balance sheet cash flow CDO and the other a partially funded synthetic CDO. The note spreads are as at time of issue (both transactions were discussed earlier in this chapter, see Figure 13.1).

In the cash flow CLO, we assume that in a short period the underlying pool has suffered 6 (out of 100) defaults. The subordination of the senior tranche has been reduced by over 50%. The note itself is unaffected and can still cover its interest and principal cash flow liabilities. But if we now re-run the same pricing methodology for the senior tranche, the results will show that we are insufficiently subordinated, and the note is now an implied BBB rating. Hence, its mark-to-market will be substantially lower than the par value it was issued at. But assuming there are no more defaults it will still repay at par. Similarly, for the synthetic CDO, the super-senior is now looking at an implied BBB rating, or possibly BB!

So we have had an effective downgrade because of the erosion of the initial subordination level. How is it that a 'triple A' security can be downgraded—with attendant implied potential loss of capital—from the top rating to the lowest investment grade rating or even sub-investment grade rating after just a handful of defaults? Because of the nature of the rating agency methodology: there is nothing sinister involved here, it is simply a case of understanding how the credit rating is arrived at for structured finance and synthetic securities. It should not come as a surprise to anyone who has understood the methodology used when calculating the rating. It remains incumbent on the investor to understand why tranches are rated where they are and what the impact of even one default will have on that rating. The bottom line remains the same: when investing in structured finance securities, be it ABCP, SIV notes or ABS/CDO tranches, one must be aware of the nature and quality of the underlying assets.

In the long run, short of the ratings agencies introducing, say, a new AAA* rating exclusively for sovereign securities such as Treasuries and Gilts, we should remember that it is possible for AAA structured finance securities to be downgraded in a way that would conceivably never happen for a AAA G7 sovereign security.[17]

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[17] First recommended by the author in an article in *Finance Dublin*, September 2007.

EXAMPLE 13.4 CALCULATIONS IN STRUCTURED CREDIT

SYNTHETIC CDO

A balance sheet synthetic CDO comprises the following underlying portfolio:

Assets:	125 single-name CDS
Principal:	£0.8 million
Maturity:	5 years
CDS spread:	200 bps
Payments:	Act/360 quarterly in arrears.

The CDO is structured with the following capital structure:

Tranche	Attachment/ Detachment point	Expected loss	Fair spread	Rating
Senior	7%–100%	0.002%	L + 45	AAA
Class A	5%–7%	0.100%	L + 70	AA–
Class B	2%–5%	2.300%	L + 120	BBB–
Equity	0%–2%	26.270%	Excess spread	N/R

1. Which note holders are long correlation? Which tranche is the most sensitive to changes in default correlation? Why is this?
2. How concerned are mezzanine note holders with changes in the level of default correlation?
3. How many defaults must there be before the senior note experiences capital loss? Assume 0% recovery. If we assume 40% recovery how much more protection does this afford the senior note holder?
4. How many defaults must there be before the implied rating of the note is downgraded?

CLO ANALYSIS

A CLO structure comprises a pool of 80 identical loans, each one having the following characteristics:

Principal:	$1.25m
Maturity:	1 year
Coupon:	12m LIBOR + 180bp
Payments:	Act/Act annually
Credit rating:	BBB+

The rating agency estimates that the individual default probability of each loan is 1.2%, consistent with their BBB rating. It also estimates that, in the case of a default, there will be a 40% recovery of principal, but no recovery of interest.

The CLO SPV capital structure is as follows:

Senior Tranche	
Principal:	$90m
Coupon:	12m LIBOR + 80bp
Payments:	Act/Act annually
Junior Tranche	
Principal:	$10m
Coupon:	nil
Redemption:	Par plus/minus capital appreciation

MARKET RATES

Assume that LIBOR is currently 5.00%.

1. What is the degree of collateralisation for holders of the senior tranche?
2. What is the interest-coverage ratio for the senior tranche? (This is the ratio of interest received to interest paid.)
3. What is the redemption amount to holders of the junior tranche if there are no defaults?
4. What is the redemption amount to holders of the junior tranche if there is one default?

(*continued*)

5. What is the redemption amount to holders of the junior tranche if there are two defaults?
6. What is the maximum number of defaults that can be sustained before holders of the senior tranche begin to suffer?
7. If the incidence of defaults were uncorrelated, what is the chance that holders of the senior tranche will suffer income or capital impairment?
8. What if the incidence of defaults were correlated? What would happen to your answer for the previous question?

Solution: Synthetic CDO

1. The equity investors are long correlation, as the equity note value increases with an increase in correlation. Higher correlation increases the probability of both less and more defaults. Equity investors are sensitive to even one default, so they will desire higher probability of fewer defaults. The Senior tranche has a high sensitivity to large changes in correlation. The senior tranche only suffers loss in extreme situations (catastrophic loss) that occur with high correlation and multiple defaults.
2. Mezzanine notes are the least sensitive to correlation and their value is least impacted by changes in correlation, so investors in these notes are less concerned with this parameter when valuing the notes.
3. The senior note has 7% subordination, therefore it is impacted once the portfolio suffers [$0.07 * 125 = 8.75$] or 9 defaults. If we assume 40% recovery, the loss per default is [$0.6 *$ £0.48] or £0.48 million. The subordination is 7% of the portfolio or £7,000,000, which is eaten into after [7,000,000/480,000 = 14.58333] or 15 defaults. Therefore assuming a recovery rate, this affords six more defaults as additional protection to the senior note.
4. We assume an implied rating downgrade after the first tranche is completely eaten away. This will be after 2% of the portfolio has suffered default, or 2.5 defaults, assuming no recovery value. In practice this will mean two defaults.

Solution: CLO analysis

1. The collateralisation is 100/90 or 111%.

2. Assuming a LIBOR of 5%, the interest-coverage ratio is 130%.

$$\frac{100 \times (5\% + 1.80\%)}{90 \times (5\% + 0.80\%)} = 1.30$$

3. No default

   Principal repayment received from loans: \$100m
   Principal repaid to senior tranche: \$90m
   Principal repaid to junior tranche: \$10m

   Income received: 80 × \$1.25m × 6.80% = \$6.80m
   Coupons paid to senior tranche: \$90m × 5.80% = \$5.22m
   Income available for junior tranche: \$1.58m

   Yield earned by senior tranche: 5.22/90 = 5.80% = LIBOR + 80bp
   Yield earned by junior tranche: 1.58/10 = 15.80% = LIBOR + 1080bp

4. One default

   Principal repayment received from loans: \$99.25m
   Principal repaid to senior tranche: \$90m
   Principal repaid to junior tranche: \$9.25m

   Income received: 79 × \$1.25m × 6.80% = \$6.715m
   Coupons paid to senior tranche: \$90m × 5.80% = \$5.22m
   Income available for junior tranche: \$1.495m

   Yield earned by senior tranche: 5.22/90 = 5.80% = LIBOR + 80bp
   Yield earned by junior tranche: 0.745/10 = 7.45% = LIBOR + 245bp

5. Two defaults

   Principal repayment received from loans: \$98.5m
   Principal repaid to senior tranche: \$90m
   Principal repaid to junior tranche: \$8.5m

   Income received: 78 × \$1.25m × 6.80% = \$6.63m
   Coupons paid to senior tranche: \$90m × 5.80% = \$5.22m
   Income available for junior tranche: \$1.41m

   Yield earned by senior tranche: 5.22/90 = 5.80% = LIBOR + 80bp

(*continued*)

Yield earned by junior tranche: $-0.09/10 = -0.90\% =$ LIBOR -590bp

6. Given that the interest coverage ratio of 130% exceeds the collateralization ratio of 111%, principal repaid will be affected before interest payments. With each default wiping \$0.75m value from the junior tranche, the junior tranche can take 13 defaults before being wiped out.

   With 13 defaults:
   Principal repayment received from loans: \$90.25m
   Principal repaid to senior tranche: \$90m
   Principal repaid to junior tranche: \$0.25m
   Income received: $67 \times \$1.25\text{m} \times 6.80\% = \$5.695\text{m}$
   Coupons paid to senior tranche: $\$90\text{m} \times 5.80\% = \$5.22\text{m}$
   Income available for junior tranche: \$0.475m
   Yield earned by senior tranche: $5.22/90 = 5.80\% =$ LIBOR + 80bp
   Yield earned by junior tranche: $-9.275./10 = -92.75\%$

   Given that there is still some excess income, we should check whether this is sufficient to cover the capital loss in the case of 14 defaults.

   With 14 defaults:
   Principal repayment received from loans: \$89.5m
   Principal repaid to senior tranche: \$89.5m
   Principal repaid to junior tranche: nil
   Income received: $66 \times \$1.25\text{m} \times 6.80\% = \$5.61\text{m}$
   Coupons paid to senior tranche: $\$90\text{m} \times 5.80\% = \$5.22\text{m}$
   Income available for junior tranche: \$0.39m

   As this income of \$0.39m is insufficient to cover the \$0.50m of capital loss to the senior tranche, we can confirm that the maximum number of sustainable defaults is 13.

7. If the chance of loans defaulting is independent of one another, it is possible to use the Poisson distribution to predict the probability that 14 more defaults occur. The value is almost zero (about 3×10^{-12}, or about 1 in 400 billion against).

   The table below shows the probabilities for 0, 1, 2 . . . defaults, assuming independence, and using both the Binomial and Poisson distributions (which produce very similar answers):

Probability of default: 1.20%
Number of loans: 80

No of defaults	Prob (Binomial dist)	Prob (Poisson dist)
0	38.07%	38.29%
1	36.99%	36.76%
2	17.75%	17.64%
3	5.60%	5.65%
4	1.31%	1.36%
5	0.24%	0.26%
6	0.04%	0.04%
7	0.00%	0.01%
8	0.00%	0.00%
9	0.00%	0.00%
10	0.00%	0.00%
11	0.00%	0.00%
12	0.00%	0.00%
13	0.00%	0.00%
14	0.00%	0.00%
15	0.00%	0.00%
16	0.00%	0.00%
17	0.00%	0.00%
18	0.00%	0.00%
19	0.00%	0.00%
20	0.00%	0.00%

8. If the incidence of defaults is correlated, then this dramatically increases the probability of multiple default.

   The table below shows the results of a Monte Carlo simulation where the number of defaulting loans was recorded on each of 10,000 trials, at different levels of correlation.

   With zero correlation, the numbers agree quite closely with the theoretical probabilities shown in the previous table. As correlation increases, however, the chance of multiple defaults goes up.

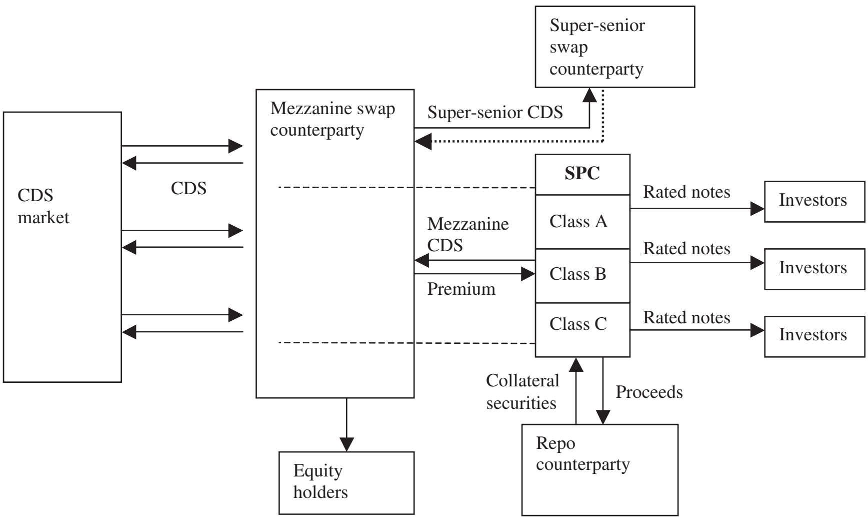
(*continued*)

If correlation is 0.3, the chance of 14 or more defaults is now 0.54%, or 1 in 200 (compared with 1 in 400 billion). Now the possibility that the senior tranche could suffer some losses is now more credible.

No of defaults	ρ=0	ρ=0.1	ρ=0.2	ρ=0.3	ρ=0.4	ρ=0.5
0	38.56%	48.94%	57.10%	63.73%	69.57%	75.59%
1	36.02%	26.81%	21.24%	17.11%	13.53%	10.08%
2	18.04%	13.25%	9.65%	7.55%	6.10%	4.56%
3	5.86%	5.79%	4.87%	3.84%	3.10%	2.49%
4	1.29%	2.77%	2.87%	2.61%	2.17%	1.63%
5	0.22%	1.44%	1.68%	1.51%	1.27%	1.13%
6	0.01%	0.48%	0.92%	0.84%	0.85%	0.65%
7	0.00%	0.28%	0.64%	0.84%	0.70%	0.65%
8	0.00%	0.10%	0.30%	0.38%	0.48%	0.53%
9	0.00%	0.09%	0.27%	0.46%	0.39%	0.32%
10	0.00%	0.01%	0.12%	0.29%	0.34%	0.37%
11	0.00%	0.02%	0.11%	0.13%	0.34%	0.36%
12	0.00%	0.00%	0.05%	0.17%	0.21%	0.26%
13	0.00%	0.01%	0.02%	0.15%	0.13%	0.19%
14	0.00%	0.01%	0.06%	0.08%	0.09%	0.14%
15	0.00%	0.00%	0.01%	0.06%	0.08%	0.11%
16			0.00%	0.05%	0.11%	0.07%
17			0.01%	0.02%	0.12%	0.06%
18			0.03%	0.02%	0.05%	0.05%
19			0.00%	0.00%	0.02%	0.05%
20			0.00%	0.00%	0.06%	0.05%

APPENDIX 13.1 HYPOTHETICAL DEAL TERM SHEET

Scarab CSO Limited



Transaction Indicative Terms and Conditions

The Issuer

[Scarab CSO Ltd] is a special purpose, bankruptcy remote, company (SPV). The company will be registered in [Jersey/Ireland/Luxembourg]. It is set up in order to acquiring securities through a **Repurchase Agreement**, selling credit protection through a **Mezzanine Credit Default Swap Agreement,** refinancing through the issuance of **Collateralised Debt Obligations** ('the Notes'), and charging its assets as security for its obligations under the Mezzanine Credit Default Swap Agreement and the Notes.

The Issuer is required to produce annual audited accounts and annual management reports.

The SPV shares will be held on trust (or equivalent in Netherlands/Luxembourg) under a Charitable Trust Agreement

Trustee	[Trust Bank of London plc]
Auditors	[ ]
SPV Administrator	[ ]
The Mezzanine Credit	The Issuer will enter into a Mezzanine Credit Swap Agreement with the Mezzanine Swap Counterparty under which the Issuer agrees to provide up to _[ ] of credit protection in respect of the Portfolio, provided aggregated losses on such Portfolio exceed _[ ]. ***Premium***: on each Interest Payment Dates, the Mezzanine Swap Counterpart will pay to the Issuer a premium defined as follow: **[A∗Ma + B∗Mb + C∗Mc + Spd∗(A + B + C)]∗ (Nd/360) + OpEx** where **A:** average daily principal amount outstanding on Class A Notes **B:** average daily principal amount outstanding on Class B Notes **C:** average daily principal amount outstanding on Class C Notes **Ma:** [ ]% per annum (Class A Notes spread over EURIBOR) **Mb:** [ ]% per annum (Class B Notes spread over EURIBOR) **Mc:** [ ]% per annum (Class C Notes spread over EURIBOR) **Spd:** [ ]% **Nd:** Actual number of days of the Interest Period **OpEx:** the Operating Expenses payable by the Issuer on the Interest Payment Date. ***Credit Events***: means the occurrence of any of the following, each of which has the meaning given to it by the 2003 ISDA Credit Derivatives Definitions: • Failure to pay • Modified Restructuring • Obligation Acceleration • Bankruptcy • Repudiation/Moratorium.
The Mezzanine Swap Counterpart	XYZ Bank plc

The Repurchase

On the Issue Date, the Issuer will enter into the Repurchase Agreement with the Repo Counterpart pursuant to which, both parties agree to enter into a series of repurchase transactions in respect of Collateral Securities. Each transaction will begin on an Interest Payment Date (Issue Date for the first transaction) and end on the following Interest Payment Date. The Issuer receives the Collateral Securities against the payment of the **Purchase Price** by the Repo Counterpart in the beginning and receives the **Repurchase Price** against delivery of the Collateral Securities at the end of the repurchase transaction.

Collateral Securities to be chosen by the Repo Counterpart, they must be Government Securities or ABS Securities as described thereafter:

Government Securities: bonds issued by a government of a country of European Union with a maturity below 10 years and a rating of at least AA1 by S&P's/Aa1 by Moody's and denominated in Euro.

ABS Securities: floating rate asset-backed securities and fixed rate covered bonds (Pfandbriefe) with an expected maturity below 10 years, rated AAA S&P's/Aaa Moody's and denominated in Euro (or any former currency of the member states of the European Union that have adopted the Euro).

Price Differential: the difference between the Repurchase Price and the Purchase Price on each Repurchase transaction will be the following:

$$(3M\ EURIBOR - Spd) * (Nd/360) * N$$

where

Spd: [ ]% per annum

Nd: the actual number of days of the Repo Transaction

N: the average principal outstanding amount of the Notes during that Transaction.

Haircut and Margin call

Haircut: Agreed Collateralisation Level: [to be checked with the rating agencies]

	Margin call: bilateral Frequency: daily Threshold Amount: _100,000 Delivery: within 3 Business Days Credit Settlement Amounts Notice: within 6 Business Days Collateral Securities concerned: the highest bid price ***Substitution*** Option for the Repo Counterpart to make any substitution in the composition of the Collateral Securities within the agreed constraints without any prior consent from the Issuer. ***Downgrade*** • In case of downgrade of any ABS Securities, the Repo Counterpart will have to replace the affected ABS Securities by eligible Collateral Securities (within 10 Business Days). • If the short-term senior unsecured debt of the Repo Counterpart ceased to be rated at least A211/P21, the Repo Counterpart should switch all ABS Securities for Government Securities. • If the short-term senior unsecured debt of the Repo Counterpart ceased to be rated at least A211/P21, the Repo Counterpart should within 10 Business Days (a) procure credit support under conditions satisfactory to Rating Agencies in order to avoid the current rating of the Notes, or (b) procure that a third party having such rating substitutes itself to the Repo Counterpart in the Repurchase Agreement.
The Repo Counterpart	XYZ Bank plc
The Security Trustee	[Trust Bank of London plc]
The Arranger	XYZ Bank plc
The Lead Manager	XYZ Bank plc
The Principal Paying Agent	[ ]
The Agent Bank and Listing Agent	[ ]
The Class A Notes	
The Class B Notes	
The Class C Notes	

Use of Proceeds	The Issuer will use the net proceeds of the Notes to purchase the Collateral Securities under the Repurchase Agreement.
Status of the Notes	
Interest on the Notes	
Mandatory Redemption	In case of termination of the Repurchase Agreement or the Mezzanine Credit Default Swap Agreement for any reason.
Optional Redemption	For tax reasons
Final Redemption	The Notes will be redeemed on the Scheduled Maturity Date, unless a Credit Event Notice is served to the Issuer less than [ ] Business Days before the Scheduled Maturity Date, in which case the redemption may be postponed until at most [ ] Business Days after the Schedule Maturity Date, which is expected to be [ ] (the 'Final Maturity Date').
Cash Management	On each Interest Payment Date, the Cash Manager will use the Price Differential received under the Repurchase Agreement and the Premium received under the Mezzanine Credit Default Swap to pay in order: • The Operating Expenses due to the Trustee. • The Operating Expenses due to the other creditors. • The termination payment under the Mezzanine Swap Agreement (provided that credit event has been verified . . .). • Any interest due on Class A Notes. • Any interest due on Class B Notes. • Any interest due on Class C Notes.
Security for the Notes	The notes will be secured by first ranking fixed security interest over the Issuer rights against its counterparts and the balance standing to the credit of the Issuer's Account. The Issuer will also pledge in favour of the Trustee its securities and bank account. In case of enforcement of the security, the Trustee will use the proceeds to make payment in the following order of priority: 1. The Repurchase Price due to the Repo Counterpart.

	2. Any Operating Expense due to the Trustee. 3. Operating Expenses due to the Operating Creditors. 4. The aggregate amounts in respect of the Cash Settlement Amounts due to the Mezzanine Swap Counterpart. 5. Accrued and unpaid interest to Class A Notes. 6. Unpaid principal due to Class A Notes. 7. Accrued and unpaid interest to Class B Notes. 8. Unpaid principal due to Class B Notes. 9. Accrued and unpaid interest to Class C Notes. 10. Unpaid principal due to Class C Notes. 11. Termination payment to the Mezzanine Swap Counterpart.
Limited Recourse	The Notes will be limited recourse obligations of the Issuer. If the net proceeds of the Security after it has been enforced/liquidated are not sufficient to cover all payments due under the Notes, no other assets of the Issuer will be available to pay any shortfall, and all the liabilities of the Issuer will be extinguished.
Rating	AAA/Aaa for class A Notes A/A1 for Class B Notes BBB/Baa1 for Class C Notes
Listing	Luxembourg Stock Exchange

Further documentation for review

The Offering Circular
The Deed of Charge
The Articles of Incorporation
The List of Relevant Agreements
The Investor Reports
The Subscription Agreement
The Agency Agreement
The Trust Deed
The Deed of Charge
The Repurchase Agreement
The Mezzanine Credit Default Swap Agreement
The Pledge Agreement
The Cash Management Agreement
The Domiciliation Agreement
The Bank Agreement

APPENDIX 13.2 THE MOODY'S DIVERSITY SCORE

The diversity score for a CDO is Moody's measure for the number of uncorrelated assets in a portfolio. A CDO portfolio must meet a minimum diversity score for its required credit rating. The strict definition of diversity score is given in the Moody's original document as 'the number of independent assets with identical nominal amount which as a portfolio have the same total notional amount, expected loss and variance as the portfolio itself'. Moody's divides assets in accordance with their industry sector and assigns a default correlation among assets in each industry.

The diversity score D is given by:

$$D = \frac{\left\{\sum_{j=1}^{T}\left(N_j * P_j\right)\right\} * \left\{\sum_{j=1}^{T}\left(N_j(1 - P_j\right)\right\}}{\sum_{j=1}^{T}\left\{\sum_{k=1}^{T}\left(r_{jk} * N_k * \sqrt{\left(p_k * \left(1 - P_j\right)\right)}\right) * N_j * \sqrt{\left(p_j * \left(1 - P_j\right)\right)}\right\}}$$

where

N_j is the outstanding principal balance of collateral debt security j
N_k is the outstanding principal balance of collateral debt security k
p_j is the default probability of security j
p_k is the default probability of security k
T is the total number of collateral debt securities in the portfolio
r_{jk} is the correlation of security j with security k.

The default correlations are assigned by Moody's to each industry sector that it classifies. The default probability is the cumulative probability that a collateral debt security defaults during its life. It is given by:

$$P_j = \frac{E}{(1 - R)}$$

where

E is the expected loss
R is the Moody's recovery rate.

The expected loss is assigned to a security based as shown on a standard table supplied by Moody's, and is based on its credit rating and term to maturity. The recovery rate is assigned to each class of security by Moody's, in accordance with its credit rating.

The CD-R that accompanies this book contains examples of spreadsheets that demonstrate the calculation of the diversity score of selected CDO transactions.

On 15 January 2009, Moody's announced a change to the diversity score calculation, in response to the 2007–2008 financial crisis, stating that 'globalisation and the increasing complexity and interdependence of credit markets have led to a substantial increase in the extent to which stress in one sector can impact another'.[18] To reflect the higher observed correlation, Moody's adjusted the calculation of the diversity score as follows:

- corporate credit ratings are reclassified under a new industry classification code. The new code incorporates the latest view on the industry characteristics of rated companies, and its practical impact is that the estimate of correlation between pools of corporate credits is increased;
- four industries (banking, finance, insurance and real estate) are merged into one. This reflects the links between companies in these sectors, and the fact that in a default situation the correlation between the sectors is effectively unity;
- the number of global industries increases from 3 to 12 with a corresponding reduction in the number of local industries from 15 to 5. Companies from global industries will be assigned higher correlation estimates than companies across local industries. The higher number of global industries results in a lower diversification benefit assumed in the rating model.

In effect, Moody's was recognising that, in a recessionary default environment, the actual 'diversity' exhibited in a CDO structure was considerably closer to unity than had previously been assumed.

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CHAPTER 14

CDO Valuation and Cash Flow Waterfall Models

To complete our discussion of synthetic collateralised debt obligations (CDOs), this chapter presents an overview of the main principles in CDO valuation. To assist understanding we will consider cash as well as synthetic CDOs. We do not discuss one common approach, Moody's Binomial Expansion technique, which is covered in existing literature that is readily accessible, and made available by Moody's. However, we present some key concepts that will set the scene satisfactorily for practitioners.

OVERVIEW

The valuation of note tranches in a CDO structure is a function of a number of factors, an important one of which is the credit quality of the underlying portfolio. This is measured by aggregating individual securities' default probabilities, and by also considering their default correlation and diversity. If the portfolio experiences a deterioration in credit quality, this has the biggest impact on the equity tranche, because this has a leveraged exposure to the portfolio and is the first-loss piece. Other factors that impact the valuation of the tranches include:

- if there are changes in the level of portfolio diversification, which increase concentration risk and may have a negative impact;
- if the underlying assets are viewed as being risky relative to a more recent CDO issue;
- if any of the rating agency guidelines are ignored or compliance tests are breached;
- if the cost of funding on the liabilities side is variable but the return on assets is fixed, any negative move regarding the former will reduce value.

Another important factor is the perception in the market of the portfolio manager.

Common valuation approaches methods include the following:

- cash flow value: the net present value (NPV) of the cash flows through to maturity;
- liquidation value: the value of the underlying assets should the CDO be unwound;
- secondary market value: the actual market price at which already-issued notes will trade;
- the 'copula' approach, which uses default probability and correlation parameters.

We consider these briefly now.

VALUATION APPROACHES

Cash Flow Method

The future cash flows approach involves modelling the cash flows under certain assumptions. It provides a reasonable expected value that is to be received on a particular note tranche, if held to maturity. A computer simulation is run to determine the expected cash flows and the expected loss for each tranche. The average of all scenarios is used to arrive at an NPV for each tranche.

The simulation uses the following parameter inputs:

- the par value of the underlying assets, assuming they are not in default;
- assumed rate of recovery;
- the amortisation profile of all assets and assumptions on rate of reinvestment;
- cash held in vehicle bank accounts.

Liquidation Value Method

The liquidation value approach to pricing CDO note tranches is based on calculating the most realistic minimum value for each tranche in the event of liquidation, based on the market value of the assets. This is undertaken by establishing the mark-to-market value of the underlying assets, whatever these are. In theory it should be possible to obtain these values for bonds, loans and credit default swaps (CDS). Once the value of the underlying is confirmed, this is offset against the principal and interest accrued on all the CDO note tranches (the liabilities).

This approach is viewed as being a tractable and transparent one and is often used by investors.

Secondary Market Value Method

This is a market observation method, which may not be applicable if the notes under consideration are particularly illiquid. The reasoning is that the secondary market provides an explicit valuation for any CDO tranche because it clears the price at which buyers and sellers for the tranche will deal. This approach is highly effective where a price can be obtained; however, many notes are not priced and there are relatively few market-makers for many issues (often a price can only be obtained from the bank that underwrote and arranged the issue).

VALUATION USING DEFAULT PROBABILITY AND CORRELATION

We now introduce the copula approach to pricing CDO tranches.

Basket CDS

The synthetic CDO is a correlation product, in effect an extension of a basket CDS or basket credit-linked note (CLN). A common approach to valuing these is via a Monte Carlo simulation. This involves generating the expected time to default from the simulation, and then calculating a basket spread as follows:

- simulate the expected time-to default of the assets in the basket, in order of default; the nth time to default is stated as $p_n(i)$ where i is the defaulted asset;
- calculate the present value of the premium or coupon stream paid up to time $p = \min[p_n(i), T]$ where T is the basket maturity date;
- where $p_n(i) < T$ then the present value is given by $M(p_n(i))(1 - r(i))$ where M is the LIBOR rate expressed as a discount factor and r is the recovery rate for defaulted asset i. If $p_n(i) > T$ then the present value is zero;
- calculate the average of the present value for the protection premium (the basket PV01) and the protection leg present value over all simulated paths;
- finally, divide the average value of this protection premium by the PV01 and this provides the premium spread.

This approach is used in practice for basket CDS of up to 100 assets although the Monte Carlo simulation takes longer the greater the number of assets.

Synthetic CDO Tranches

The above approach can also be used to price a synthetic CDO note tranche. The simulation is run this time to generate a time-to-default for each asset in the reference portfolio and then the note tranche is spread over LIBOR calculated as before. Another approach is to price a note from its loss distribution. We will describe this qualitatively here.

Consider a basket CDS linked to a note tranche, where the tranche is described by upper and lower values *Pu* and *Pd,* which are percentages of the notional value of the reference portfolio. This value is given by:

$$N_{Tranche} = N_{Portfolio}(P_u - P_d).$$

The basket CDS has expiry date of T and for the period $t < T$ the cumulative loss in the portfolio up to time t is denoted by $L(t)$. The loss amount of the tranche is given by:

$$L_{Tranche}(t) = \max[L(t) - P_d.0] - \max[L(t) - P_u, o].$$

This is actually the payoff profile that one would use to describe an option. In fact Picone (2001) describes CDO note tranches as options on the reference portfolio.

We then proceed to price the note using the same approach to price a CDS, which requires us to calculate or obtain a probability of default for the tranche. This is given by:

$$\text{Probability}(t) = \frac{E_0^T[L_{Tranche}(t)]}{N_{Tranche}}$$

where E is the risk-neutral expectation operator.

Carrying on the CDS analogy, we now price the ‘contingent payment leg’ of the note as follows

$$PV = N_{Tranche} \int_0^T M(0, u) dP(u)$$

where $M(0, u)$ is the LIBOR discount factor for the period from t to T.

The value of the payment premium leg is denoted by the premium spread s and we wish the value at time of default of asset i. We introduce a factor for the accrued payments at I denoted by a_i, and so the premium value present value is given by:

$$PV = sN_{Tranche} \sum_{j=1}^{n} a_i(1 - \text{Prob}(T_i))M(0, T_i).$$

The investor therefore values the note tranche as follows:

$$PV_{Tranche} = \text{Premium Leg PV} - \text{Protection Leg PV}.$$

Thus the synthetic CDO note can be valued provided we generate a loss distribution for the note applicable to the valuation period t to T.

The next section provides a worked example of this valuation approach.

PRICING METHODOLOGY FOR SYNTHETIC CDO NOTES[1]

A synthetic CDO is made up of a portfolio of CDS contracts. The arranger of a synthetic CDO distributes the credit risk of the portfolio by creating and selling tranches to investors. Every tranche has an attachment and detachment point that determines the amount of loss, and correspondingly the number of defaults that the tranche can absorb. For example, the first tranche, known as the equity tranche, might be responsible for portfolio credit losses between 0% and 3%, the next tranche would then be responsible for portfolio losses that exceed 3% up to the size of the tranche and so on. The least risky tranche of a CDO is known as the senior tranche, or super-senior tranche. Tranches between the equity tranche and the most senior tranche are known as mezzanine tranches.

The challenge in pricing a synthetic CDO lies in the difficult task of formulating a model for the joint default behaviour of the underlying reference assets. Understanding and modelling the joint default dynamics of the reference assets are important in order to compute the expected losses for each tranche. The expected losses, in turn, determine the fair spread of the tranche. In fact, once the joint default distribution of the reference assets has been specified, we can price any tranche that references these assets.

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[1]This section was written by Jaffar Hussain. The author is writing in his individual private capacity.

In this section we present an approach to computing the joint default distribution of a reference portfolio. The approach is based on a one-factor recursive procedure and requires no Monte Carlo simulations. We compare the results of this recursive approach with the results obtained using a Monte Carlo procedure that simulates the default times of the reference assets and the corresponding losses in the portfolio. The Monte Carlo approach is computationally time consuming as it requires a large number of simulations in order to produce enough defaults that can impact the most senior tranches of a CDO.

Computing the Distribution of Default Losses

Pricing a synthetic CDO boils down to computing the joint distribution of defaults of the reference portfolio. Computing the default distribution, in turn, depends crucially on the default probabilities of the reference credits and the pair-wise correlation between every pair of credits. The correlation among the assets will drive the joint default behaviour of the assets. The model we use here is a one-factor model whereby the defaults are driven by one factor that we take to represent a common economic driver of credit events. Default losses are then calculated conditional on the state of this economic factor. This procedure will result in computing the conditional default distribution. The next step is to integrate the conditional default distribution over the common factor to arrive at the unconditional distribution of default losses. This modelling framework has an appealing and easy interpretation. Conditional on the state of the common economic factor, credits will default when their asset values fall below a pre-specified threshold. This default threshold usually represents the level of debt of a company. If we further assume that the variables driving the returns process follow a normal distribution, then this modelling framework is also known as the Gaussian copula.

We assume that the reference portfolio contains n credits and each credit is described by its notional amount, probability of default and recovery rate. For any credit 'i' we then have a notional $A(i)$, a default probability $p(i)$ and a recovery rate $r(i)$. The return process of each credit is driven by a common factor M and a noise factor $\varepsilon(i)$ that is specific to the i-th credit according to the following equation:

$$Z(i) = \beta(i).M + \varepsilon(\mathrm{i}).\sqrt{}(1 - \beta(i)2) \tag{14.1}$$

where the $Z(i)$ represents the returns of credit i. The market factor M, and the idiosyncratic factor $\varepsilon(i)$ are independent standard 'normals' with zero means and unit variances. The asset returns, $Z(i)$, follow a standard normal distribution as well. Within this specification of the returns dynamics, the correlation between any two credits, i and j, is simply given by the product of $\beta(i)$ and $\beta(j)$, where $\beta(i)$ and $\beta(j)$ are taken to represent the betas of credits i and j respectively. That is, they represent the sensitivities of credits i and j to changes in the common factor, as shown below.

$$p[Z(i),\ Z(j)] = \beta(i).\beta(j) \tag{14.2}$$

Conditional on the realisations of the common factor, defaults are only driven by the noise factors $\varepsilon(i)$ and are thus independent. A credit, i, is assumed to default if its asset return, $Z(i)$, falls below a pre-specified level or default threshold given by the $\Phi - 1\ [p(i)]$ where $\Phi - 1$ denotes the inverse of the cumulative standard normal distribution. If we denote the default threshold of credit i by $D(i)$, then a credit i defaults when:

$$Z(i) < D(i), \quad \text{where} \quad D(i) = \Phi - 1[p(i)]. \tag{14.3}$$

Equivalently, by rearranging equation (14.1), default occurs when:

$$\varepsilon(i) < [D(i) - \beta(i).M]/\surd(1 - \beta(i)2). \tag{14.4}$$

Finally, since $\varepsilon(i)$ are standard normals and we assume a flat correlation across all credits, the default probability of credit i conditional on the realisations of the common factor M is given by:

$$\text{Prob}[Z(i) < D(i)|M] = \Phi\big(\big[D(i) - \text{M}.\surd\text{p}\big]/\surd[1 - p]\big). \tag{14.5}$$

This last equation demonstrates that only a single correlation parameter and a single common factor M are needed to calculate the joint distribution of default losses.

There are two ways to move on from here. One approach involves a Monte Carlo simulation of M and $\varepsilon(i)$ in equation (14.1) to generate realisations of the asset returns $Z(i)$. Defaults will then be triggered whenever $Z(i)$ falls below a threshold as described by equation (14.3). The term structure of default probabilities for each credit can be calibrated to market spreads or implied from the credit ratings. A second approach takes advantage of the fact that defaults are independent, conditional on the common market factor. It then uses a recursive method to construct the conditional default distribution. The details of this recursion method are discussed in Gibson (2004); Hull and White (2003); and Andersen, Sidenius and Basu (2003); and an alternative approach using generating functions is discussed in Mina and Stern (2003). We can calculate the conditional probability that a portfolio of n credits will lose exactly k credits by time t with the following recursion:

$$\begin{aligned} Pn(k,\ t|M) = {} & Pn-1(k,t|M).(1-P(Z(i) < D(i)|M)) \\ & + Pn-1(k-1,\ t|M).P(Z(i) < D(i)|M) \end{aligned} \tag{14.6}$$

where the superscript n in Pn refers to the size of the portfolio and should not be understood as P to the power of n. By starting with a portfolio of size 0 and successively adding credits according to the recursion equation we can construct the conditional default distribution. Finally, by weighting the conditional probabilities by the probability distribution of the common factor we arrive at the unconditional default distribution.

For the results here we use the Monte Carlo and the recursion methods to generate the default loss distribution. The Monte Carlo method, though slower, allows more flexibility in modelling the correlation and default parameters. If we run both models using the same correlation and default assumptions, we will obtain the same results.

Pricing Synthetic CDO Tranches

Pricing a CDO tranche is a function of the tranche's notional, spread and expected default losses. The expected losses on a tranche can be estimated from the default distribution of the reference portfolio. Thus, for each payment date we need to estimate the credit losses sustained by the portfolio and distribute these losses to each tranche based on the relative position of the tranche in the capital structure: the protection leg. Also, each tranche receives a premium that is a function of the remaining notional amount of the tranche on the payment date: the premium leg. Thus, both the premium leg and the protection leg are a function of a common denominator: the portfolio credit losses sustained by the payment date. To compute the fair spread on a tranche we need to equate its premium leg to its protection leg, which reduces the pricing of a synthetic tranche to the more familiar analytics of a single-name default swap. If we denote the expected loss of a tranche at payment date ti by $E(Li)$, then:

$$\text{Total expected losses on the tranche} = \Sigma iDFi\ .\ [E(Li) - E(Li-1)] \tag{14.7}$$

$$\text{Total expected premium payments} = s.\Sigma iDFi\, .\, E(Ni) \tag{14.8}$$

where DFi is the discount factor at payment date i, s is the tranche spread, $E(Ni)$ is the tranche expected remaining notional by payment date i, and the summation is taken over all payment dates. We also note that the remaining notional is a function of the expected losses on the tranche, which is driven by the portfolio credit losses. That is:

$$E(Ni) = N0 - E(Li) \tag{14.9}$$

where $N0$ is the original notional of the tranche.

Based on standard swap pricing that both legs must have net present value equal, we can then calculate the fair spread of the tranche as:

$$sfair = \Sigma iDFi \;.\; [E(Li) - E(Li - 1)]/\Sigma iDFi \;.\; E(Ni) \tag{14.10}$$

Once again, the pricing equations show that all one needs in order to compute the price of any synthetic CDO tranche is the default distribution of the reference credits.

Example Illustration: Pricing the Tranche

To illustrate the results of the modelling approach described above, we work with the following transaction: \$1 billion reference portfolio for a 5-year hypothetical CDO consisting of 100 reference credits. All credits have the same spread of 100 bps and an average recovery rate of 40%. The flat asset correlation is assumed to be 25%, and the risk-free discount rate is a constant 5%. In addition, all credits have the same notional amount: \$10 million. Table 14.1 shows the tranches of this hypothetical CDO, along with their fair spreads as calculated using the one-factor pricing model.

As Table 14.1 shows, the equity and more junior tranches bear the majority of the portfolio credit risk, although they represent a small portion of the capital structure of the CDO. In addition, we can use the expected losses to infer the implied rating of each tranche. The implied ratings show how the credit risk of a Ba2-rated reference portfolio can be distributed as

TABLE 14.1 Pricing of a hypothetical CDO.

Tranches	Attachment point	Detachment point	Expected loss %	Fair spread (bps)	Implied rating
Equity	0%	3%	65.05	2557	Unrated
Class D	3%	6%	34.27	923	Caa3
Class C	6%	9%	19.15	465	Caa1
Class B	9%	12%	10.99	255	B2
Class A	12%	22%	3.81	86	Ba2
Senior	22%	100%	0.08	1.8	Aa3
Portfolio	0.00%	100%	4.80%	100	Ba2

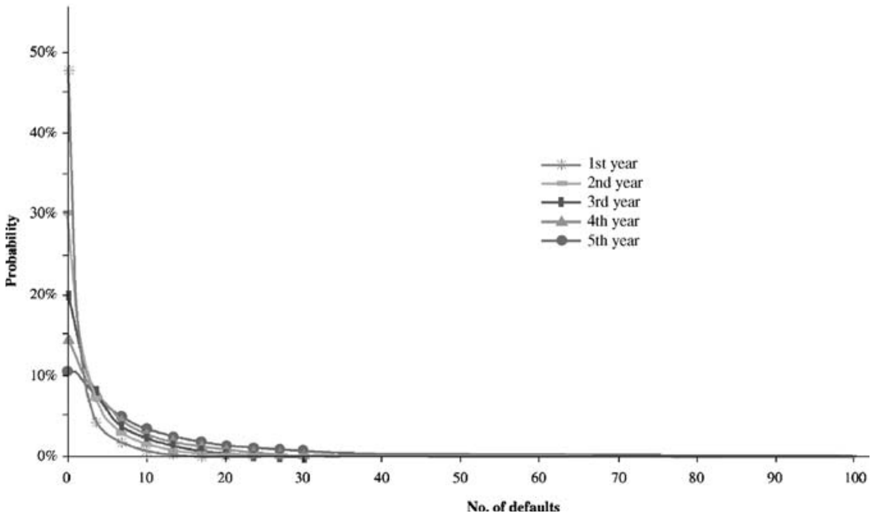

FIGURE 14.1 Unconditional default probability distributions of a hypothetical CDO.

to create buckets of lower and higher quality tranches suitable for various investors. Figure 14.1 shows the unconditional default probability distribution of the reference credits.

Figure 14.2 shows the total expected losses on the reference credits conditional on the realisations of the common economic factor. In this graph, the common factor takes values in the interval $[-5, 5]$ where the negative realisations represent progressively deteriorating market conditions. For example, a value of -5 for the common factor represents a 5-sigma market event. This graph has an intuitive interpretation: lower values of the common economic factor correspond to lower economic growth and higher probabilities of economic recession. Therefore, the expected losses of the portfolio conditional on the economic factor will be higher for lower values of the common factor. The graph can therefore serve as a 'scenario' or 'what-if' analysis.

Similar graphs can also be produced for each tranche. To illustrate this analysis further, I take the 37th, 50th, and 63rd percentiles of the common factor realisations and calculate the portfolio expected losses at these points. The 37th percentile corresponds to a value of -1.3 for the common factor and represents a market downturn, the 50th corresponds to a value of 0 for the common factor and represents a stable market, and the 63rd percentile corresponds to a value of 1.3 for the common factor and represents an expanding market. Table 14.2 on page 518 shows the results of this scenario analysis. For the sake of completion, Figure 14.3 and Table 14.3 show

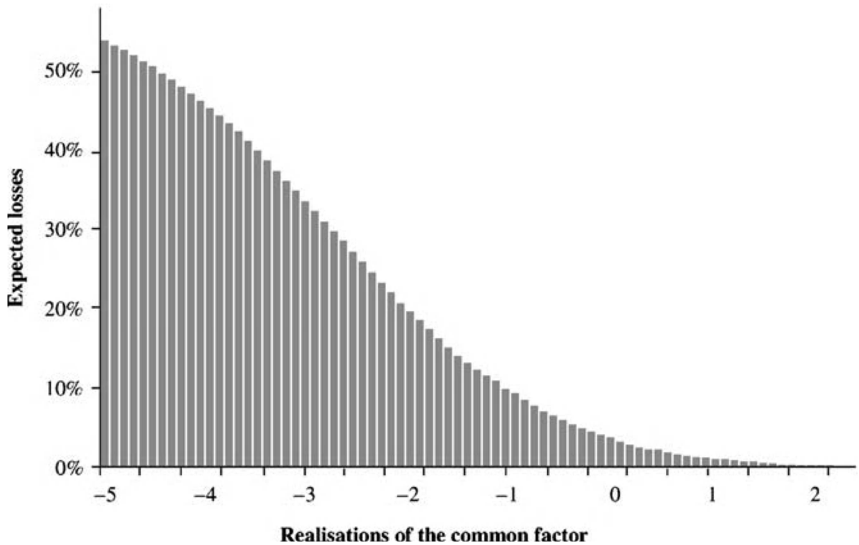

FIGURE 14.2 Conditional distribution of expected losses for the reference credits over five years.

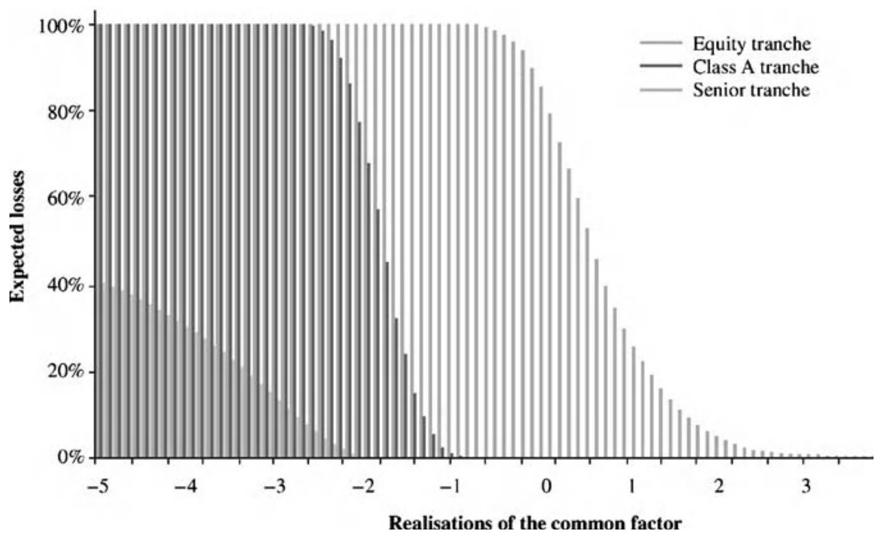

FIGURE 14.3 Conditional distribution expected losses for selected tranches over five years.

TABLE 14.2 Scenario analysis of conditional expected losses over five years.

	The states of the economy		
Scenario analysis of expected losses	Downturn	Stability	Growth
Expected losses of the portfolio	11.63%	3.20%	0.54%

TABLE 14.3 Scenario analysis of conditional expected losses for selected tranches over five years.

	The states of the economy		
Scenario analysis of expected losses	Downturn	Stability	Growth
Expected losses of equity tranche	100%	85.6%	18.0%
Expected losses of Class A	7.74%	0.00%	0.00%
Expected losses of senior trance	0.00%	0.00%	0.00%

the conditional expected losses for the equity tranche, class A tranche, and the senior tranche.

Figure 14.3 clearly shows that the most senior tranche is not totally immune to losses, while the equity tranche bears a substantial risk of default losses even under relatively positive market conditions. In interpreting these results, the reader should bear in mind that we are starting with a Ba2-rated reference portfolio.

As discussed in Gibson (2004), Table 14.3 illustrates how the mezzanine tranches can be thought of as leveraged bets on business cycle risk. Investors in mezzanine tranches receive spreads ranging from 923 to 86 bps according to Table 14.1; however, they have to absorb the majority of credit risk in difficult and recessionary market conditions.

PARAMETER SENSITIVITIES OF SYNTHETIC CDO TRANCHES

In addition to calculating the conditional and unconditional expected losses of the tranches, we can also extend the risk analysis of a synthetic CDO tranche to include:

- computing the tranche sensitivity to changes in correlation;
- computing the tranche sensitivity to broad changes in credit spreads;

- computing the change in subordination necessary to maintain the base value of a tranche as a function of the average credit quality of the reference portfolio;
- computing the standard deviation of losses.

We consider these issues next.

Correlation Sensitivity

Figure 14.4 shows the correlation sensitivity of the equity and mezzanine tranches. The graph shows the fair spread of each tranche at different correlation assumptions as a multiple of the base spread 25% correlation. The equity tranche is clearly long correlation as its value increases with higher correlations: the spread falls as correlation increases. This is typical for an equity tranche because higher correlation increases the probability of fewer defaults as well as the probability of more defaults. Since equity investors are sensitive to any default it makes sense that they would prefer higher probabilities of fewer defaults—hence, higher correlation. In contrast, Class A investors, the 12–22% tranche, are short correlation. For Class A investors, higher correlation reduces the value of the tranche and increases its spread.

Tranches in the middle of the capital structure share similar behaviour with either the equity tranche or the more senior tranches, but with much

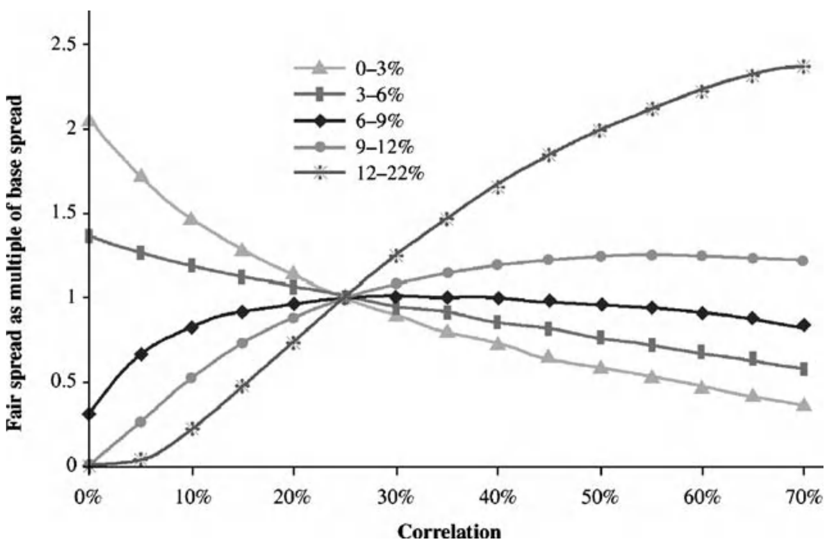

FIGURE 14.4 Correlation sensitivity of CDO tranches: base spread is calculated at 25% correlation.

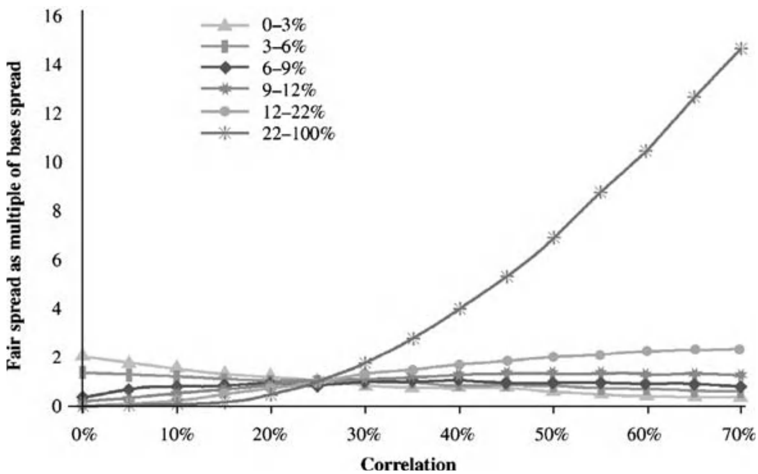

FIGURE 14.5 Correlation sensitivity of CDO tranches, including senior tranche: base spread is calculated at 25% correlation.

less sensitivity to correlation assumptions. For example, Class C, the 6–9% tranche, shows very little sensitivity to changes in correlations far beyond the initial assumption of 25% correlation. Figure 14.5 completes the picture by showing the high sensitivity of the most senior tranche to changes in correlation. More senior tranches of a CDO transaction are only susceptible to extreme market shocks that cause higher market correlations and multiple defaults to occur.

These observations are consistent with the scenario analysis shown in Table 14.3 and Figure 14.4, which illustrate the conditional impact of wide economic downturns on the value of senior tranches. In fact, although not shown in Table 14.3, at the 24th percentile value of the common default driver, Class A is expected to lose all its notional and the most senior tranche is expected to suffer a 7% loss. Economic shocks of such a magnitude are not unheard of.

The correlation sensitivity analysis illustrates two important features of CDO investing:

- Investors with different correlation assumptions will attach different values to the same tranche. This creates both model risk and an opportunity for correlation and/or model arbitrage. Correlation is a very difficult parameter to measure and estimates of correlation are susceptible to estimation errors, personal judgments and correlation breakdowns among many others.
- Mezzanine tranches are the least sensitive to changes in the correlation parameter. Therefore, these tranches are also the least sensitive to

modelling errors. For example, Class C investors will notice very little change to the value of their tranche even if correlation doubles. Investors who wish to minimise parameter risk will therefore prefer the middle tranches of a CDO transaction.

The Subordination Effect

The expected loss of a tranche is driven not only by the credit spreads of the reference assets, but also by the credit enhancement available to the tranche. To illustrate the effect of subordination, or location of a tranche within the capital structure, consider the following analysis: the original reference portfolio is divided into two equal groups. In the first group, the reference credits retain their initial spreads of 100 bps, while the second group's credit spreads are varied to 120, 130, 140, 150 and 160 bps. Starting with the base case of a 100 bps for all credits, we calculate the expected loss on Class D, the 3–6% tranche. Then we change the reference portfolio so that half of the credits have a spread of 120 bps, and back out the subordination necessary to bring about a similar expected loss for Class D. We repeat the same analysis with 130, 140, 150, 160 and 180 bps to obtain the levels of subordination that will maintain the expected loss of Class D at the same base level in each case.

The graph in Figure 14.6 shows how the subordination varies with the average spread on the reference portfolio. As we progressively decrease the quality of the reference portfolio, we need higher levels of subordination to maintain the expected loss of Class D at a level similar to its base level of 34.27%. This analysis illustrates another subtle feature of CDO structuring:

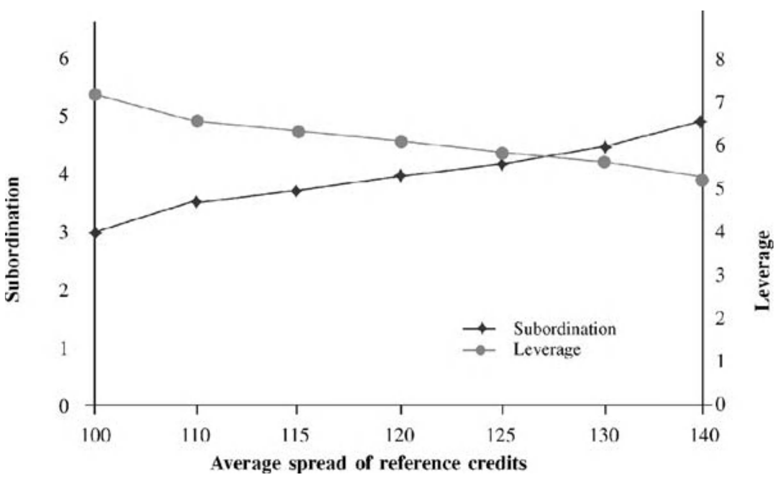

FIGURE 14.6 Subordination effect on expected losses and leverage.

practically any desirable rating can be attained for a tranche provided the right amount of credit enhancement can be provided to that tranche. The lower the credit quality of the reference portfolio, the more subordination the tranche will require to achieve the same rating. Figure 14.6 also shows the effect of higher subordination on tranche leverage. Leverage is defined as the expected loss of the tranche divided by the expected loss of the reference portfolio. As Figure 14.6 shows, higher subordination leads to lower leverage. In other words, the lower the credit quality of the reference portfolio, the lower the leverage a tranche will require to achieve a particular rating. These are important results.

Monte Carlo Simulation of Losses

The Monte Carlo approach, described in Li (2000), generates the loss distribution by simulating the default times of the reference credits using the Gaussian copula. This approach is flexible in that it allows for stochastic modelling of the recovery and default parameters. The Monte Carlo approach can easily incorporate more than one economic factor, it allows for sampling losses from fat-tailed distributions, and it is capable of capturing a more complex correlation structure. However, it is time-consuming as it requires a large number of simulations in order to reduce estimation error and capture extreme losses that will only affect the most senior tranches. The recursive approach, on the other hand, is simpler and faster, but lacks the flexibility of the Monte Carlo approach.

Using the same modelling assumptions, the Monte Carlo approach should produce similar results to those obtained from the recursion method. That is, if we set the recovery rates, credit spreads and correlation parameter in the Monte Carlo model to those used for the recursion method, the results of both approaches ought to be similar. Table 14.4 shows Monte Carlo results using one million simulations. As evident from Table 14.4, the recursion approach provides a robust and accurate estimation of expected losses and standard deviations.

TABLE 14.4 Expected losses and standard deviations with one million Monte Carlo simulations.

	Portfolio	0–3%	3–6%	6–9%	9–12%	12–22%	22–100%
Expected losses (%)	4.8	66.8	35	19.1	10.6	3.5	0.076
Standard deviations (%)	5.0	37.8	44	37	29.3	15.5	0.009

CDO NOTE PRICING: SUMMARY

We have demonstrated a simple, yet accessible technique to calculate the default distribution of a credit portfolio. Using this technique, we have shown how the fair spreads and risk parameters of synthetic CDO tranches can be calculated. The important highlights can be summarised as follows:

- the equity and most junior tranches of a synthetic CDO bear the majority of credit risk of the reference portfolio;
- the most senior tranche is not completely immune to credit losses;
- the value of the equity and most junior tranches increases as correlation across the credits rises. On the other hand, the value of the senior tranches decreases with higher correlation;
- the mezzanine tranche has the least sensitivity to the correlation parameter and to correlation model risk;
- the senior tranches are more sensitive to broad changes in credit spreads;
- there is a trade-off between the quality of the reference credits and the subordination required to attain a particular rating for a tranche. The lower the quality of the reference credits, the higher the required subordination.

Both originators and investors will need to be aware of the main issues associated with CDO structuring and pricing, most especially with regard to tranche correlation sensitivity.

HYPOTHETICAL CASE STUDY: CASH FLOW APPROACH

For comparison, let us examine the valuation of a cash flow CDO (that has been 'structured' for this book) using the cash flow approach.

ABC 2003-1 CDO

Assets:	Bank loans
Close date:	June 2003
Maturity:	June 2013

The capital structure and extract of the portfolio is shown in Table 14.5. We aggregate the cash flows and apply the cash flow valuation

TABLE 14.5 Capital structure and extract from portfolio.

Class	Principal €m	WAM years	Per cent	Coupon	Issue price	Proceeds
Class A	400,000,000	4.05	80	L + 40	100	400,000,000
Class B	50,000,000	5.65	10	L + 80	100	50,000,000
Class C	25,000,000	6.08	5	L + 150	100	25,000,000
Class D	10,000,000	6.95	2	L + 280	100	10,000,000
Equity	15,000,000	1.85	3	Excess spread	100	15,000,000
	500,000,000					500,000,000

Portfolio summary

Number of issuers	80
Notional €m	485,250,000
Price	94.75
Average spread	192.5
Average maturity	Oct 08
Average rating	BBB–
Aggregate principal balance	468,251,000
Cash reserve	13,252,125
Average loan price	91.55

Extract of portfolio

Issue	Security	Country	Seniority	Amount €m	Price	Spread	Maturity	Average life	Sector
Airco Ltd	Loan	UK	Senior secured	2,939,451	89.55	355	13-Aug-08	5.49	Aviation
BriTel	Loan	UK	Senior secured	4,791,258	93.25	289	25-Jun-08	5.65	Telecoms
Brosnan	Loan	Germany	Senior secured	6,000,000	45.25	855	1-Dec-07	4.95	Utilities

TABLE 14.6 Cash flow valuation.

Period	AAA/Aaa	AA/Aa2	BBB/Baa2	BB/Ba2
Jun-04	−400,000,000	−50,000,000	−25,000,000	−15,000,000
Jun-05	8,498,562	385,256	325,252	1,254,145
Jun-06	48,259,784	504,215	441,520	1,428,525
Jun-07	98,586,987	558,625	445,251	1,427,525
Jun-08	59,868,524	579,452	417,852	1,427,852
Jun-09	895,652	39,254,181	1,524,584	1,426,875
Jun-10			456,825	1,434,582
Jun-11			20,125,415	852,541
Jun-12			125,485	1,434,589
Jun-13			1,548,528	115,215
IRR	1.78%	2.75%	2.84%	−1.69%
LIBOR spread	0.40%	0.91%	1.15%	−4.29%

method, a summary for which is shown in Table 14.6. This enables us to obtain the values for the note tranches, which are shown below.

	IRR	Original coupon
AAA/Aaa	0.40%	0.40%
AA/Aa2	0.91%	0.80%
BBB/Baa2	1.15%	1.50%
BB/Ba2	−4.29%	2.80%

We then compare these values to the secondary market values for notes of comparable quality and structure, to obtain a reasonable valuation for the tranches.

CASH FLOW WATERFALL MODEL: STATIC SYNTHETIC CDO[2]

For illustrative purposes we show the basic breakdown of a cash flow model for a static synthetic CDO. This is done via Excel spreadsheets.

Cash Flow Model

This is a working cash flow waterfall model for a hypothetical static synthetic collateralised debt obligation, 'Synthetic CDO Ltd', with issue size $115 million. It is a partially funded CSO, with super senior portfolio CDS and tranched CLNs. The liabilities of the CDO reference a portfolio of 100 corporate reference assets. The proceeds of the CLN issue are invested in collateral securities of German Bunds, which are then repo'd out to a repo counterparty and act as collateral for the CLN issue. The return on the collateral securities represents the protection for the CLN investors, who can expect a minimum return based on return on collateral. However, the excess return to CLN note holders is made up of the credit-linked return, linked to reference assets.

The definitions refer to a hypothetical 'Offering Circular' (OC) for this transaction.

[2]This section was co-authored with Suleman Baig of Deutsche Bank AG who is also the author of the waterfall model. The authors are writing in their individual private capacity.

STATIC DATA	
Closing Date	8/9/2002
Scheduled Maturity Redemption Date	8/9/2012
Final Payment Date	10/9/2013
Period Start Date	11/25/2002
Period End Date	2/24/2003
Period (days)	91
Pay Method	360
Three-month EURIBOR	0.03045
Repurchase Date	Y
Maturity or Redemption Date	N
Repo Termination Event	N
Unsettled Credit Events	N
Denomination	50,000

Note class	Price	Original value	Period start principal amount	Deferred interest (b/f)	Principal amount adjusted for intra period events*	Principal reduction	Period end principal amount	Deferred interest (c/f)	Denom. O/S (start)	Denom. O/S (end)	Number of shares	Interest per EUR 1k note	Margin	Interest due	Interest paid
A-1	100%	38,250,000	38,250,000	—	38,250,000	—	38,250,000		50,000.00	50,000.00	765.00	441.73	0.0045	337,923.45	337,923.45
A-2	100%	21,250,000	21,250,000	—	21,250,000	—	21,250,000		50,000.00	50,000.00	425.00	467.01	0.0065	198,479.25	198,479.25
A-3	100%	29,750,000	29,750,000	—	29,750,000	—	29,750,000	—	50,000.00	50,000.00	595.00	587.08	0.0160	349,312.60	349,312.60
B-1	100%	20,400,000	10,656,875	—	10,656,875	—	2,985,625		26,119.79	7,317.71	408.00	—	—	—	—
B-2	100%	5,100,000	—	—	—	—	—		0.00	0.00	102.00	—	—	—	

*Cash settlement amounts and deferred interest outstanding at such time

FIGURE 14.7 'Synthetic CDO', terms of deal and note tranching.
Source: © Suleman Baig 2003.

Inputs	Fees	Accounts	Events	Static data	Note amount O/S (b/f)	Credit events	Terms
Static Data							
Period Start Date	11/25/2002						
Period End Date	2/24/2003						
Three-month EURIBOR	0.03045						
Events							
Maturity or Redemption Date	N						
Repo Termination Event	N						
Unsettled Credit Events	N						
Aggregate Amount Outstanding (b/f)							
Class A-1 Note	38,250,000						
Class A-2 Note	21,250,000						
Class A-3 Note	29,750,000						
A-3 Notes Deferred Interest	—						
Class B-1 Note	10,656,875						
Class B-2 Note	—						
Accounts							
Collateral Account (24437301)							
Opening Balance (bf)	31,717						
Net Proceeds of the Notes	99,906,875						
Market Value of the Repo Securities	105,027,176						
Payment Account (24437303—Balance at Pay Date)							
Opening Balance	—						

FIGURE 14.8 Inputs to waterfall model.

Expense Account (24437304)	
Opening Balance	60,640
Unpaid Issuer Expenses	—
Other Net Movements	—
Collection Account (24437302)	
Opening Balance	95,768
Fees	
Taxes, Registration owing by the Issuer	
Trustee and Administrator Charges	*9,015*
Other Admin. Expenses	*46,640*
Credit Events	
Aggregate of all Cash Settlement Amounts	14,843,125.00
Aggregate of all Re-instatement Amounts	—
Cash Settlement Amounts	7,671,250.00
Re-instatement Amounts	—
Terms	
Repurchased Securities: Originator to Provide Figures	
Initial Purchase Price	114,750,000.00
Payment of Principal on the notes to be made	
Agg. Collateral Account Replenishment Payment (to date)	653,476.05
Aggregate Repurchase Price paid (to date)	22,514,375.00
Repo Rate Payents Accrued and Unpaid	—
Repo Rate Payments Paid	762,341.92
Calculation Amount (for Unsettled Credit Events)	—
Max Portfolio Notional Amount (p51)	841,500,000.00
Credit Swap Payment	792,303.19
Interest rec'd wrt to Securities sold by Issuer	—
Discount Payments (After Repo term.)	—

FIGURE 14.8 (*Continued*)
Source: © Suleman Baig 2003

REMAINING PURCHASE PRICE	
Cash settlement amount	7,671,250
Payment of Principal on the notes to be made	—
Initial Purchase Price	114,750,000
Collateral Account Replenishment Payments	—
Repo Rate Payments accrued and unpaid	—
Repo Rate Payments Paid	762,342
Aggregate of Collateral Account Replenishment Amounts paid	653,476
Aggregate of Repurchase Prices Paid	22,514,375
TERMS	
Issuance of Notes Proceeds	114,750,000
Excess Repo Securities	—
Calculation Amount (for Unsettled Credit Events)	—
Max Portfolio Notional Amount	841,500,000
Credit Swap Payment	792,303
Collateral Account Investment Income	762,342
Interest rec'd wrt to Securities sold by Issuer	—
Repo Rate Payment	762,342
Discount Payments (After Repo term.)	—
PAR COVERAGE TEST	
Ratio (at period start)	1.040774241
Value	1.11
Test	PASS
10/1/2003	1.11
10/1/2004	0
Thereafter	0
PURCHASED SECURITIES "A"	
Reviewed Weekly	
Applicable Percentage	1.03
Required Amount	88,288,743
De Minimis Amount	214,293
Condition	**MARGIN SURPLUS**
	TRUE
CREDIT EVENTS "B"	
Aggregate of all Cash Settlement Amounts	14,843,125
Aggregate of all Re-instatement Amounts	—
Cash Settlement Amounts	7,671,250
Re-instatement Amounts	—
	SUFFICIENT FUNDS TO PAY CASH SETTLEMENT AMOUNT

FIGURE 14.9 Model input showing cash receipts to vehicle.

INTEREST WATERFALL	1,650,413.23		
	Due	*Paid*	*Balance*
Taxes, Registration owing by the Issuer	—	—	1,650,413.23
Trustee and Administrator Charges	9,015	9,015	1,641,398.44
Other Admin. Expenses	46,640	46,640	1,594,758.00
Expense Account Top Up	—	—	1,594,758.00
Interest payments on Class A-1	337,923	337,923	1,256,834.55
Interest payments on Class A-2	198,479	198,479	1,058,355.30
Interest payments on Class A-3	349,313	349,313	709,042.70
Par Coverage	709,043	709,043	—
Class B-1 Interest Distribution Amount	—	—	—

PRINCIPAL WATERFALL	—		
	Amounts due	*Paid*	*Balance*
REVISED BALANCE ON PRINCIPAL PAYMENT DATE (Int. on Subordinate Notes)			—
Unpaid Taxes, Registration Owing by the Issuer	—	—	—
Unpaid Trustee and Administrator Charges	—	—	—
Unpaid Other Admin. Charges	—	—	—
Unpaid Expense Account Top Up	—	—	—
Unpaid Interest Payments on Class A-1	—	—	—
Principal Payments on Class A-1	38,250,000	—	—
Unpaid Interest Payments on Class A-2	—	—	—
Principal Payments on Class A-2	21,250,000	—	—
Interest payments on Class A-3	—	—	—
Principal Payments on Class A-3	29,750,000	—	—
Class A-3 Deferred Interest	—	—	—
B-1Note Rate Interest	—	—	—
Principal Payments on Class B-1	10,656,875	—	—
Principal Payments on Class B-2	5,279,156	—	—

FIGURE 14.10 Waterfall payment calculations.
Source: © Suleman Baig 2003.

The note tranching to this transaction is given at Figure 14.7 on page 526, which also shows the terms of the deal. It also shows the calculation of interest at the time this snapshot is taken. The amounts calculated here are shown on the summary sheets that appear later.

Figure 14.8 on page 527–528 is the inputs to the model, showing the various types of fees and payments that make up cash flows of the waterfall.

COLLATERAL ACCOUNT		PAYMENT ACCOUNT (BALANCE AT PAY DATE)	
Opening Balance (bf)	31,716.84	Opening Balance	—
Net Proceeds of the Notes	99,906,875.00	Transfer from Collection Account	1,650,413
Repo Securities (Market Value)	105,027,176	Waterfall Payments	1,650,413
Replenishment Payment	709,043	Revenue	1,650,413
Principal Amortisation Payment (c/f)	—	Principal	—
B-2 Note Principal Balance Adjustment	—	Excess Repo Securities	—
Reinstatement Amounts	—	Closing Balance	—
Cash Settlement Amount	7,671,250		
Closing Balance	198,003,561		

EXPENSE ACCOUNT		COLLECTION ACCOUNT	
Opening Balance	60,640	Opening Balance	95,768.12
Movements	—	Credit Swap Receipts	792,303.19
Condition as per O.C.	—	Collateral Investment Income	762,341.92
Unpaid Issuer Expenses	—	Interest rec'd wrt to Securities sold by Issuer	—
Other Net Movements	0	Repo Receipts	762,341.92
Closing Balance*	60,640	Discount Payments (After Repo term.)	—
		Transfer Balance to Payment Account	1,650,413.23
		Closing Balance	—

*On Final Principal Pay Date, balance transferred to Payment Account

FIGURE 14.11 Bank account movements.

Figure 14.9 shows receipts of cash to the vehicle beginning with note proceeds on issue and then subsequent items such as repo interest. It also shows results of the 'Par Coverage Test', which shows if the vehicle has sufficient cash to cover liabilities at par, as well as cash flows resulting from credit events of any assets in the portfolio. These are marked 'A' and 'B' on Figure 14.9 for readers' reference.

Figure 14.10 shows the waterfall itself. We reference at 'A' where the value for the Class B-1 note interest distribution amount will fall, this amount is the payment of excess interest, after the application of interest and principal payments of A3 and Par coverage tests. The bottom half of the spreadsheet shows the remaining calculations required, for the junior note liabilities.

Finally, Figure 14.11 shows the cash flow movements in the vehicle's bank accounts at the time the calculation is made on the model.

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Structured Credit Products: Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

CHAPTER 15

Synthetic Conduits and Credit Derivative Funding Structures

In this final chapter we show how the concept of synthetic securitisation has been applied to other established structured finance vehicles. Conduits are vehicles that are set up to issue commercial paper on behalf of their sponsor, while 'repacks' are repackaging vehicles, set up to transform an existing asset or basket of asset into another form of liability.[1] We also show how synthetic structures have presented new opportunities for funding.

To set the discussion in the proper context, it is necessary to discuss the cash securitisation vehicles first, before considering how the synthetic version of these structures is put together.

COMMERCIAL PAPER CONDUITS

Commercial paper (CP) is a short-term money market funding instrument issued by corporates. Companies' short-term capital and working capital requirement is usually sourced directly from banks, in the form of bank loans. An alternative short-term funding instrument is CP, which is available to corporates that have a sufficiently strong credit rating. CP is an unsecured promissory note. The issuer of the note promises to pay its holder a specified amount on a specified maturity date. CP normally has a zero coupon and trades at a discount to its face value. CP is typically issued in bearer form, although some issues are in registered form.

[1] Actually, 'conduit' is another term for an SPV, and this author is at a loss to explain logically why a vehicle that issues asset-backed short-term paper is a conduit while one that issues asset-backed long-term paper is a collateralised debt obligation (CDO)! A repack is also effected through an SPV.

TABLE 15.1 Comparison of US CP and Eurocommercial CP.

	US CP	Eurocommercial CP
Currency	US dollar	Any Euro currency
Maturity	1–270 days	2–365 days
Common maturity	30–50 days	30–90 days
Interest	Zero coupon, issued at discount	Usually zero-coupon, issued at discount
Quotation	On a discount rate basis	On a yield basis
Settlement	T + 0, T + 1	T + 2
Registration	Bearer form	Bearer form
Negotiable	Yes	Yes

Originally the CP market was restricted to borrowers with high credit rating, and although lower rated borrowers do now issue CP, sometimes by obtaining credit enhancements or setting up collateral arrangements, issuance in the market is still dominated by highly rated companies. The majority of issues are very short term, from 30 to 90 days in maturity; it is extremely rare to observe paper with a maturity of more than 270 days or nine months. This is because of regulatory requirements in the US,[2] which states that debt instruments with a maturity of less than 270 days need not be registered. Companies therefore issue CP with a maturity lower than nine months and so avoid the administration costs associated with registering issues with the US Securities and Exchange Commission (SEC).

There are two major markets, the US dollar market and the Eurocommercial paper market. A comparison is given at Table 15.1

Commercial Paper Programmes

Although CP is a short-dated security, typically of 3- to 6-month maturity, it is issued within a longer term programme, usually for three to five years for euro paper; US CP programmes are often open-ended. For example, a company might arrange a 5-year CP programme with a limit of $100 million. Once the programme is established the company can issue CP up to this amount, say for maturities of 30 or 60 days. The programme is

[2]This is the Securities Act of 1933. Registration is with the Securities and Exchange Commission.

continuous and new CP can be issue at any time, daily if required. The total amount in issue cannot exceed the limit set for the programme. A CP programme can be used by a company to manage its short-term liquidity; that is, its working capital requirements. New paper can be issued whenever a need for cash arises, and for an appropriate maturity.

Issuers often roll over their funding and use funds from a new issue of CP to redeem a maturing issue. There is a risk that an issuer might be unable to roll over the paper where there is a lack of investor interest in the new issue. To provide protection against this risk, issuers often arrange a stand-by line of credit from a bank, normally for all of the CP programme, to draw against in the event that it cannot place a new issue.

There are two methods by which CP is issued, known as direct-issued or direct paper and dealer-issued or dealer paper. Direct paper is sold by the issuing firm directly to investors, and no agent bank or securities house is involved. It is common for financial companies to issue CP directly to their customers, often because they have continuous programmes and constantly roll-over their paper. It is therefore cost-effective for them to have their own sales arm and sell their CP direct. The treasury arms of certain non-financial companies also issue direct paper; this includes, for example, British Airways plc corporate treasury, which runs a continuous direct CP programme, used to provide short-term working capital for the company. Dealer paper is paper that is sold using a banking or securities house intermediary. In the US, dealer CP is effectively dominated by investment banks, as retail (commercial) banks were until recently forbidden from underwriting commercial paper. This restriction has since been removed and now both investment banks and commercial paper underwrite dealer paper.

ASSET-BACKED COMMERCIAL PAPER

During the 1980s and 1990s the rise in popularity in the use of securitisation as a means of diversifying bank liquidity led to the introduction of short-term money market paper backed by the cash flows from other assets, known as asset-backed commercial paper (ABCP). Vehicles through which ABCP is issued are usually called conduits. These issues paper backed by the cash flows from a specified assets, such as residential mortgages, car loans or commercial bank loans, as backing for an issue of bonds. The assets themselves are transferred from the original owner (the originator) to a specially created legal entity, the special purpose vehicle (SPV).

Generally, securitisation is used as a funding instrument by companies for three main reasons: it offers lower cost funding compared with traditional bank loan or bond financing; it is a mechanism by which assets such as corporate loans or mortgages can be removed from the balance sheet, thus improving the lender's return on assets or return on equity ratios; and it increases a borrower's funding options. When entering into securitisation, an entity may issue term securities against assets into the public or private market, or it may issue CP via a special vehicle known as a conduit. These conduits are usually sponsored by commercial banks.

Entities usually access the CP market in order to secure permanent financing, rolling over individual issues as part of a longer term programme and using interest rate swaps to arrange a fixed rate if required. Conventional CP issues are typically supported by a line of credit from a commercial bank, and so this form of financing is in effect a form of bank funding. Issuing ABCP enables an originator to benefit from money market financing that it might otherwise not have access to because its credit rating is not sufficiently strong. A bank may also issue ABCP for balance sheet or funding reasons. ABCP trades exactly as conventional CP. The administration and legal treatment is more onerous, however, because of the need to establish the CP trust structure and issuing SPV. The servicing of an ABCP programme follows that of conventional CP and is carried out by the same entities, such as the 'Trust' arms of banks; for example, Deutsche Bank and Bank of New York.

Example 15.1 details a hypothetical ABCP issue and typical structure.

EXAMPLE 15.1 ILLUSTRATION OF ABCP STRUCTURE

In Figure 15.1 we illustrate a hypothetical example of a securitisation of bank loans in an ABCP structure. The loans have been made by ABC Bank plc and are secured on borrowers' specified assets. They are denominated in sterling. These might be a lien on property, cash flows of the borrowers' business or other assets. The bank makes a 'true sale' of the loans to an SPV, named Claremont Finance. This has the effect of removing the loans from its balance sheet and also protecting them in the event of bankruptcy or liquidation of ABC Bank. The SPV raises finance by issuing CP, via its appointed CP dealer(s), which is the Treasury desk of MC investment bank. The paper is rated A-1/P-1 by the rating agencies and is issued in US dollars. The liability of the CP is met by the cash flow from the original ABC Bank loans.

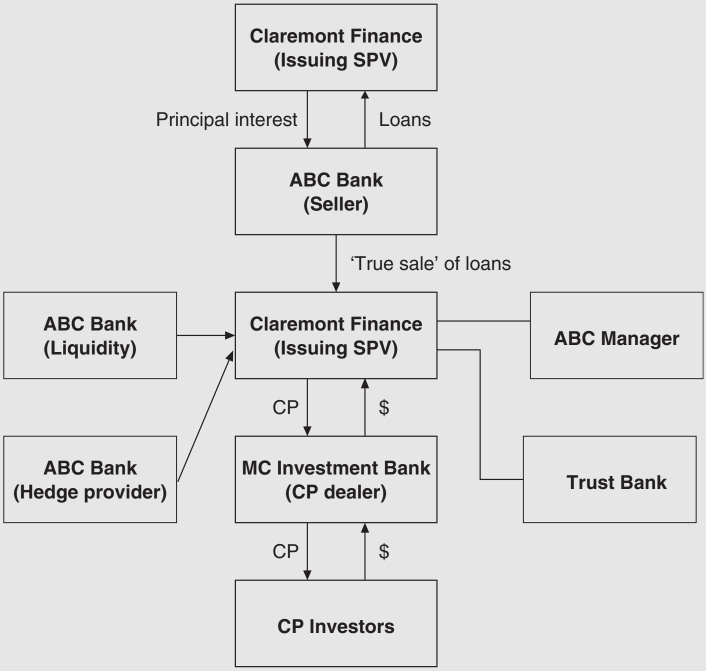


FIGURE 15.1 Claremont finance ABCP structure.

ABC Manager is the SPV manager for Claremont Finance, a subsidiary of ABC Bank. Liquidity for Claremont Finance is provided by ABC Bank, who also act as the hedge provider. The hedge is effected by means of a swap agreement between Claremont and ABC Bank; in fact, ABC will fix a currency swap with a swap bank counterparty, who is most likely to be the swap desk of MC investment bank. The trustee for the transaction is Trust Bank Limited, who act as security trustee and represent the investors in the event of default.

The other terms of the structure are as follows:

Programme facility limit:	\$500 million
Facility term:	The facility is available on an uncommitted basis renewable annually by the agreement of the SPV manager and the security trustee. It has a final termination date five years from first issue.

(continued)

Tenor of paper:	Seven days to 270 days
Prepayment guarantee:	In the event of prepayment of a loan, the seller will provide Claremont Finance with a guaranteed rate of interest for the relevant interest period.
Hedge agreement:	Claremont Finance will enter into currency and interest rate swaps with the hedge provider to hedge any interest rate or currency risk that arises.
Events of default:	Under event of default the issuance programme will cease and in certain events will lead to Claremont Finance to pay loan collections into a segregated specific collection account. Events of default can include non-payment by Claremont Finance under the transaction documentation, insolvency or raking of charge (where the charge ceases to be a first ranking charge over the assets of Claremont Finance.
Loans guarantee:	Loans purchased by Claremont Finance will meet a range of eligibility criteria, specified in the transaction offering circular. These criteria will include requirements on currency of the loans, their term to maturity, confirmation that they can be assigned, that they are not in arrears and so on.

EVOLUTION OF ABCP PROGRAMMES

Once the basic premise that assets may be securitised to provide cash flow backing for an issue of liabilities (debt financing), there is in principle no significant difference between this process being used to originate short-term paper in the form of CP or long-term paper in the form of bonds such as ABS. A key difference between CP and ABS is of course the shorter time required for refinancing with the former: a CP issuer must roll over paper a maximum of every 270 days (or 364 days with euro-CP). As with conventional CP programmes, as paper matures it is redeemed with the proceeds of a roll-over issue. If for any reason a roll-over issue cannot be placed in the market (for example, there is a market correction and investor confidence disappears, or the issuer suffers a credit rating downgrade), the issuer will need to call on a bank loan of credit to repay investors. This line of credit is known as a liquidity facility. The liquidity facility acts as a form of credit enhancement to investors, providing comfort that in the last resort, there will be sufficient funds available to repay them. Another form of credit enhancement is over-collateralisation, which is when (say) 115% worth of assets are used as securitisation backing for issue of 100% nominal of paper.

ABCP conduits have followed the evolutionary path thus:

First generation:	A fully supported programme backed by 100% Letters-of-Credit (LOC) from sponsor banks
Second generation:	Partially supported programmes with multi-asset backing, with 100% bank LOC and 10–15% credit enhancement
Third generation:	Security arbitrage vehicles that are unsupported by bank LOCs and have minimal credit enhancement. These conduits issue both CP and medium-term notes (MTNs), so are also known as structured investment vehicles (SIVs)
Fourth generation:	Multi-asset conduits also viewed as finance companies in their own right, with credit ratings based on quality of underlying assets. There is no bank LOC and the companies invest in high-quality assets and project finance programmes. Credit enhancement in SIV-type structures may take the form of subordinated notes and capital notes or 'equity'.

Figure 15.2 on page 540 shows a single-seller ABCP structure.

A single-seller conduit is established for the sale of assets originated by one entity. Typically it is 100% supported by a bank liquidity facility and by 10% credit enhancement. The liquidity provided is usually required by the credit ratings agencies to have a short-term rating of A-1/P-1/F.

A multi-seller conduit would have more than one seller into the conduit SPV.

Structural Development

During 2001 and 2002 new structures were observed in the market that built on the first- and second-generation conduits first introduced. These focused on arrangements that reduced the need for bank liquidity support, and set up alternative sources of liquidity and credit enhancement. This was a response to the increasing difficulty in arranging traditional liquidity; for instance, the number of banks rated A-1/P-1 was in decline, banks were conserving their liquidity lines, investors were demanding higher return to reflect the true level of risk involved in these vehicles, and the growing popularity of conduits themselves made liquidity more expensive.

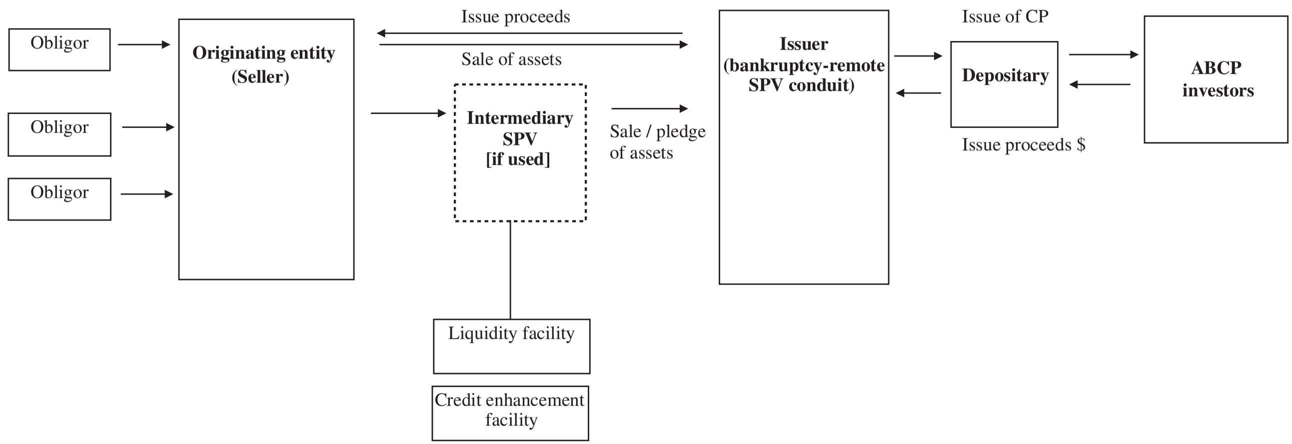


FIGURE 15.2 Single-seller ABCP conduit structure.

The newer generation of conduits featured alternative sources of liquidity including:

- capturing liquidity from the underlying assets, through matching asset/liability profiles, and capturing the excess spread between assets and liabilities;
- using non-bank liquidity providers, such as highly rated entities;
- using investors as proxy liquidity providers, through issue of extendible notes and structured liquidity notes, and through issue of long-dated MTNs;
- use of derivative structures, such as TRSs, credit default swaps (CDSs) and credit-linked notes (CLNs);
- using mono-line insurance firms to provide support backing to the conduit.

Vehicles such as arbitrage conduits and SIVs have much lower levels of credit enhancement, typically ranging from 0%–4% rather than to 10%–15%.

Another development in the US and euro-CP market is floating-rate CP. Unlike traditional CP, which is discount paper, this is issued as interest-bearing CP at par. The paper is rolled typically at 1-month or 3-month LIBOR reset dates. Interest is paid to investors at each LIBOR reset date. Floating-rate paper is preferred by issuers to discount CP if they are expecting short-term interest rates to fall.

The newer vehicles securitise a wider range of assets, including equities and synthetic structures. We consider the synthetic ABCP conduit next.

The Synthetic ABCP Conduit

A development in conduits using credit derivatives is the synthetic structure. Exactly as with synthetic structured credit products, this uses credit derivatives to make an economic transfer of risk and exposure between the originator and the issuer, so that there is not necessarily a sale of assets from the originator to the issuer. We describe synthetic conduits by means of a hypothetical transaction, 'Golden Claw Funding', which is a TRS-backed ABCP structure.

EXAMPLE 15.2 HYPOTHETICAL CASE STUDY: GOLDEN CLAW FUNDING

Figure 15.3 is a structure diagram for a synthetic ABCP vehicle that uses TRSs in its structure. It illustrates a hypothetical conduit, Golden Claw Funding Ltd, which issues paper into both the US CP market

(*continued*)

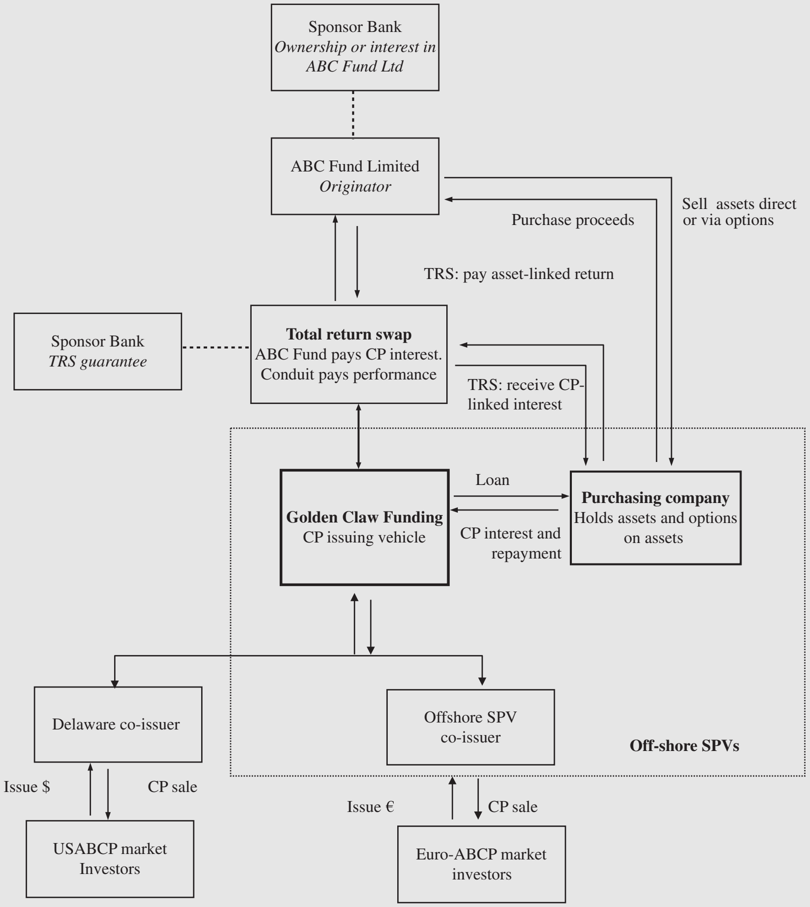


FIGURE 15.3 Synthetic ABCP conduit, hypothetical deal 'Golden Claw Funding'.

and the Euro CP market. It has been set up as a funding vehicle, with the originator accessing the CP market to fund assets that it holds on its balance sheet. The originator can be a bank, non-bank financial institution such as a hedge fund, or a corporate. In our case study the originator is a hedge fund called ABC Fund Limited.

The structure shown at Figure 15.3 has the following features:

- the CP issuance vehicle and SPV 2 are based offshore at a location such as Jersey, Ireland or Cayman Islands;

- the conduit issues CP in the USD market via a co-issuer based in Delaware. It also issues euro-CP via an offshore SPV;
- proceeds of the CP issue are loaned to SPV 2, which uses these funds to purchase assets from the originator. As well as purchasing assets directly, the vehicle may also acquire an 'interest' in assets that are held by ABC Fund Limited via a contract for difference option called a zero-strike call (ZSC). (We describe ZSCs in Example 15.3.) If assets are purchased directly on to the balance sheet of SPV 2, this is akin to what happens in a conventional ABCP structure. If interests in the assets are acquired via a ZSC, then they are not actually sold to SPV 2, and remain on the balance sheet of ABC Fund Limited. Assets can be bonds, structured finance bonds, equities, mutual funds, hedge fund shares, convertible bonds, synthetic products and private equity;
- simultaneously as it purchases assets or ZSCs on assets, SPV 2 enters into a TRS contract with ABC Fund Limited, under which it pays the performance on the assets and receives interest on the CP proceeds it has used to purchase assets and ZSCs. The TRS is the means by which ABC Fund retains the economic interest in the assets it is funding, and the means by which SPV 2 receives the interest it needs to pay back to Golden Claw as CP matures;
- the issue vehicle itself may also purchase assets and ZSCs, so we show at Figure 15.3 that it also has a TRS between itself and ABC Fund Limited.

We reproduce the term sheet for the TRS contract below. This states that the notional value and maturity of the TRS matches those of the CP issue.

The Golden Claw structure is a means by which funds can be raised without a true sale structure. The TRS is guaranteed by the sponsor bank, so will ensure that the conduit is rated at least at the short-term rating of the sponsor bank. As CP matures, it will be repaid with a roll-over issue of CP, with interest received via the TRS contract. If CP cannot be rolled over, then the PC or the issuer will need to sell assets or exercise ZSCs in assets to repay principal, or otherwise the TRS guarantor will need to cover the repayment.

EXAMPLE 15.3 ZERO-STRIKE CALL

A zero-strike call (ZSC) is a call option with strike price set at zero. It is written on an underlying asset such as a bond or shares in a hedge fund, and is sold at par. It is essentially a means by which an interest in illiquid assets can be transferred to a customer. Consider the two following examples showing how ZSCs might be used:

- Buying a ZSC: a hedge fund of funds wishes to acquire an interest in assets that are not on its balance sheet. It buys a ZSC from a hedge fund that holds the assets, who writes the ZSC. If the asset appreciates in value, the gain is realised by the hedge fund of funds.
- Selling a ZSC: a hedge fund of funds holds assets on its books, which a client (investor) wishes to acquire an interest in. The fund of funds writes a ZSC to the investor, enabling the investor to acquire an interest in the assets.

These examples are illustrated at Figure 15.4.

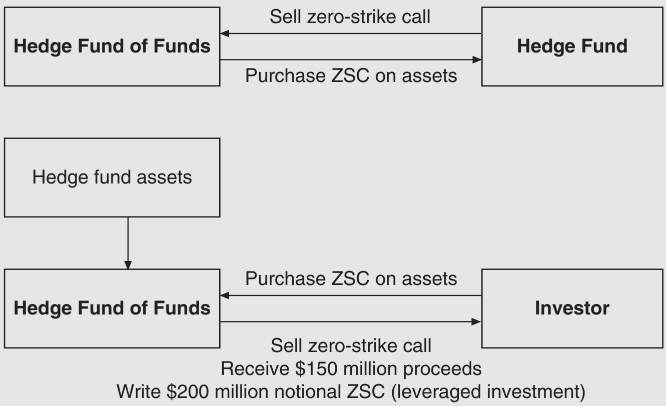


FIGURE 15.4 Zero-strike call options.

Frequently, the ZSC is transacted as part of a leveraged investment play, so that in the example above described as 'selling a ZSC', the fund of funds will invest its own funds in a leveraged proportion to those of the client. For example, for every $25 invested by the client, the fund of funds will invest $75, as part of a notional $100 investment in a ZSC option.

Synthetic ABCP Conduit: Example TRS Term Sheet

To illustrate the terms of the TRS used in the Golden Claw Funding Limited hypothetical case study, we produce below an example of what the term sheet for the TRS contract might look like. This describes the terms of the TRS used in the structure and has been produced for the Sponsoring Bank that is the guarantor to the TRS.

ABC FUND LIMITED

Golden Claw Funding Limited

Total Return Swap Term Sheet

Programme Summary Golden Claw is set up to raise money in the US CP and Euro CP market. It will lend this money to Golden Claw Purchase Company (PC). PC will buy assets such as bonds or equities from ABC Fund Limited. Golden Claw PC simultaneously enters into a TRS contract with ABC Fund Limited. The TRS contract is the means by which ABC Fund Limited retains the price risk of the assets. Via the TRS, Golden Claw PC will transfer the return on the assets to ABC Fund Limited, and receive sufficient interest from ABC Fund Limited to pay Golden Claw the interest on maturing CP. The mark-to-market on the TRS will be set in line with CP repayment dates. The TRS payments are guaranteed by the Sponsor Bank.

General Terms	A TRS is entered into between Golden Claw PC and ABC Fund Limited. One leg of the TRS pays the performance of the underlying assets, while the other leg will pay the maturing CP interest. These payments are made two days after the TRS reset dates, which coincide with the CP issue maturity date. A TRS is entered into simultaneously each time CP is issued. The notional value of each TRS will be equivalent to the outstanding nominal value of each CP issue. The maturity of the TRS will match the maturity of the CP issue.
Assets	Each of the Issuers and each PC will own a portfolio of assets of a particular type. Initially, the types of assets will include debt securities, equity securities and hedge fund investments (including zero strike calls relating to such investments).

Total Return Swaps	The Issuer and the PC will enter into a TRS ('Swap') with the Swap Counterparty (as defined below). The aggregate amount paid to the Issuer or PC under the Swap shall be sufficient to pay: (a) the interest payable on the CP issued to fund the related Assets through maturity and (b) expenses of the Issuer or the PC, including the fees of the Issuer's or PC's agents, taxes, rating agency and legal fees. All payments received in relation to the Assets held by the Issuer or the PC will be paid to the related Swap Counterparty. Each Swap Agreement may also provide for periodic transfer (a) by the Issuer or the PC to the Swap Counterparty of market value increases of the related Assets and (b) by the Swap Counterparty to the Issuer or the PC, of market value decreases of the related Assets.
Swap counterparty	[tbc]
TRS Bookings	The Issuer or PC will enter into a TRS with ABC Fund Limited under which the Issuer or PC will (a) pay the performance on the TRS reference asset to KBC Bank and (b) receive proceeds equivalent to maturing CP interest and costs. ABC Fund Limited will enter into a TRS with the Issuer or PC under which it will (a) pay proceeds equivalent to maturing CP interest and other costs, and (b) receive the performance on the TRS reference assets. The notional value of the Swap will be equal to the nominal value of outstanding CP. A Swap will be written each time there is an issue of CP. Net payments will be exchanged on Swap payment dates (value two days after Swap reset date), which will coincide with CP maturity payment date and Swap maturity.
Issue Mechanics	Golden Claw will issue CP on Trade date for settlement on T + 2. Simultaneously, on T + 0 PC will (a) enter into a loan with Golden Claw for the CP settlement proceeds, value date T + 2, loan to expire on CP maturity date; (b) will transact to purchase assets to the value of the loan from ABC Fund Limited, or ZSCs written on assets held by ABC Fund Limited, for asset delivery to PC on T + 2; (c) will enter into a TRS agreement with ABC Fund Limited, for value date T + 2, for the nominal value of the CP issue. The TRS reset date will be two days prior to CP

maturity. ABC Fund Limited will pay CP interest and receive asset performance on this Swap.

On T + 0 ABC Fund Limited will enter into a TRS with PC for nominal value of CP issue, for value T + 2. PC will pay asset performance and receive CP maturing interest on this Swap.

The term sheet describes the mechanics of the swap arrangement for the synthetic asset-backed CP structure.

Essentially, the TRS is the means by which the conduit can be used to secure LIBOR-flat based funding for the originator, as long as payments under it are guaranteed by a sponsor or guarantor bank. Alternatively, the originator can arrange for a banking institution to provide a standby liquidity backup for the TRS in the event that it cannot roll over maturing CP. This service would be provided for a fee.

EXAMPLE 15.4 'GOLDEN CLAW' SYNTHETIC ABCP CONDUIT CASH FLOW MECHANICS

Assume the first issue of CP by the Golden Claw structure. The vehicle issues \$100 nominal of 1-month CP at an all-in price of \$99.50. These funds are lent by the vehicle to its SPV 2, which uses these funds to buy \$99.50 worth of assets synthetically from ABC Fund, in the form of par-priced options referenced to these assets. Simultaneously it enters into a TRS with ABC Fund, for a nominal amount of \$100.

On CP maturity, assume that the reference assets are valued at \$103. This represents an increase in value of \$3. ABC Fund will pay this increase in value to SPV 2, which would then pay this, under the terms of the TRS, back to ABC Fund (in practice, this cash flow nets to zero so no money actually moves). Also under the terms of the TRS, ABC Fund pays the maturing CP interest of \$0.50, plus any expenses and costs of Golden Claw itself, to the purchase company, which in turn pays this to Golden Claw, enabling it to repay CP interest to investors. The actual nominal amount of the CP issue is repaid by rolling it over (re-issuing it).

If for any reason CP cannot be rolled over on maturity, the full nominal value of the CP must be paid under the terms of the TRS by ABC Fund to the purchase company.

SYNTHETIC REPACKAGING STRUCTURES

Repackaging structures or 'repacks' were introduced in the cash securitisation market first, before also becoming a feature of the synthetic markets. In its simplest form, a repack is an underlying security or group of securities that have been packaged-up and transformed into a new note or class of notes that are more attractive to investors than the original securities. This may have been done because the original security has become illiquid or otherwise not tradable.[3] Repacks were originally classed as 'single-asset' or 'multi-asset' repacks according to how many underlying securities they represented. Multi-asset repacks may be considered prototype CDOs.

In the synthetic market, investment banks have also structured repacks using credit derivatives. Often this will be to transform a particular feature of an existing bond (or bonds) in ways other than to make it more attractive to new investors; for example, to transfer an existing credit exposure or to reduce balance sheet capital requirement. In other words, synthetic market repacks make use of the credit derivatives market to hedge out risk exposure on other bonds, which are frequently also structured products.

Synthetic Repack Motivations

A synthetic repack uses funded or unfunded credit derivatives in its structure. It may be originated for the following reasons:

- by an investment bank that is tasked with making an asset 'tradable' again;
- by a broker-dealer to transform a current interest rate or credit risk exposure;
- by a portfolio manager looking to extract value from assets currently held on the balance sheet or assets in the market that are trading below fair value.

The assets in question are often existing structured finance securities, such as CDO notes or CLNs. Hence, if the repack vehicle SPV issues securities this will be a repack of securities issued by another SPV. As a result, a repack structure is usually similar in certain respects to a synthetic CDO and often targeted at the same class of investors.

[3]For instance, one of the first repacks was of Japanese convertible bonds. With the bear market in Japanese equities during the 1990s, these became illiquid as they no longer were attractive to investors. Individual convertibles or groups of convertibles were packaged up, often with an enhanced coupon or additional new feature of attraction, and sold on to new investors.

EXAMPLE DEAL STRUCTURE

To illustrate the mechanics of a synthetic repack, we present a hypothetical transaction that is a repack of a synthetic CDO. The repack has been structured by an investment bank, ABC Securities Limited, to hedge a position it holds in the junior tranche of a CDO. Through this transaction the bank hedges the credit risk exposure in its existing holding, while also meeting the needs of client investors who seek an exposure to the risk-reward profile the repack represents.

It is necessary to describe first the original synthetic CDO deal. We then consider the motivation behind and structure of the repack.

All names and situations quoted are of course hypothetical.

Synthetic CDO: Black Island Finance Ltd

The underlying CDO is a fully unfunded synthetic CDO ('Black Island Finance Ltd'). This is a CDO originated on a pool of 100% risk-weighted bank assets, with the credit risk and regulatory capital requirements of the assets transferred via a tranched series of CDSs to investors. Figure 15.5 shows the structure of Black Island Finance Ltd.

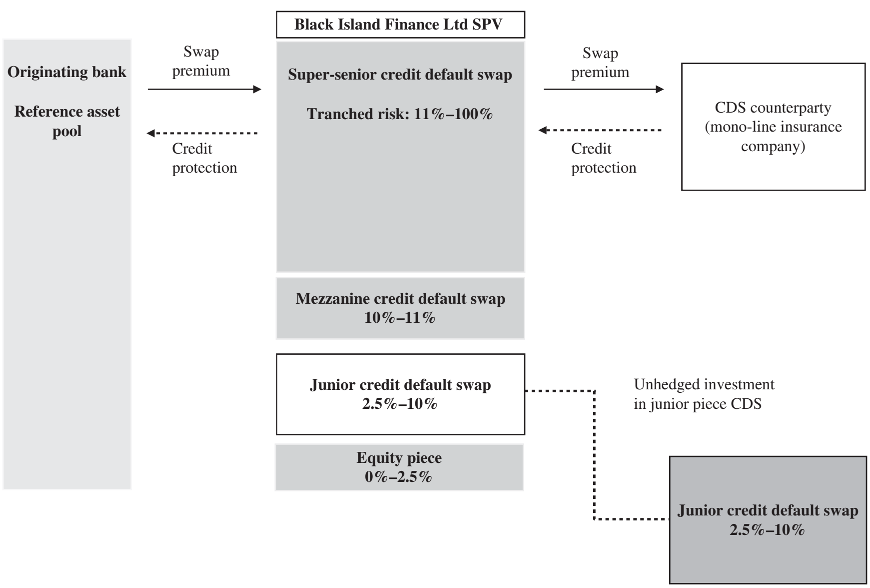


FIGURE 15.5 Black Island Finance, hypothetical unfunded synthetic CDO.

The liabilities of the CDO are split into a series of CDSs, which pay a premium based on their seniority. If there are any credit events among reference assets then the nominal amounts of the CDS contracts is reduced (thereby reducing the interest receivable by protection sellers) in order of priority. On issue, ABC Securities invests in the junior tranche of Black Island CDO. This represents the 2.5% to 10% tranche of risk in the reference pool. Assume it is at BBB level and so would represent this level of risk-return for the investor.

Later on in the deal life, ABC Securities Ltd decides to hedge its unhedged position in the 2.5%–10% risk piece of Black Island CDO. It also identifies a client requirement for a funded investment at a BBB-rated risk-return level. It therefore structures a repackage vehicle; let us call it Red Sea Finance Limited to meet this client requirement while simultaneously hedging its exposure in Black Island CDO.[4]

Synthetic Repackage Vehicle: Red Sea Finance Ltd

The purpose of Red Sea Finance Ltd is to hedge out the ABC Securities Ltd exposure in Black Island Finance CDO, which is a position in the junior CDS of that deal. The client order, however, is for a funded position. Red Sea Finance Ltd is set up to repackage the exposure, thus transforming it from a CDS into a CLN. An SPV is set up to issue the CLN to the investor. The liabilities of Red Sea CDO are the single CLN; that is, there is no tranching. This is placed with the client investor. The proceeds of the note issue are invested in eligible investments, which are risk-free securities. These are repo'd out with a bank and act as a reserve against losses suffered due to credit events in Black Island CDO.

The structure diagram for Red Sea Finance Ltd CDO is shown at Figure 15.6 on page 551.

By structuring its holding via a synthetic repack, ABC Securities has transferred its credit risk exposure in its initial investment, while also meeting the needs of its client.

SYNTHETIC FUNDING STRUCTURES

Investment banks are increasingly turning to offshore synthetic structured solutions for their funding, regulatory capital and accounting treatment requirements. We saw in Chapter 5 how TRSs could be used to obtain

[4]The author has no qualms to admit that he is a keen fan of the works of Georges Remi, in particular *The Adventures of Tintin* . . .

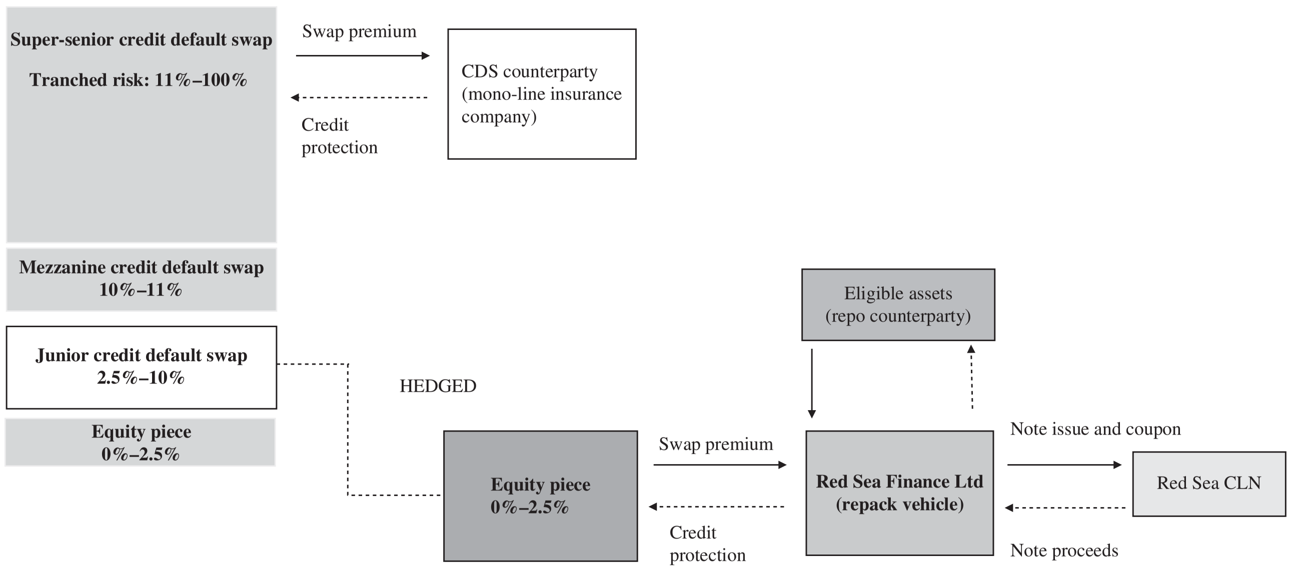


FIGURE 15.6 Red Sea Finance Ltd, hypothetical synthetic repack vehicle.

off-balance sheet funding of assets at close to LIBOR, and earlier in this chapter we saw how synthetic conduit structures can be used to access the asset-backed commercial market at LIBOR or close to LIBOR.[5] In this section we discuss synthetic structures that issue in both the CP and medium-term note (MTN) market, and are set up to provide funding for investment bank portfolios or reference portfolios of their clients. There are a number of ways to structure these deals, some using multiple SPVs, and new variations are being introduced all the time.

We illustrate the approach taken when setting up these structures by describing two different hypothetical funding vehicles.

Offshore Synthetic Funding Vehicle

A commercial bank or investment bank can set up an offshore SPV that issues both CP and MTNs to fund underlying assets that are acquired synthetically. We describe this here, as 'Long-term Funding Ltd'.

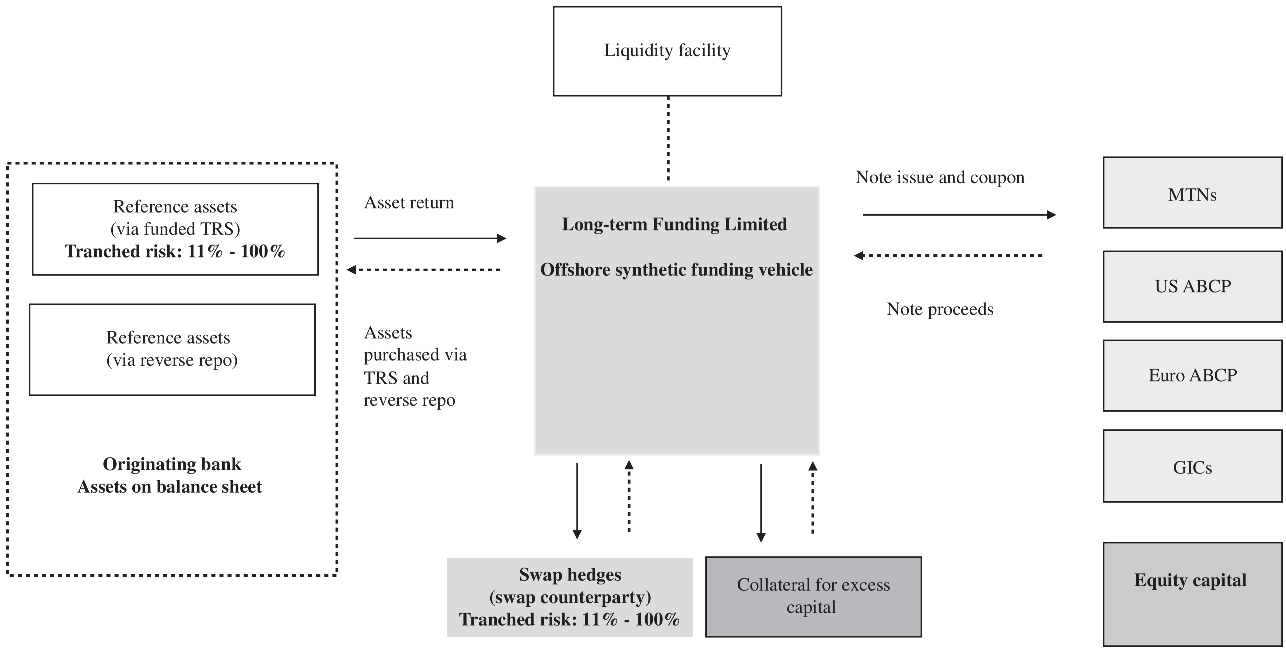
Assume an investment bank wishes to access the CP and MTN markets, and borrow funds at close to LIBOR. It sets up an offshore SPV, Long-term Funding Limited, which has the freedom to issue the following liabilities as required:

- commercial paper;
- medium-term notes;
- guaranteed investment contracts (GICs); these are deposit contracts that pay either a fixed coupon to lenders or a fixed spread over LIBOR;
- repo agreements.

These liabilities are used to fund the purchase of assets that are held by the investment bank. These assets are purchased synthetically via TRS contracts or sometimes in cash form as a reverse repo trade. The vehicle is illustrated at Figure 15.7 on page 553.

The vehicle is structured in such a way that the liabilities it issues are rated at A-1/F-1 and Aaa/AAA. It enables the originating bank to access the money and capital markets at rates that are lower than it would otherwise obtain in the inter-bank (unsecured) market. The originator invests its own capital in the structure in the form of an equity piece. At the same time, a liquidity facility is also put in place, to be used in the event that the vehicle is not able to pay maturing CP and MTNs. The liquidity facility is an additional factor that provides comfort to the rating agencies.

[5]For more information on ABCP, see Choudhry (2004b).



Vehicle capital structure
MTNs maximum $5,000 million (Aaa/AAA)
USCP maximum $4,000 million (A-1/F-1)
ECP maximum $1,000 million (A-1/F-1)

FIGURE 15.7 Long-term Funding Ltd, offshore synthetic funding vehicle.

The types of assets and liabilities that can be held are described below.

Underlying Reference Assets The vehicle's asset structure is composed of mainly synthetic securities, accessed using funded TRS contracts. However, to retain flexibility the vehicle is also able to bring in assets in cash in the form of reverse repo transactions.

Possible types of assets that can be 'acquired' by Long-term Funding Ltd include:

- short-term money market instruments rated AAA;
- bullet corporate bonds rated from AAA to BB;
- structured finance securities including ABS, residential mortgage-backed securities (RMBS) and commercial mortgage-backed securities (CMBS securities rated from AAA to BB;
- government agency securities such as those issued by Ginnie Mae, Fannie Mae and Freddie Mac, as well as Pfandbriefe securities;
- secondary market bank loans and syndicated loans rated at AAA to BBB.

Reference assets can be denominated in any currency, and currency swaps are entered into to hedge currency mismatch as the vehicle only issues liabilities in US dollars and euros.

As well as the quality of the underlying reference assets, the credit rating of the TRS and repo counterparties is also taken into consideration when the liabilities are rated.

Liability Transactions Long-term Funding Ltd finances the purchase of TRS and reverse repos by issuing CP, MTNs and GICs. The interest rate risk that arises from issuing GICs is hedged using interest rate swaps.

The ability of Long-term Funding Ltd to issue different types of liabilities means that the originating bank can access funding at any maturity from 1-month to very long-term, and across a variety of sources. For instance, CP may be bought by banks, corporates, money market funds and super-national institutions such as the World Bank; GIC contracts are frequently purchased by insurance companies.

Multi-SPV Synthetic Conduit Funding Structure

One of the main drivers behind the growth of synthetic funding structures has been the need for banks to reduce regulatory capital charges.

While this has been achieved by setting up an offshore SPV that issues liabilities and references assets synthetically, recent proposals on changing accounting treatment for SPVs means that this approach may not be sufficient for some institutions.[6] The structure we describe here can reference an entire existing SPV synthetically; in effect, a synthetic transfer of assets that have already been synthetically transferred. The vehicle would be used by banks or fund managers to obtain funding and capital relief for an entire existing portfolio without having to move any of the assets themselves.

The key to the synthetic multi-SPV conduit is the CP and MTN issuance vehicle, which is a stand-alone vehicle established by a commercial or investment bank. This provides funding to an existing SPV or SPVs, and acquires the assets of the assets synthetically. The assets are deemed as being held within the structure and as such attract a 0% risk-weighting under Basel I.

The structure is illustrated at Figure 15.8. This structure has the following features:

- an offshore SPV that issues CP into the US and Euro markets;
- a synthetic purchase of the entire balance sheet of an existing SPV; the funds issued in the CP market are used to provide a funded TRS contract to the SPV whose assets are being funded;
- the customer realises funds and also retains the return on the assets; however, it benefits from reduced capital charge and no more necessity to mark-to-market the assets;
- the investment bank originator, and CP investors (in that order) offer to wear any losses on the reference portfolio due to credit events or default, and earn a fee income for setting up this facility;
- assets and additional SPVs can be added at any time;
- a liquidity facility is in place in the event that CP cannot be issued.

This structure is yet another example of the flexibility and popularity of credit derivatives and structured credit products created from credit derivatives, in the debt capital markets today.

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[6]We refer to new US accounting rules on consolidating SPVs that are not deemed truly arms-length. This was in response to the Enron episode, which uncovered the use of SPVs for less-than-savoury purposes. While we discuss a new synthetic structure that would enable banks to maintain separate accounting treatment for offshore companies, the subject of accounting treatment is outside the scope of this book.

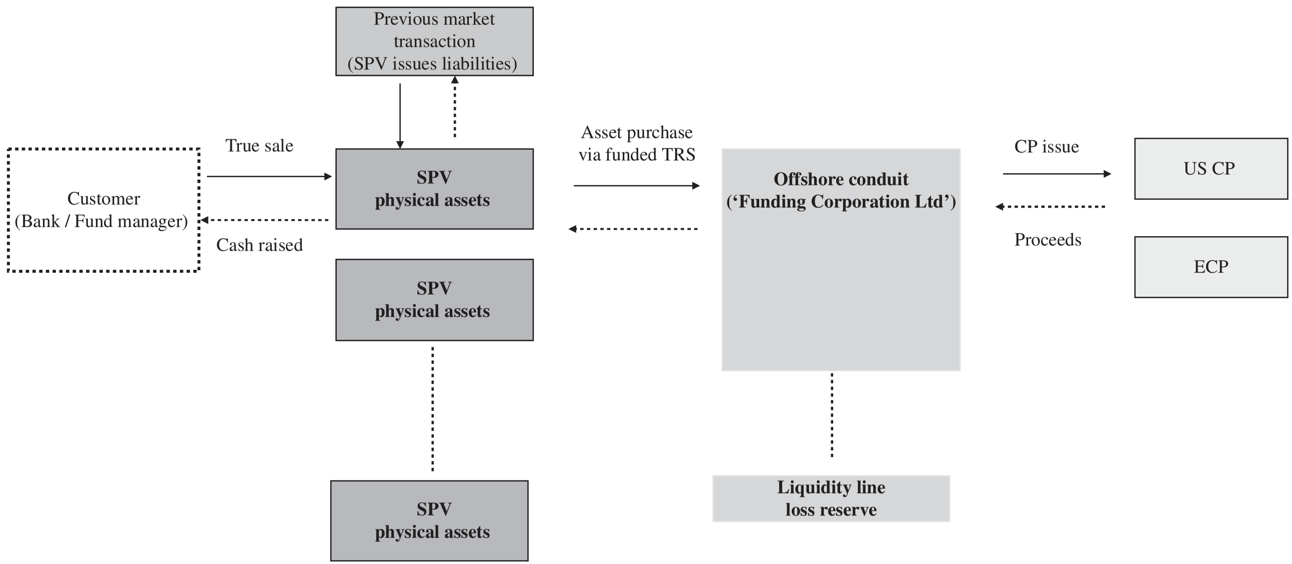

FIGURE 15.8 Multi-SPV offshore synthetic conduit funding structure.

CDS-LINKED TRS TERM FUNDING STRUCTURE

The 2007–2008 credit and liquidity crunch created severe funding pressures for all but the largest and most creditworthy banks such as HSBC, J.P. Morgan and Deutsche Bank. Most other banks sought to diversify funding sources to replace the tightening inter-bank market, and several approaches involved the use of credit derivative structures. We describe one such new structure here.

Figure 15.9 shows a CDS-linked term total return swap (TRS) funding arrangement, which was available from a number of large money-centre banks. It is described as follows:

- the investor purchases a rated bond (sovereign, corporate or ABS) or pool of illiquid assets in the form of an asset swap package; the investor pays the asset swap counterparty par for the package;
- simultaneously the investor and the dealer bank enter into a TRS to fund the asset purchase;
- the investor delivers the asset or pool of assets to the dealer bank under the TRS and receives par for it.

Under the TRS, the dealer bank returns all of the risks and rewards of the asset(s) to the investor. The investor pays the dealer bank the TRS financing leg until maturity, and repayment of the loan at maturity:

- on each coupon date, the investor receives from the dealer bank the actual coupon received by the holder of the cash asset;
- the investor pays the dealer bank the TRS financing payments on the asset purchase cash.

The maturity of the financing arrangement with the dealer bank matches that of the cash asset purchased by the investor. On maturity the

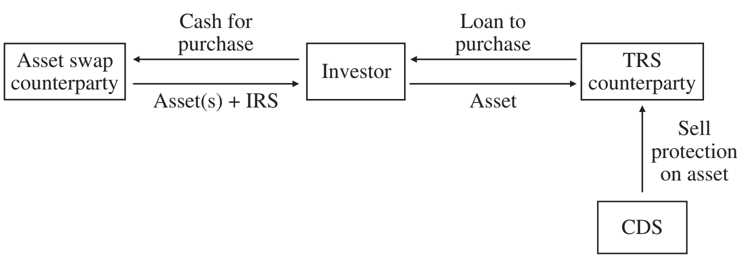

FIGURE 15.9 TRS funding structure.

cash proceeds of the cash asset is paid back to the investor under the TRS, which is used to repay the loan facility.

The structure can be terminated early at the investor's request or on the occurrence of credit event.

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Structured Credit Products: Credit Derivatives and Synthetic Securitisation, Second Edition
by Moorad Choudhry

PART III

CD-R

The final part of the book introduces and describes the files on the accompanying CD-R. These files cover three sets of data: teaching aids of Microsoft PowerPoint slides (in PDF format) that cover courses in credit derivatives and synthetic structured credit products; examples of ratings review reports of CDO transactions by Fitch and reproduced here with the kind permission of Fitch Ratings; and various Microsoft Excel files on CDS and CDO pricing and CDO diversity models. The next chapter describes the contents of the CD-R in detail.

CHAPTER 16

Files on the Accompanying CD-R

The CD-R at the back of this book holds a number of files that can be used by practitioners and lecturers in credit derivatives. These are detailed here.

CDO-NOTE: SYNTHETIC CDO NOTE PRICING MODEL[1]

Software Description

CDO-NOTE uses a one-factor Gaussian mathematical framework to price synthetic CDO note tranches. The software is extremely easy to use and comes with a full description of the model and its parameters. In addition, there is a step-by-step description on how to use the model and view and interpret the results. The software is meant to provide users with an affordable means to understand the dynamics of CDO pricing and default distributions. The software offers two representations:

1. A Monte Carlo approach to simulate correlated default times of portfolio credits and generate portfolio expected losses;
2. A recursive approach based on conditional default independence to produce the portfolio expected losses.

The two representations of the default process are equivalent under the Gaussian assumption and thus ought to produce the same results.

Each method has its pros and cons. The recursive approach, on the one hand, is extremely efficient and fast. On the other hand, the Monte Carlo approach is more flexible but slower. For example, the recursive approach is ill-suited for high levels of spreads and correlations above 70%. High

[1]This model was written by Jaffar Hussain.

levels of spreads and correlations are more appropriately handled by the Monte Carlo approach.

Algorithm Accuracy

The mathematical algorithms of the model have undergone extensive validity checks. The software provides the user with references to check the results of the software for themselves. In addition, the software provides a list of useful functions that appear in various papers on CDO pricing such as:

- functions for conditional default probabilities;
- functions to compute unconditional default probabilities and hazard rates implied by markets spreads and/or credit ratings;
- functions to compute implied survival probabilities;
- functions to compute market spreads implied from default probabilities.

An excellent source to validate the results of these functions is David Li's paper, 'On Default Correlation: a Copula Approach' (*RiskMetrics*™, April 2000). To validate the results of the pricing algorithm, we recommend the paper by Michael Gibson, 'Understanding the Risk of Synthetic CDOs' (Federal Reserve Board, July 2004). The software is capable of reproducing the results discussed in these papers to within a small estimation error. In addition, we have presented a paper by Jaffar Hussain that describes the mathematics of the software and presents examples on how to use the software for risk management of a synthetic CDO note. The paper can be viewed on www.yieldcurve.com.[2] The user can copy the results into other worksheets and a 'User Notes' sheet is provided for the user to perform other calculations.

Model Inputs/Outputs

The software requires the following input parameters; namely:

- the credit ID, market spread and recovery rate: this is required for each credit; however, only the spreads and recovery rates are necessary for pricing purposes. Spreads and recovery rates are used to calculate the default probabilities of the credits;

[2] An abridged version of this paper was given in Chapter 14.

- the user's view on default correlation: a flat asset correlation is used as a proxy for the level of default correlation. Please note, default correlations are usually much lower than asset correlations. The software is capable of producing the implied default correlations; however, this functionality is not provided to the user;
- the term structure of interest rates: the user can also assume a flat interest rate. The interest rates are used to discount portfolio losses;
- the tranche's attachment and detachment points, which determine the size of the tranche and the number of defaults it can withstand;
- the maturity of the transaction in years: the software doesn't incorporate payment frequencies of less than one year;
- the notional per credit;
- note: if the user wishes to use the Monte Carlo approach, then they will also need to input the number of desired simulations.

Following the input of the parameters above, the software will produce:

- the unconditional default distribution for each year; for example, for a 5-year synthetic CDO note, the software will show the five portfolio default distributions—one for each year;
- the conditional default distributions: the user can choose to view the conditional default distributions, which will show the portfolio default distribution for each realisation of the common market factor;
- the actual and discounted expected losses of the portfolio and the tranche analysis;
- the actual and discounted volatility or standard deviation of the portfolio and the tranche;
- the fair spread of the tranche;
- except for the fair spread calculation, which is only computed with the recursion method, all outputs are produced for both the recursive and Monte Carlo approach;
- the leverage of the tranche by providing the actual market price of the tranche being analysed;
- the implied default correlation: the model will generate the default correlation between credits 1 and 2. The default correlation is the correlation between the default times of the first two credits generated via the Monte Carlo approach. The flat correlation, on the other hand, is usually estimated from market data.

CDS PRICING SPREADSHEET[3]

The spreadsheet is provided in Microsoft Excel front end. Two versions are supplied, one as the basic model and the other with sample data added to demonstrate the calculation of the CDS curve.

To view the Visual Basic codes, go to the 'Visual Basic Editor' window. One accesses it from the menu: Tool->Macro->Visual Basic Editor or by clicking Alt+F11. In the left-hand side of the Visual Basic Editor window, there is a folder named 'VBAProject(CDSC0070412.xls)'. Double click it and one is asked to input a password. Enter the password: 123456 (which can be seen in the main sheet of the .xls file). One then observes the subfolders: Microsoft Excel Objects, Forms, Modules, and References. Most of the VB codes are in the 'Modules' subfolder, with the remainder in the 'Microsoft Excel Objects' subfolders.

DIVERSITY SCORE SPREADSHEETS

In Chapter 13 we described the Moody's diversity score, which is used by the rating agency as part of its ratings process to calculate the 'diversity' in a pool of assets. The CD-R holds three working Microsoft Excel spreadsheets that demonstrate the calculation of the diversity score for an actual pool of CDO assets.

The spreadsheets are:

- 'EuroCDO', a hypothetical deal closed in 2003. This model shows the diversity score on the actual portfolio of assets (which is also detailed);
- FINALTAIR CDO I B.V., an actual deal closed in December 2002. This model shows the portfolio concentration limitations, collateral quality and cash flow waterfall coverage tests. Again, the actual portfolio is also listed;
- XYZ CDO, a hypothetical deal closed in 2001. This is a simpler model demonstrating the diversity score calculation.

Readers can modify the second of the models above to incorporate a full cash flow waterfall for all the tranches of any ABS security.

FITCH RATING AGENCY REPORTS

For an understanding of the structuring and rating process of a structured credit product, we reproduce four Fitch ratings reports for different types of transaction. These are:

[3]This model was written by Zhuoshi Liu.

- Colonnade III: a partially funded synthetic CDO of ABS, a particularly complex and multi-faceted transaction of the type that is unlikely to be seen in the post-credit crunch era (the deal was closed in March 2007, at the height of the structured credit boom);
- Euclid CDO, a funded synthetic CDO closed in March 2007, managed by Deutsche Asset Management;
- Harvest CLO, a conventional cash leveraged loans CLO, closed in March 2007 and managed by Mizuho Investment Management;
- Pembridge Square Finance Limited, a complex hybrid synthetic CDO of ABS and corporate securities, closed in October 2006 and managed by KBC Financial Products. This transaction had weighted average credit rating of BBB that included some BB-rated assets. Following the 2007 financial crisis, it was typical of many CDO and SIV portfolios that suffered significant losses.

The reports are reproduced with the kind permission of Fitch Ratings.

STATIC SYNTHETIC CDO CASH FLOW WATERFALL MODEL

This is a working cash flow waterfall model for a hypothetical synthetic CDO, *Synthetic CDO Ltd,* with an issue size of $115 million. It was written by Suleman Baig and Moorad Choudhry. The note tranching to this transaction is given in the sheet, along with terms to the deal. The waterfall and associated calculations are on their own tabs in this spreadsheet. The definitions refer to a hypothetical offering circular (OC) for this transaction, which is not shown.

TEACHING AIDS: POWERPOINT SLIDES

We include in the CD-R a set of PDF format PowerPoint slides that can be used by lecturers and instructors for courses in credit derivatives, securitisation and CDOs. The set comprises slides on:

Lecture 1: Securitisation

Lecture 2: Cash CDOs

Lecture 2A: Basel regulatory capital

Lecture 3: Credit derivatives

Lecture 4: Synthetic CDOs

Lecture 4A: Synthetic CDO waterfall and diversity score
Lecture 5: Synthetic CDO pricing
Lecture 6: CLO structure analysis
Lecture 7: The credit rating process
Lecture 8: Impact of defaults on tranche implied rating
Lecture 9: Fitch revised CDO rating methodology

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AFTERWORD

Econometrics, Finance and Football . . .

MOORAD CHOUDHRY TALKS TO HARRY CROSS[1]

Are you an academic who dabbles in banking or a banker who does a bit of academia in his spare time?

That's easy! I'm an investment banker. I have been since I started out in 1989. There's no question that that's what I've always been and where my focus and expertise lies. But I'm happy to admit to more than a passing interest in the academic side of things, and I may well get into it formally later. I think working in both areas helps the practitioner, it assists creativity and innovation, and it makes one's approach to analysis more robust. But my experience and background is rooted in banking; besides, my publishing record in academic journals wouldn't do justice to a true academic!

[1] Graham 'Harry' Cross and Moorad Choudhry were part of Sean Baguley's gilt-edged market-making team at ABN Amro Hoare Govett during 1994–1996. Harry is now on the faculty of 7city Learning in London, where he lectures on fixed income and interest rate derivatives. He was speaking to the author in December 2008.

Are credit derivatives financial weapons of mass destruction, or tools that have helped to mitigate risk and assist in the disintermediation of markets?

Ha, ha! You're trying to start a debate going when really there isn't one. Investing using cash or synthetic is just two sides of the same coin, and while I could go on for hours about the beauty and elegance of the credit default swap (CDS), all I'll say is that having a liquid market in synthetic credit has made valuation and risk-reward assessment much more accessible and transparent compared to when we only had a cash market. The tail is now wagging the dog, and 11 years after I first wrote anything about credit derivatives we see that the market uses CDS prices for a true valuation of credit, not bond yields or asset swap spreads, and the cash-synthetic basis has become a very useful relative value indicator. The massive losses we've seen in banks who bought structured credit bonds isn't because the bonds are flawed, it's because the underlying assets defaulted. People lost a fortune in 1929 and other crises preceding that, and we didn't have derivatives of any kind then, let alone credit derivatives. I'm a big fan of them in principle . . . and in practice.

What tips would you give a student or youngster looking to get into investment banking?

Where to start?! First, remember that you're up against it, because there's a lot of competition for entry-level places in banks. It helps to have something that stands out on your CV. So, in no particular order, get a good degree, go to the best school you can and take a quantitative subject or something like business studies. A specialised degree like the ones from the ICMA Centre or Cass Business School is very worthwhile if you wish to work in banking. Languages, especially European ones, and nowadays Arabic, Hindi and Mandarin, are always useful. Finally, a published article (it doesn't have to be in the *Journal of Finance*—something I've not managed yet!) on a subject within Finance will help you stand out.

Then of course there are the interviews and assessments. Practice the arithmetic side of things, like the quant side of the GMAT, before any test days. And remember to charm the interviewer! This is a people business after all . . . at the end of the day, apply to as many banks as you can. If you aren't coming from a Top 10 university you are up against it so you need to add some strings to your bow.

How did you get into academic and textbook writing? I know that it wasn't when we were on the gilts desk at Hoare Govett!

Correct, it came after that! It was actually suggested to me by someone else—it wasn't my idea! I was out of the market after being made redundant when Hambros Bank was taken over by Soc Gen in 1997, and looking for ways to earn some income to help pay the rent when I saw an advert from the Securities Institute (my professional association) looking for trainers for their courses. I did a course for them in 1998, and one of the deliverables for the delegates was a 'course companion', which ended up being like a mini-textbook. The lady who organised the courses, Zena Doidge, suggested that I turn the course companion into a book; this had never occurred to me and when I asked how I should go about doing that she said it was no problem because the Institute had its own publishing arm! So it was easy to get it published . . . that book is now in its fourth edition with John Wiley & Sons. It kind of snowballed from there: I thought the market needed an accessible text on bonds, and then one on money markets and so on. I only consciously decided to stop last year with my book *Bank ALM*, but then came out of 'retirement' because I wanted to update my credit derivatives book—the market moves so fast that I thought the book deserved a revamp!

So in other words, never say never . . . !

Yes, indeed, if we can paraphrase James Bond . . . I'll never say never again! ☺

When and where do you usually read finance and other textbooks?

That's easy, at home. There isn't really the time to read them at work, whereas at home one can get into a text quite easily. When I first got to the City there didn't seem to be a culture of learning from books, it seemed to be all on-the-job training on the desk, so to speak. Even on the trading desk, there didn't seem to be any formal training as such. That's all changed in banks now, and there is a strong emphasis on classroom courses and textbook learning. But back in my time that influence wasn't there, so I found myself getting into it in my own time, at home. The research for my Doctorate was quite specialised (as one would expect) and econometrics-based, so it didn't apply so much to the day job, but the reading around it did.

At the end of the day there is no downside to learning, even if it's only connected to your day job on the periphery.

What finance texts are you currently reading?

None right now, I'm taking a break! I got Professor Carol Alexander's multi-volume boxed set on risk management this month, but haven't had a chance to read it yet . . . Professor Fabozzi's *Handbook of Finance*, which I contributed to, was just delivered to me, but that one won't get opened, I'll just look at it! ☺

Who are your favourite finance writers?

There are some quality authors out there. Real legends. One of my earliest texts, which I borrowed off a fellow graduate trainee when I was at Hoare Govett Securities in 1992, was *Financial Market Analysis* by David Blake. It's actually quite a dry text but it did the job and I have used it a lot; he did a second edition in 2000 that was 10 years after the first edition! I never saw another book by Professor Blake, though. I like Sheldon Ross on probability, his derivation of the bond price equation was the most accessible I'd seen anywhere. I also liked Mark Rubinstein's book *Rubinstein on Derivatives*, again a very accessible treatment of a complex subject, and Professor Jarrow's book on modelling fixed income securities (especially the first two chapters. That gave me all I needed to know to proceed!). I've always liked authors who make the effort to present technical or quantitative material in a reader-friendly way.

Kenneth Garbade's book *Fixed Income Analytics* was a real eye-opener for me. I had it on the desk when I was at Hambros Bank where I was setting up a gilts proprietary desk there. It's totally brilliant on bond analysis and very accessible; anyone working in fixed income should read that. I got in touch with him a few years later and he wrote the foreword to my book, *Derivative Instruments*, which was very kind of him. I really appreciated that. Jonathan Ingersoll's coverage of yield curve modelling is always worth a read, as is Campbell, Lo and Mackinlay's book *The Econometrics of Financial Markets*. That is a totally fab book! It is always worth getting to grips with the econometrics behind yield curve modelling, it helps put things in perspective. Carol Alexander's book on market models is amazing, so comprehensive . . . she writes brilliantly. Totally brilliant.

Galen Burghardt's book on the Treasury bond basis is a very high-quality book, for its insight into fixed income and interest rates. One doesn't need to be into basis trading to get something out of his book, it's worthwhile reading for anyone in bond markets. Another quality book on fixed income is the one by Professor Suresh Sundaresan, now in its second or third edition. It is very nicely written. Add that in with Simon Benninga's book *Financial Modelling*, with its Excel hints and tips, and you have a nice set to get started with right away.

Professor Duffie's books are world-renowned and rightly so, but I will freely admit that the maths in them is a bit over my head!

Of course, the absolute daddy of them all is Professor Frank Fabozzi—I mean, who doesn't have at least one Fabozzi title on his or her shelf? I had his book *Bond Markets: Analysis and Strategies* with me on the desk at

Hoare Govett Securities back in 1992, and years later, after I'd begun working with him, I met him and got him to sign that copy. I had the second or third edition, by that time it was out in its sixth or seventh edition I think! An absolute demon, rightly a legend—he really influenced me a lot and inspired me to work harder on whatever I was doing. His books with Professor Steven Mann are also very high quality.

I liked Brian Eales *Financial Risk Management* because of his accessible writing style, and later co-wrote a book with him. Lionel Martellini and Philippe Priaulet are demon authors with classic Gallic style, and finally check out Tom Windas' text from 1993, it's brilliant because he shows how to write in a way that makes complex subjects accessible.

Have any of their books changed your life?

Well I guess seeing all these top-quality writers out there in the market made me think I wanted to produce something of value, something that the market wanted to see updated on a regular basis, just like Professor Fabozzi's books get updated regularly, and so I got into the whole business of writing texts in as accessible a fashion as I could. As book writing takes a lot of time, yes I suppose one could say that reading them changed my life! For the better I might add . . . ☺

If you had to pick one, which book influenced you most?

Probably David Blake's book, just because it got me into a mindset of wanting to know more about financial instruments . . . and I've been learning ever since!

Do you think it helps practitioners if they get into textbook writing?

That depends what you mean by 'helps' . . . helps them in what way? A co-authored book of mine, *Capital Market Instruments*, which was published by FT Prentice Hall, helped one of the authors move into investment banking—after it came out he sent it to someone he knew who worked in structured finance and they gave him an interview. He's been in the market ever since. So it did help him in a way, I suppose. I think one shouldn't necessarily see it as a career-enhancing thing, although it might well be, and there is certainly no downside to it. And the surest way to get to grips with any subject—master it, if you like—is to research it and then write about it. Or teach it. Or both.

There are a fair few football references in the Prefaces of your books . . . not to mention music and film quotes, and cartoons. What's that all about?!

Ha, ha, ha! Yes, playing football helped me a lot, both personally and professionally, so I thought I would mention it in passing as a sort of thank you. It wasn't my winter sport at school, which was hockey, and I only started playing it when I joined JPMorgan Chase in 2000 . . . I learnt the value of teamwork and never giving up, to always keep at it, things like that . . . not to mention camaraderie and *joie de vie* . . . . so all in all it was very beneficial. Alan Fulling and the lads at Chase have no idea how much they influenced my life! I'd say all team sports are good for everyone, I think.

The cartoons are all based on real-life happenings at work! I got a friend of mine to draw them, they lighten the serious mood of the topic a bit.

What books are on your 'I really must read that next' pile?

No finance texts, not right now anyway! On the coffee table at home there's Musa Okwonga's *A Cultured Left Foot*, *In the Service of the Sultan* by Ian Gardiner, Ed Smith's *What Sport Tells Us about Life*, *Lost Moon* by James Lovell, *War of the Century* by Lawrence Rees, a biography of Neil Armstrong called *First Man* by James Hansen, and *When Thunder Rolled* by Ed Rasimus. I'm about halfway through all of them!

This year my sister got me a first edition mint-condition *His Last Bow* by Sir Arthur Conan Doyle, which dates it at about 1917! Awesome . . . again that's not for reading, just to look at!☺

Okay thanks very much Moorad, and good luck.

My pleasure, thank you . . . and good luck to you too sir.

Glossary

A

A note A tranche of a collateralised debt obligation that is senior to other note tranches.
ABS Asset-backed security.
Amortising A financial instrument whose nominal principal amount decreases in size during its life.
Arbitrage The process of buying securities in one country, currency or market, and selling identical securities in another to take advantage of price differences. When this is carried out simultaneously, it is in theory a risk-free transaction. There are many forms of arbitrage transactions. For instance, in the cash market a bank might issue a money market instrument in one money centre and invest the same amount in another centre at a higher rate, such as an issue of 3-month US dollar CDs in the United States at 5.5% and a purchase of 3-month Eurodollar CDs at 5.6%. In the futures market arbitrage might involve buying 3-month contracts and selling forward 6-month contracts.
Arbitrage CDO A collateralised debt obligation (CDO) that has been issued by an asset manager and in which the collateral is purchased solely for the purpose of securitising it to exploit the difference in yields ('arbitrage') between the underlying market and securitisation market.
Asset-backed commercial paper (ABCP) A form of commercial paper (CP) that is secured by a purchase of assets.
Asset-backed securities (ABS) Securities that have been issued by a special purpose legal entity (SPV) and which are backed by principal and interest payments on existing assets, which have been sold to the SPV by the deal originator. These assets can include commercial bank loans, credit card loans, auto loans, equipment lease receivables and so on.
Asset & Liability Management (ALM) The practice of matching the term structure and cash flows of an organisation's asset and liability portfolios to maximise returns and minimise risk.
Asset swap An interest rate swap or currency swap used in conjunction with an underlying asset such as a bond investment.
Asset swap spread The spread over Libor that is received by the person selling the asset swap. This spread reflects the credit quality of the asset.
Asset-swap spread (ASW) The difference between the yield of a bond and the LIBOR curve, expressed in basis points. It is created by combining a fixed-coupon bond with an interest-rate swap, with the bondholder paying fixed and

receiving floating-rate. The net effect is that the bondholder now receives floating-rate interest. Often referred using the acronym 'ASW' because that is also the asset-swap screen on the Bloomberg system.

Average life The weighted-average life of a bond, the estimated time to return principal based on an assumed prepayment speed. It is the average number of years that each unit of unpaid principal remains outstanding.

B

Balance sheet CDO A CDO backed by a static pool of assets that were previously on the balance sheet of the originator.

Basel rules The set of rules that require banks to set aside a minimum level of capital to back assets. Now known as Basel I from the original set of rules and the replacement Basel II rules implemented in 2007.

Basis The underlying cash market price minus the futures price. In the case of a bond futures contract, the futures price must be multiplied by the conversion factor for the cash bond in question.

Basis points (bps) In interest rate quotations, 0.01%.

Basis swap An interest rate swap where both legs are based on floating rate payments.

Binary default swap See *digital credit default swap*.

Bullet A loan/deposit has a bullet maturity if the principal is all repaid is maturity. See *amortising*.

C

CDO Collateralised debt obligation, a structured financial product.

CMBS Commercial mortgage-backed securities.

Cash flow CDO A CDO that is structured by securitising bonds or loans, undertaken by selling these assets to an issuing company (SPV) that funds this purchase through the issue of note liabilities. The buyers of the notes take on the credit risk of the securitised assets.

Cash flow waterfall The rules by which the cash flow that the issuer can pay to investors, after all expenses have been paid, is allocated to service issue liabilities and pay investors in order of seniority.

Cash settlement A process by which a credit default swap (CDS) contract is settled on termination. On occurrence of a credit event, the protection seller will deliver to the protection buyer a payment of (100 – RR), where 100 represents par value of the contract and RR is the recovery rate associated with the defaulting name.

Collateralised bond obligation (CBO) A securitisation structure via a special purpose vehicle (SPV) in which the SPV purchases bond assets to generate income, with the assets being funded by an issue of bonds into the debt capital markets.

Collateralised loan obligation (CLO) A securitisation structure via a special purpose vehicle (SPV) in which the SPV purchases bank loan assets to generate income, with the assets being funded by an issue of bonds into the debt capital markets.

Collateralised synthetic obligation (CSO) The term used by JPMorgan Chase Bank to refer to synthetic collateralised debt obligations (CDO).

Commercial paper (CP) An unsecured fixed-rate discounted debt obligation of a bank or corporate entity, issued for a maturity of 1-270 days (US CP) or 1-360 days (Euro CP).

Conditional prepayment rate (CPR) A method of expressing the prepayment rate for an asset pool or mortgage pool that assumes a constant fraction of the remaining principal is prepaid each month or year. Specifically, the conditional prepayment rate is an annualized version of the single monthly mortality (SMM).

Cover The act of either (i) acting to ensure the ability to settle a transaction just entered into or (ii) hedging an existing market exposure. A bank that has sold short a security it does not own may *cover* this by entering into a stock loan agreement that enables it to borrow the security and thereby deliver it to a counterparty it has sold it to. Alternatively, if a bank is exposed to a certain market movement, such as a change in FX or interest rates, it may *cover* this by using a derivative instrument such as a futures contract or swap that hedges its exposure.

Credit event A term used to refer to a number of occurrences that trigger payment under a credit derivative contract. These occurrences include default on payment of interest or principal, bankruptcy, administration and loan restructuring.

Credit (or default) risk The risk that a loss will be incurred if a counterparty to a derivatives transaction does not fulfil its financial obligations in a timely manner.

Credit default swaps (CDSs) Agreement between two counterparties to exchange disparate cash flows, at least one of which must be tied to the performance of a credit-sensitive asset or to a portfolio or index of such assets. The other cash flow is usually tied to a floating-rate index (such as LIBOR), a fixed rate or is linked to another credit-sensitive asset.

Credit derivatives Financial contracts that involve a potential exchange of payments in which at least one of the cash flows is linked to the performance of a specified underlying credit-sensitive asset or liability.

Credit enhancement A level of investor protection built into a structured finance deal to absorb losses among the underlying assets. This may take the form of cash, 'equity' subordinated note tranches, subordinated tranches, cash reserves, excess spread reserve, insurance protection (wrap), and so on.

Credit-linked note (CLN) A bond whose performance and return is linked to the credit performance of a specified reference entity. Typically issued with a floating-rate coupon by a special purpose vehicle (SPV).

Credit risk (or default risk) exposure The value of the contract exposed to default. If all transactions are marked to market each day, such positive market value is the amount of previously recorded profit that might have to be reversed and recorded as a loss in the event of counterparty default.

Credit spread The interest rate spread between two debt issues of similar duration and maturity, reflecting the relative creditworthiness of the issuers.

Credit spread option A credit derivative contract that confers the option buyer with the right, but not the obligation to enter into a credit spread position at a pre-specified spread level. The underlying spread position can be an asset swap, a floating-rate note bond or another credit derivative such as a credit default swap.

D

Debt Service Coverage Ratio (DSCR) A ratio of the amount of cash available to meet debt obligations compared to the total amount of debt obligations.

Debt service coverage ratio (DSCR) The ratio of cash available for debt servicing to interest, principal and lease payments. Used to measure an entity's ability to produce sufficient cash to cover its debt payments. The higher this ratio is, the higher the assumed credit quality and the easier to obtain a loan.

Delinquency Ratio A figure showing percentage of late loans, that is, the ratio of the number or value of loans that have not been repaid by the due date to the total number or value of loans outstanding.

Default A failure by one party to a contractual agreement to live up to its obligations under the agreement; a breach of contract such as non-payment of debt service interest or principal.

Default correlation The degree of covariance between the probabilities of default of a given set of counterparties. For example, in a set of counterparties with positive default correlation, a default by one counterparty suggests an increased probability of a default by another counterparty.

Default Ratio The number of loans in default, divided by the total number of loans in the pool.

Digital credit default swap A credit default swap contract in which the payment made by the protection seller on occurrence of a credit event is a fixed pre-determined amount. Also known as a *binary default swap*.

Diversity score A Moody's CDO calculation that assigns a numeric value to an asset portfolio that represents the number of uncorrelated assets theoretically in the portfolio. A low diversity score indicates industry and/or geographical concentration and will be penalised in the ratings process.

E

Earnings per share (EPS) The portion of a company's profit allocated to each outstanding share of common stock. Earnings per share serves as an indicator of a company's profitability. Calculated as:

$$= \frac{\text{Net Income} - \text{Dividends on Preferred Stock}}{\text{Average Outstanding Shared}}$$

Equity Generally, the ownership share of a joint-stock company. Also known as a *share*. In the context of structured credit products, the most junior tranche note of a structured credit vehicle, so known as the *Equity Note*. It is also known as the *first-loss piece*, because losses in the vehicle are taken out of its value first. Its return is comprised of excess return in the vehicle, after all other note liabilities have been paid.

Equity-linked swap Swap where one of the cash flows is based on an equity instrument or index, when it is known as an equity index swap.

Equivalent life The weighted average life of the principal of a bond where there are partial redemptions, using the *present values* of the partial redemptions as the weights.

European Central Bank (ECB) The central bank based in Frankfurt created by the European Union as part of the introduction of the single European currency, the euro.

Excess spread Total cash left over in a securitisation, after paying all costs.

Expected (credit) loss Estimate of the amount a derivatives counterparty is likely to lose as a result of default from a derivatives contract, with a given level of probability. The expected loss of any derivative position can be derived by combining the distributions of credit exposures, rate of recovery and probabilities of default.

Expected default rate Estimate of the most likely rate of default of a counterparty expressed as a level of probability.

Expected rate of recovery See *rate of recovery*.

F

Face value The principal amount of a security generally repaid (redeemed) all at maturity, but sometimes repaid in stages, on which the *coupon* amounts are calculated.

Federal Deposit Insurance Corporation (FDIC) The independent agency created by the US Congress to maintain stability and public confidence in the banking system.

First-to-default (FtD) basket A credit default swap contract written on a pool or 'basket' of reference assets, on which the protection seller sells protection on all the assets, and pays out on occurrence of the first credit event in the basket. There are also 2nd-, 3rd-, and *N*th-to-default contracts.

Financial Accounting Standards Board (FASB) The designated private sector organisation in the US that establishes financial accounting and reporting standards.

Floating rate An interest rate set with reference to an external index. Also an instrument paying a floating rate is one where the rate of interest is re-fixed in line with market conditions at regular intervals such as every three or six months. In the current market, an exchange rate determined by market forces with no government intervention.

Floating rate note (FRN) Capital market instrument on which the rate of interest payable is re-fixed in line with market conditions at regular intervals (usually six months).

Floating-rate note (FRN) A bond instrument issued with a coupon that is floating-rate, that is, linked to a non-fixed interest-rate index such as LIBOR, as opposed to a fixed coupon.

Future value An amount to be received in the future. Calculated by multiplying the present value (PV) with $(1 + r)$, where r is the interest rate. This amount is then adjusted for compound interest if the period of return is greater than one interest payment period.

G

GIC Guaranteed investment contract. A bank account that pays either a fixed rate for its life, or a fixed spread under LIBOR for its life.

H

Hedging Protecting against the risks arising from potential market movements in exchange rates, interest rates or other variables. See *cover*, *arbitrage*, *speculation*.

Historic volatility The actual *volatility* recorded in market prices over a particular period.

Hybrid A term used to refer to a structure comprising elements of cash and synthetic securitisation.

I

Implied volatility The volatility used by a dealer to calculate an option price; conversely, the volatility implied by the price actually quoted.

Index swap A total return swap contract in which the total return payer pays the counterparty the return on a specified index, such as a bond index or credit reference index.

Inter-bank The market in unsecured lending and trading between banks of roughly similar credit quality.

Interest rate swap An agreement to exchange a series of cash flows determined in one currency, based on *fixed* or *floating* interest payments on an agreed *notional* principal, for a series of cash flows based in the same currency but on a different interest rate. May be combined with a *currency swap*.

Interest-rate swap (IRS) A derivative contract that exchanges interest payments, usually fixed-coupon versus floating-rate coupon, on a specified notional amount. The notional amount is not exchanged, only the net of the two interest payments.

Internal rate of return The yield necessary to discount a series of cash flows to a net present value of zero.

Investment grade Debt rated at or above BBB2 by Standard & Poor's or Baa3 by Moody's.

L

Liquidity asset purchase agreement (LAPA)

Liability swap An interest rate swap or currency swap used in conjunction with an underlying liability such as a borrowing. See *asset swap*.

Letter of credit (LOC) A document issued by a bank that guarantees the payment of a customer's liability; it substitutes the bank's credit for the customer's credit. The LOC guaranteeing that a buyer's payment to a seller will be received on time and for the correct amount, with the buyer's bank making the guarantee.

LIBID The London Interbank Bid Rate, the rate at which banks will pay for funds in the inter-bank market.

LIBOR The London Interbank Offered Rate, the lending rate for all major currencies up to one year set at 11 am each day by the British Bankers Association.

Liquidity A word describing the ease with which one can undertake transactions in a particular market or instrument. A market where there are always ready buyers and sellers willing to transact at competitive prices is regarded as liquid. In banking, the term is also used to describe the requirement that a portion of a bank's assets be held in short-term risk-free instruments, such as government bonds, T-Bills and high-quality Certificates of Deposit.

Liquidity loan agreement (LLA)

Loan-only credit default swap (LCDS) A credit default swap (CDS) contract that references specifically and only the loan obligations of the specified reference entity.

Long A long position is a surplus of purchases over sales of a given currency or asset, or a situation that naturally gives rise to an organisation benefiting from a strengthening of that currency or asset. To a money market dealer, however, a long position is a surplus of borrowings taken in over money lent out (which gives rise to a benefit if that currency weakens rather than strengthens). See *short*.

Long-term assets Assets that are expected to provide benefits and services over a period longer than one year.

Long-term liabilities Obligations to be repaid by the firm more than one year later.

M

Market-maker A market participant who is committed, explicitly or otherwise, to quoting two-way bid and offer prices at all times in a particular market.

Market risk Risks related to changes in prices of tradable macroeconomics variables, such as exchange rate risks.

Mark-to-market The act of revaluing securities to current market values. Such revaluations should include both coupon accrued on the securities outstanding and interest accrued on the cash.

Maturity date Date on which stock is redeemed.

Medium-term note (MTN) A debt issuance of either fixed-or floating-rate interest in the bond market from a corporate or special-purpose legal entity, ranging in maturity from two years to 30 years. It is an unsecured obligation of the borrower.

Mezzanine The intermediate tranche note of a structured credit product such as a collateralised debt obligation or mortgage backed security (MBS) issue, senior to the Equity note.

Modified-modified restructuring (MMR) The expression used to refer to the adjusted rules on physical settlement of a US CDS contract following occurrence of a credit event that is a result of restructuring. Refer to www.isda.org.

Mortgage-backed security (MBS) A structured finance security issued by a special purpose vehicle (SPV) that is backed by a pool of mortgage assets.

N

Net asset value (NAV) The value of an entity's assets minus the value of its liabilities. Commonly used in relation to mutual funds or unit trusts, but also used to represent the value of the total equity, or divided by the number of entity's shares to represent the per share net asset value.

Net present value (NPV) The net present value of a series of cash flows is the sum of the present values of each cash flow (some or all of which may be negative).

Nominal amount Same as *face value* of a security.

Non-performing A loan or other asset that is no longer being serviced, or has experienced default.

Normal A normal *probability distribution* is a particular distribution assumed to prevail in a wide variety of circumstances, including the financial markets. Mathematically, it corresponds to the probability density function:

$$\frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\phi^2}$$

Notional In a bond futures contract, the bond bought or sold is a standardised non-existent notional bond, as opposed to the actual bonds that are *deliverable* at maturity. *Contracts for differences* also require a notional principal amount on which settlement can be calculated. Otherwise, the balance that is used as the basis for calculating interest or credit protection due with respect to an obligation.

O

Option-adjusted spread (OAS) The flat spread over the Treasury yield curve that is required to present value a bond's cash flows to match its market price. The measure is applied to asset-backed securities (ABS), as well as callable bonds and convertible bonds. The word 'Option' in option-adjusted spread relates to the right of property owners, whose mortgages back an MBS security, to prepay the full mortgage amount at any time.

OTC. 1 Over-the-counter. Strictly speaking any transaction not conducted on a registered stock exchange. Trades conducted via the telephone between banks, and contracts such as Forward Rate Agreements and (non-exchange traded) options are said to be over-the-counter instruments. OTC also refers to non-standard instruments or contracts traded between two parties; for example, a client with a requirement for a specific risk to be hedged with a tailor-made instrument may enter into an OTC structured option trade with a bank that makes markets in such products.

Over the counter. 2 An OTC transaction is one dealt privately between any two parties, with all details agreed between them, as opposed to one dealt on an exchange—for example, a forward deal as opposed to a futures contract.

Overcollateralisation A capital structure in which assets exceed liabilities.

P

Paper Another term for a bond or debt issue.

Par In foreign exchange, when the *outright* and *spot* exchange rates are equal, the *forward swap* is zero or par. When the price of a security is equal to the face value, usually expressed as 100, it is said to be trading at par. A par swap rate is the current market rate for a fixed *interest rate swap* against *LIBOR*.

Par yield curve A curve plotting maturity against yield for bonds priced at par.

Pay-as-you-go (PAUG) A mechanism in the CDS of ABS market in which the CDS premium and any credit payment are made during the life of the deal, as the underlying bond notional is paid down.

Physical settlement A process by which a credit default swap (CDS) contract is settled on termination. On occurrence of a credit event, the CDS protection buyer will deliver to the protection seller an existing debt obligation of the reference entity, in return for a payment of par from the protection seller.

Plain vanilla See *vanilla*.

Present value (PV) The amount of money that needs to be invested now to achieve a given amount in the future when interest is added. See *time value of money*, *future value*.

Primary market The market for new debt, into which new bonds are issued. The primary market is made up of borrowers, investors and the investment banks that place new debt into the market, usually with their clients. Bonds that trade after they have been issued are said to be part of the secondary market.

Principal protected note A financial instrument that guarantees repayment of its principal amount (par amount) to investors on maturity or on termination. This feature is often added to higher risk notes such as credit-linked notes referenced to a risky security. The addition of a principal protected feature lowers the coupon that would otherwise be paid to investors in the note.

Protection buyer The party to a credit default swap (CDS) contract that has arranged for credit protection on a stated amount of debt obligation to a specified reference entity. The protection buyer pays a CDS protection payment to the protection seller.

Protection seller In a credit default swap transaction, the party that accepts the credit risk associated with specified assets. If losses are incurred on the assets, the protection seller makes credit protection payments to the protection buyer. A fee is payable for this protection.

Q

Quanto swap A *swap* where the payments, one or both legs, are based on a measurement (such as the interest rate) in one currency but payable in another currency.

R

RMBS Residential mortgage-backed security.

Rate of recovery Estimate of the percentage of the amount exposed to default; that is, the credit risk exposure which is likely to be recovered from an institution if a counterparty defaults.

Record date A coupon or other payment due on a security is paid by the issuer to whoever is registered on the record date as being the owner.

Redeem A security is said to be redeemed when the principal is repaid.

Redemption yield The rate of interest at which all future payments (coupons and redemption) on a bond are discounted so that their total equals the current price of the bond (inversely related to price).

Return on equity The net earnings of a company divided by its equity.

Return On Risk-Adjusted Capital (RORAC) A rate of return used in financial analysis, whereby riskier projects and investments are evaluated based on the capital at risk. RORAC makes it easier to compare and contrast projects with different risk profiles. Given by:

$$\text{RORAC} = \frac{\text{Net Income}}{\text{Allocated Risk Capital}}$$

Allocated risk capital is the firm's capital, adjusted for a maximum potential loss based on the probability of future returns or volatility of earnings.

Risk adjusted return on capital (RAROC) A risk-based profitability measurement framework for analysing risk-adjusted financial performance and providing a consistent view of profitability across businesses. The concept was developed by Bankers Trust in the 1970s.

S

Secondary market The market in instruments after they have been issued. Bonds are bought and sold after their initial issue by the borrower, and the marketplace for this buying and selling is referred to as the secondary market. The new issues market is the primary market.

Securitisation An issue of securities backed by specific assets.

Security A financial asset sold initially for cash by a borrowing organisation (the issuer). The security is often negotiable and usually has a maturity date when it is redeemed.

Short A short position is a surplus of sales over purchases of a given currency or asset, or a situation that naturally gives rise to an organisation benefiting from a weakening of that currency or asset. To a money market dealer, however, a short position is a surplus of money lent out over borrowings taken in (which give rise to a benefit if that currency strengthens rather than weakens). See *long*.

Single Monthly Mortality (SMM) A method of measuring the prepayment rate of a mortgage pool. Specifically, the single monthly mortality is equal to the unscheduled prepayments during a month divided by the scheduled balance for the end of the month expressed as a percentage.

Special A security that for any reason is sought after in the repo market, thereby enabling any holder of the security to earn incremental income (in excess of the General Collateral rate) through lending them via a repo transaction. The repo rate for a special will be below the GC rate, as this is the rate the borrower of the cash is paying in returning for supplying the special bond as collateral. An individual security can be in high demand for a variety of reasons; for instance, if there is sudden heavy investor demand for it, or (if it is a benchmark issue) it is required as a hedge against a new issue of similar maturity paper.

Speculation In finance, a transaction that does not promise safety or any return on the initial investment. A speculator may rely on an asset appreciating in price due to any of a number of factors that cannot be well enough understood by the speculator to make an informed decision.

SPV Special purpose vehicle, a legal entity set up to effect securitisation.

Standard deviation The standard deviation of a set of numbers is the square root of their variance. Variance is usually denoted by σ^2 and the standard deviation by σ, with:

$$\sigma^2 = 1/\mathrm{n}\ \Sigma(x_i - \mu)^2$$

where x_i is one of n numbers and μ is the mean of all n numbers x.

The most common use of the standard deviation in finance is to measure the risk of holding a security or portfolio.

Structured investment vehicle (SIV) A defunct investment structure in which long-dated structured finance assets such as ABS or CDO were purchased by an SPV, using short-dated liabilities such as CP as funding.

Synthetic A package of transactions that is economically equivalent to a different transaction. In the structured finance market, a transaction that replicates some of the economic effects of a cash securitisation without recourse to an actual sale of assets, and which involves the use of credit derivatives.

Synthetic CDO A CDO in which true sale of assets to an SPV does not take place. Rather, the economic effect of transferring the credit risk of the assets is created through the use of credit derivatives that reference the assets.

T

Time value for money The concept that a future cash flow can be valued as the amount of money which it is necessary to invest now in order to achieve that cash flow in the future. See *present value*, *future value*.

Total return swap (TRS) A credit derivative contract in which the total return payer pays the return on a reference asset to the counterparty, who in return pays LIBOR or LIBOR plus a spread. If a funded TRS, the market value of the reference asset is exchanged up-front.

Trustee A third-party specialist appointed to act on behalf of investors.

U

Underlying The underlying of a futures or option contract is the commodity of financial instrument on which the contract depends. Thus underlying for a bond option is the bond; the underlying for a short-term interest rate futures contract is typically a 3-month deposit.

Underwriting An arrangement by which a company is guaranteed that an issue of debt (bonds) will raise a given amount of cash. Underwriting is carried out by investment banks, who undertake to purchase any part of the debt issue not taken up by the public. A commission is charged for this service.

Unexpected default rate The distribution of future default rates is often characterised in terms of an expected default rate (for example, 0.05%) and a worst-case default rate (for example, 1.05%). The difference between the worst-case default rate and the expected default rate is often termed the *unexpected default* (that is, $1\% = 1.05 = 0.05\%$).

Unexpected loss The distribution of credit losses associated with a derivative instrument is often characterised in terms of an expected loss or a worst-case loss. The unexpected loss associated with an instrument is the difference between these two measures.

V

Value-at-risk (VAR) Formally, the probabilistic bound of market losses over a given period of time (known as the holding period) expressed in terms of a specified degree of certainty (known as the confidence interval). Put more simply, the VAR is the worst-case loss that would be expected over the holding period within the probability set out by the confidence interval. Larger losses are possible but with a low probability. For instance, a portfolio whose VAR is $20 million over a one-day holding period, with a 95% confidence interval, would have only a 5% chance of suffering an overnight loss greater than $20 million.

Value date The date on which a deal is to be consummated. In some bond markets, the value date for coupon accruals can sometimes differ from the settlement date.

Vanilla A vanilla transaction is a straightforward one.

Variance (σ^2) A measure of how much the values of something fluctuate around its mean value. Defined as the average of $(\text{value} - \text{mean})^2$. See *standard deviation*.

Variance–covariance methodology Methodology for calculating the *value-at-risk* of a portfolio as a function of the *volatility* of each asset or liability position in the portfolio and the correlation between the positions.

Volatility The standard deviation of the continuously compounded return on the underlying. Volatility is generally annualised. See *historic volatility*, *implied volatility*.

W

Weighted Average Coupon (WAC) The weighted average of the gross interest rate of the mortgages underlying the pool as of the pool issue date, with the balance of each mortgage used as the weighting factor.

Weighted Average Life (WAL) Also referred to as the average life, the weighted average life is the average number of years that each dollar of unpaid principal due on the asset or mortgage remains outstanding. Average life is computed as the weighted average time to the receipt of all future cash flows, using as the weights the dollar amounts of the principal paydowns.

Weighted Average Maturity (WAM) The weighted average maturity of an asset-backed security (ABS) is the weighted average of the remaining terms to maturity of the assets in the underlying collateral pool at the date of issue, using as the weighting factor the balance of each of the assets of the issue date.

Y

Yield The interest rate that can be earned on an investment, currently quoted by the market or implied by the current market price for the investment—as opposed to the coupon paid by an issuer on a security, which is based on the coupon rate and the face value. For a bond, generally the same as yield to maturity unless otherwise specified.

Yield curve Graphical representation of the maturity structure of interest rates, plotting yields of bonds that are all of the same class or credit quality against the maturity of the bonds.

Z

Zero-strike call A call option with a strike price set at zero. It is written on an underlying asset such as a bond or shares in a hedge fund, and is sold at par. A means by which an interest in illiquid assets can be transferred to a customer.

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